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Abstract Book

Oral Session -
100 - Welcome Address and INSAR President Address
8:30 AM - 9:00 AM - Hall B

8:30 Welcome Address and INSAR President Address

Keynote Address
101 - Environment and Autism: Understanding Causes from an Epidemiologic Perspective
9:00 AM - 10:00 AM - Hall B

Speaker: I. Hertz-Picciotto, Dept of Public Health Sciences, School of Medicine, UC Davis MIND Institute, Davis, CA

By the end of the 20th century, very little rigorous research had been conducted to uncover the causes for autism, although a few studies provided compelling clues. This evidence pointed to several conclusions: first, that both genetic and environmental factors could play a role, and second, that the non-heritable causes might include both microbiologic (rubella, influenza) and pharmacologic (thalidomide, valproic acid) agents. Even as theories and myths have multiplied, the past decade has witnessed a new wave of increasingly rigorous epidemiologic research, some of it quite robust. This presentation will summarize: current knowledge on specific exposures in early prenatal or postnatal life that are potential or likely contributing factors to ASD; parallels with the literature on neurotoxins and cognitive impairment; and promising approaches for integrating environmental epidemiology with advances in molecular genetics. To meaningfully assess the current science, key concepts will be interwoven, including the challenges to causal inference from observational studies, and some under-appreciated implications of multifactorial causation. Reflections will be offered for future directions in research on etiologies of autism.

9:00 Environment and Autism: Understanding Causes from an Epidemiologic Perspective

***I. Hertz-Picciotto**, Dept of Public Health Sciences, School of Medicine, UC Davis MIND Institute, Davis, CA*

By the end of the 20th century, very little rigorous research had been conducted to uncover the causes for autism, although a few studies provided compelling clues. This evidence pointed to several conclusions: first, that both genetic and environmental factors could play a role, and second, that the non-heritable causes might include both microbiologic (rubella, influenza) and pharmacologic (thalidomide, valproic acid) agents. Even as theories and myths have multiplied, the past decade has witnessed a new wave of increasingly rigorous epidemiologic research, some of it quite robust. This presentation will summarize: current knowledge on specific exposures in early prenatal or postnatal life that are potential or likely contributing factors to ASD; parallels with the literature on neurotoxins and cognitive impairment; and promising approaches for integrating environmental epidemiology with advances in molecular genetics. To meaningfully assess the current science, key concepts will be interwoven, including the challenges to causal inference from observational studies, and some under-appreciated implications of multifactorial causation. Reflections will be offered for future directions in research on etiologies of autism.

Panel Session
102 - Pushing the Boundaries for Understanding Environmental Influences on Neurodevelopment
10:30 AM - 12:30 PM - Hall B

Panel Chair: Irva Hertz-Picciotto, *Dept of Public Health Sciences, School of Medicine, UC Davis MIND Institute, Davis, CA*

Often, attention is drawn to the potential for neurodevelopmental damage after a man-made disaster or accidental poisoning event, as occurred with PCBs, methyl-mercury, and most recently, with lead in Flint, Michigan. Those earlier tragedies, which led to serious mental and physical disabilities, served as warning signs and led to in-depth research on lower level exposures to the same substances, levels for which clinical signs are not obvious, yet large epidemiologic studies have now uncovered the adverse consequences. In this panel, Dr. Lanphear describes how low-level exposures have been dismissed, even when comparisons with known toxins or drugs that trigger problems at similarly low doses indicate reasons for concern. His presentation outlines what clinicians and scientists need to know about the biologic impacts from lead, arsenic, and other exposures in early development. Dr. Rauh uses novel approaches in a longitudinal study to examine how commonplace prenatal exposures may have long term impacts, and how imaging studies are showing changes that correlate with gestational pesticide exposures. Her team has also identified surprising neurologic outcomes in school-aged children. Dr. Engel takes a step back to consider various biomarkers and how to circumvent the common pitfalls in environmental epidemiology and strengthen the inferences that can be made with regard to causal relationships, based not only on consistency and replication across studies but also on temporality, mechanistic considerations, dose-response, and other attributes of observational studies. Dr. Fallin will lay out a framework for integrating research on genetics with environmental epidemiology to harness the power of -omics technology with large-scale well-designed epidemiologic studies to advance the science of etiology in its multi-factorial complexity.

10:30 **102.001** Little Things Matter: The Impact of Toxins on the Developing Brain

***B. Lanphear**, Simon Fraser University, Burnaby, BC, Canada*

The impact of toxic chemicals on brain development is usually subtle for an individual child, but they can be substantial at the population level. Low-level exposures to toxic chemicals - such as lead, tobacco, pesticides and flame retardants - are implicated in the development of intellectual deficits, behavioral problems and preterm birth. Yet, too little has been done to protect children from these ubiquitous, but insidious toxins. This session will provide an overview of the population impact of toxic chemicals on children's health to set the stage for dialogue about ways to articulate their impact and importance for brain development.

11:00 **102.002** Atypical Neuropsychological Profiles, Attention Deficit Disorder, Brain Anomalies and Environmental Insecticide Exposure

***V. Rauh**, Columbia University, New York, NY*

Background: Underlying variability in neuropsychological profiles has been demonstrated among children with attention deficit disorders, and this may contribute to the differences in behavioral phenotype and clinical disorders in this population.
Objectives: This study investigated the contribution of prenatal exposure to chlorpyrifos, a widely used organophosphate pesticide, to neuropsychological patterns and clinically defined ADHD-type outcomes at 12 years of age. Observed patterns were associated with anatomical MRI findings.
Methods: An inner-city community-based cohort was followed prospectively from the prenatal period through 12 years of age (n=250), including repeated biomarkers of environmental exposures, full neuropsychological test battery, and structural MRI.
Results: Highly exposed children showed a unique neuropsychological profile, with significant deficits (all ps<0.01) in auditory attention and fine motor performance, but no deficits on more complex visual attention and inhibitory control tasks. Children with pesticide exposure and the signature profile were at increased risk of clinically-meaningful ADHD, as measured by the DuPaul-Barkley ADHD Rating Scale. These findings were consistent with abnormalities in morphological measures of the cortical surface, including the posterior temporal region, subserving attention and receptive language.
Conclusions: Findings suggest that prenatal organophosphate pesticide exposure, at relatively modest doses common in agricultural regions of the US, result in a signature pattern of neuropsychological deficits, accompanied by disturbances in brain morphology by MRI, persisting into the early school years. Furthermore, highly exposed children with this atypical profile were at significantly increased risk of ADHD-type symptoms.

11:30 **102.003** Strengthening Inferences in Environmental Epidemiology

***S. M. Engel**, Epidemiology, University of North Carolina at Chapel Hill, Chapel Hill, NC*

Background: Environmental chemical exposures are increasingly recognized as contributors to the development of neurological diseases. However, exposure measurement is frequently challenged by uncertainty in the relevant etiological window, and the retrospective nature of study designs for rare developmental outcomes, like Autism.
Objectives: This talk will describe the principals of causal inference in molecular environmental epidemiology, opportunities for exposure assessment that take advantage of new developments in environmental biomarkers, and will consider other conventional approaches to exposure assessment that may be implemented in case-control and prospective study designs.
Conclusions: Attention to causal inference methods will strengthen the impact of the literature linking environmental exposures to developmental outcomes. Replication and consistency, temporality, and dose-response will be discussed in connection with standard criteria for evaluating biomarker validity, using a series of conventional and novel biomarkers of environmental toxicants as case studies. Examples of persistent and non-persistent contaminants measured in conventionally collected matrices, such as urine

and blood, will be examined. In addition, biomarkers that make use of novel matrices, including blood spots, hair, and exfoliated deciduous teeth, will be discussed. Exposure assessment methods that strengthen the evidence linking environmental exposure to health outcomes will contribute to a better understanding of the relevant etiological pathways.

12:00 **102.004** The Power of "Omics" for Environmental Epidemiology of ASD

***M. D. Fallin**, Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD*

Background:
There is clear evidence that both genetic and environmental factors influence ASD risk. However, much more work has been done in genetic discovery and resulting mechanistic insights. The "omics" revolution offers multiple opportunities to combine efforts and inform environmental discovery, which is critical for policy and prevention efforts regarding modifiable risk.
Objectives:
To review the current opportunities for integration of "omics" measurement into studies of the environmental risk factors for ASD.
Methods:
Large scale measurement of the genome, epigenome, transcriptome, proteome, and metabolome are now feasible for epidemiologic studies. Now, epidemiologic methods must be applied with specific goals in mind for the integration of these measures into questions of environmental risk.
Results:
Associations have been observed between environmental exposures and epigenomics, transcriptomics, proteomics, and metabolomics, and there is some evidence for the influence of the genome on environmental susceptibility. We provide a framework for how to integrate these pairwise relationships to provide insight on mechanistic questions for environmental epidemiology of ASD as well as to develop potential biomarkers that can enable even larger scale environmental epidemiology investigation. We also present the methodologic challenges that must be overcome to realize the potential of such integration.
Conclusions:
The omics revolution is a great opportunity to maximize discovery in environmental health through both mechanistic work and development of new biomarkers. There are multiple methodologic challenges to overcome, but these are now surmountable opening the door for important discovery that can have prevention and policy implications.

Panel Session
103 - Transcranial Magnetic Stimulation (TMS) in Autism Spectrum Disorder

10:30 AM - 12:30 PM - Room 307

Panel Chair: Peter Enticott, *Deakin University, Burwood, Australia*

Discussant: Stewart Mostofsky, *Johns Hopkins School of Medicine, Baltimore, MD*

Transcranial magnetic stimulation (TMS) is an emerging neuroscience technique that can be used to probe in vivo brain function. When applied repeatedly, TMS also has therapeutic applications in a number of psychiatric and neurological conditions, most notably depression. In recent years a number of research groups have begun to use TMS in autism spectrum disorder (ASD). This has included studies of neuroplasticity, neurochemical systems, and cortical excitability, but also the interventional use of repetitive TMS (rTMS) in an attempt to elicit a therapeutic response. In 2013, an international group of leading ASD and brain stimulation researchers formed a consensus group for TMS in ASD, and are currently working toward a coordinated approach for advancing basic and clinical science in this area. This panel will provide an overview from four different labs that conduct TMS research in ASD, and will feature both investigative and therapeutic studies.

10:30 **103.001** Transcranial Magnetic Stimulation Provides a Means to Investigate Cortical Excitability and Plasticity in Autism Spectrum Disorder

***L. Oberman**, Bradley Hospital, East Providence, RI*

Background: The etiology and neurobiology of Autism Spectrum Disorder (ASD) is complex and insufficiently understood. Recent studies across multiple research areas, including genetics, animal model research, and human studies have implicated mechanisms of cortical excitability and plasticity in the pathophysiology of ASD. Our group has pioneered the development of transcranial magnetic stimulation (TMS) and repetitive TMS (rTMS) metrics of cortical excitability and plasticity as putative endophenotypes in ASD. However, both the intraindividual and interindividual reliability of these measures has not been clearly established. Additionally, how abnormalities at the local circuit level impact developmental and experience-based functional brain connectivity and how the functioning of these circuits impact behavior is still a mystery.
Objectives: To use TMS to explore cortical excitability and plasticity in ASD.
Methods: Our published and ongoing studies employ TMS-based measures of cortical excitability and plasticity in children and adults with ASD including single-pulse, paired-pulse, and rTMS protocols.
Results: Across multiple studies, application of an rTMS protocol proposed to index non-Hebbian plasticity and GABAergic inhibitory tone (theta burst stimulation (TBS)) results in a prolonged modulation of corticospinal excitability in adults with ASD. Specifically, while controls show a modulation of the TMS-induced motor evoked potentials (MEPs) for approximately 30-40 minutes following TBS, the effect lasted for over 60 minutes in individuals with ASD. This finding is quite reliable at the group level, but has proved elusive to replicate at the individual level. State-dependent factors relating to expectation and attention likely impact the reliability of this measure. Additionally, we find that a subgroup of individuals with ASD show paradoxical responses to paired pulse and rTMS protocols thought to be related to GABAergic tone.
Conclusions: We continue to explore the utility of TMS and rTMS indices of excitability and plasticity in an effort to develop a valid and reliable endophenotype that would facilitate ASD diagnosis early in life, enable efficient study of ASD risk factors, and eventually serve as a useful biomarker to inform the development of effective therapies and assess treatment response in future clinical trials, however, given the heterogeneity of this disorder (both at the behavioral and physiological level) individual and subgroup analyses, rather than group averages, need to be considered when determining the validity of these measures.

10:55 **103.002** Transcranial Magnetic Stimulation Treatment: Focusing on Core Pathological Features of Autism Spectrum Disorders

***M. F. Casanova**, Pediatrics and Biomedical Sciences, University of South Carolina School of Medicine, Greenville, SC*

Background: Recent evidence suggests the symptoms of autism spectrum disorder (ASD) may be related to an increased ratio of cortical excitation to inhibition. Using specific parameters of stimulation, rTMS has been shown to increase cortical inhibition by selectively activating interneurons.
Objectives: In a number of investigations, our group evaluated the effects of rTMS on indices of selective attention and executive functioning, as well as measures of social awareness, hyperactivity, irritability, and repetitive/stereotyped behavior.
Methods: Subjects with ASD were assessed at baseline and following rTMS with electroencephalographic (EEG) and event-related potential (ERP) measures of selective attention and executive functioning. Subjects were also assessed for ASD symptomatology using neuropsychological questionnaires.
Results: Our preliminary findings in experimental studies using 6-, 12, or 18 session-long, low frequency rTMS courses in children (age<18 years) with ASD indicate significant improvement in EEG and ERP measures of selective attention and executive functioning, and also showed significant improvement in measures of irritability and repetitive/stereotyped behavior.
Conclusions: rTMS has the potential to become an important therapeutic tool in research and treatment and may play an important role in improving the quality of life for many individuals with ASD.

11:20 **103.003** Repetitive Transcranial Magnetic Stimulation for Executive Function Deficits in Autism Spectrum Disorder and Effects on Brain Structure and Function

***S. H. Ameis**, University of Toronto, Toronto, ON, Canada*

Background: There are no satisfactory treatments for executive functioning (EF) deficits that predict real-world disability and long-term morbidity in individuals with high functioning autism spectrum disorder (HF-ASD). Our randomized, double-blind, sham-controlled pilot study results suggest that four weeks of repetitive transcranial magnetic stimulation (rTMS) applied to dorsolateral prefrontal cortex (DLPFC) can significantly improve EF performance in adults with schizophrenia (Cohen's d=0.91). As there may be overlapping etiology resulting in EF impairments in HF-ASD and in schizophrenia, the same biological treatments may improve performance deficits in both conditions.
Objectives: To complete a pilot study exploring the novel application of rTMS to DLPFC for treatment of EF deficits in adolescents and young adults with HF-ASD. This pilot study focuses on evaluating the feasibility of implementing our rTMS treatment protocol in HF-ASD. Our primary aims are to: (i) determine if our rTMS protocol can be successfully applied in people with HF-ASD, (ii) examine whether active rTMS improves EF performance in HF-ASD, and (iii) use structural and functional MRI in a pre/post design to identify mechanisms of treatment response .
Methods: We are using a randomized, double-blind, sham-controlled design comparing active (20Hz) vs. sham rTMS applied 5 days per week for 4 weeks bilaterally to DLPFC in young people with HF-ASD (active, N=20 vs. sham, N=20, 16-35 years). Outcome measures of EF performance (measured using Cambridge Neuropsychological Test Automated Battery) are being evaluated before and after the 4-week intervention. Structural and functional neuroimaging measures (MRI/DTI/rs-fMRI and task-based

fMRI) will also be acquired at baseline, and at the end of the 4-week rTMS trial in HF-ASD subjects to assess for biomarkers of treatment response.
Results: We have now completed year 1 of our 2-year clinical trial. 20 subjects have now successfully completed our study protocol. Over the past 12 months, we have demonstrated feasibility and tolerability of our rTMS protocol in HF-ASD, having successfully recruited ~2 HF-ASD subjects/month (total N=20) to our study, retaining 100% of randomized subjects, with only transient and mild side-effects reported following rTMS.
Conclusions: At IMFAR 2016, we will present our novel protocol, as well as preliminary data regarding the feasibility of implementing our study protocol in HF-ASD participants. In addition, we will present preliminary neuroimaging results including: associations between baseline measures of cognitive performance and DLPFC structure and DLPFC activation, as well as microstructure of white matter tracts connecting to the DLPFC.

11:45 **103.004** Clinical Trials of Deep Repetitive Transcranial Magnetic Stimulation (rTMS) to Bilateral Dorsomedial Prefrontal Cortex in Autism Spectrum Disorder

***P. Enticott**, Deakin University, Melbourne, VIC, Australia*

Background: Autism spectrum disorder (ASD) is characterised by impairments in social relating, which have been linked to abnormal activation within 'social brain' networks that include dorsomedial prefrontal cortex (dmPFC).
Objectives: Across two clinical trials, we investigated whether high-frequency (5 Hz) stimulation of bilateral dmPFC, using a deep rTMS coil to achieve the necessary depth of stimulation, could induce clinical, cognitive, and neurobiological changes among 'high-functioning' adults with ASD.
Methods: Study One involved a randomised, sham- controlled clinical trial of deep rTMS to bilateral dmPFC in 28 adults with ASD. Participants received active or sham deep rTMS each weekday for two weeks. Clinical and cognitive assessments were conducted before, after, and one-month following the treatment phase. Study Two was an open-label study where 20 adults with ASD received 16 active treatments over 4 weeks. Participants underwent positron emission tomography (PET) to assess brain glucose metabolism before and after the treatment course, while clinical and cognitive assessments were conducted before, after, 1-month, 3-months, and 6- months following treatment.
Results: In Study One, there was a significant decrease in self-reported clinical ratings of social impairment for those in the active condition, but no change for participants allocated to sham stimulation. In Study 2, there was again a decrease in clinical ratings of social impairment, and evidence for enhanced glucose metabolism (mid cingulum) following deep rTMS.
Conclusions: These data provide preliminary support for the safety and efficacy of deep rTMS to dmPFC in ASD, and suggest effects on neural networks that support the integration and understanding of social information. The clinical significance of these findings will be explored.

Panel Session
104 - Improving Early Access to Autism Screening and Specialized Services: Reaching Historically Underserved Communities
10:30 AM - 12:30 PM - Room 308

Panel Chair: Ivy Giserman Kiss, *University of Massachusetts Boston, Boston, MA*

Discussant: Alice Carter, *Department of Psychology, University of Massachusetts Boston, Boston, MA*

Presentations in this panel present strategies for identifying and addressing health disparities in the early detection of ASD, with a focus ranging from evaluating psychometric properties of specific screening tools (BITSEA, M-CHAT) in diverse populations to qualitative and systems-level visual analysis of multiple aspects of service delivery in community-based settings. The use of methods such as machine learning (M-CHAT) and receiver operating characteristic analyses (BITSEA) to optimize screener effectiveness highlights the availability of psychometrically-sound screening instruments for use in diverse populations. However, broader systems analyses of completing multi-stage screening, obtaining referrals for diagnostic evaluations, participating in diagnostic evaluations, and receiving services reveal challenges to implementation of ASD screening in community-based settings. Challenges include limited capacity of the service delivery system, family factors such as hesitance to acknowledge a child's problem, and finances. Implementation of ASD screening is best understood as a dynamic process that is shaped by organizational setting and mission and the unique characteristics of the populations being served. Therefore, it is important to document variations in practices designed to reach racial and ethnic minorities. Multiple contextual factors must be considered and multiple stakeholders engaged when supporting families attempting to navigate service delivery systems for children with possible ASD.

10:30 **104.001** Examining the Influence of Race and Gender on Autism Spectrum Disorder Screening Using the M-CHAT-R: A Self-Organizing Map Approach

***R. S. Factor**[1], L. E. Achenie[2], A. Scarpa[1,3], M. V. Strege[1], D. L. Robins[4] and S. McCrickard[5], (1)Psychology, Virginia Polytechnic Institute and State University, Blacksburg, VA, (2)Department of Chemical Engineering, Virginia Polytechnic Institute and State University, Blacksburg, VA, (3)Virginia Tech Center for Autism Research, Blacksburg, VA, (4)Drexel University, Philadelphia, PA, (5)Department of Computer Science, Virginia Polytechnic Institute and State University, Blacksburg, VA*

Background: Early screening of Autism Spectrum Disorder (ASD) has been found to facilitate early intervention. The Modified Checklist for Autism in Toddlers-Revised (M-CHAT-R; Robins, Fein, & Barton, 2009) is a 20 item revised version of an evidence-based parent-report instrument recommended by the American Academy of Pediatrics (Johnson & Myers, 2007). One survey found only 60% of pediatricians reported using formal ASD screening at 18 months and only 50% at 24 months (Arunyanart et al., 2012).
Further, differences in diagnosis based on demographic characteristics (i.e., race and gender) can impact the age of diagnosis. One study indicated White children received a diagnosis earlier than African-American children (Mandell et al., 2002). In addition, there may be gender differences in ASD presentation, as ASD is diagnosed later and less frequently in females—especially high functioning females (Head, et al., 2014; Hiller, Young, & Weber, 2014). Since current screening practices rely on clinician training and subjective judgment, machine learning (ML) may be a powerful complementary scoring tool to examine race and gender group differences. Self Organizing Maps (SOM) is a type of ML that clusters data according to similar responses (Bock, 2003).
Objectives: This study examined the use of ML to 1) simplify the administration and scoring of the M-CHAT-R, and 2) improve performance across demographic groups, while examining item-level differences.
Methods: This study used SOM to classify groups based on archival data of 14,995 toddlers (46.51% male; 15 years average maternal education), ranging from 16-30 months, collected during their 18- or 24- month well visit. Children at risk were referred for diagnostic assessment. Comparisons of group assignment and item analysis were conducted based on race (Whites versus African-Americans) and gender. MATLAB script was created to interface with the SOM Toolbox (SOM Toolbox Team, Helsinki University of Technology, Finland) and run for different data sets. All 20 M-CHAT-R items were included as inputs and SOM selected the most informative questions to create clusters based on similar traits.
Results: SOM was able to separate toddlers into risk status groups based on fewer items (12/20 items) and identify symptom presentation differences. Three risk status groups emerged: Typically Developing (TD), Low Risk (LR), and High Risk (HR). Risk status indicates that a toddler may be at risk for any developmental disability, including ASD. In all groups, 100% of ASD cases (determined by follow-up testing) fell into HR clusters. Similar cluster results emerged for Whites and African-Americans, and item analysis indicated deficits in joint attention (JA; i.e., pointing, coordinated gaze) differentiated HR from other groups. While SOM also resulted in three risk status levels in males, SOM failed to provide these differentiations for females, resulting in only LR and HR clusters. This indicates inconsistencies in capturing ASD symptoms in females, such that both the M-CHAT-R and SOM might not as acutely capture at-risk females.
Conclusions: This illustrates the potential utility in using ML in ASD screening and the need to target JA in screeners, although different items or algorithms may be needed to improve screening in females.

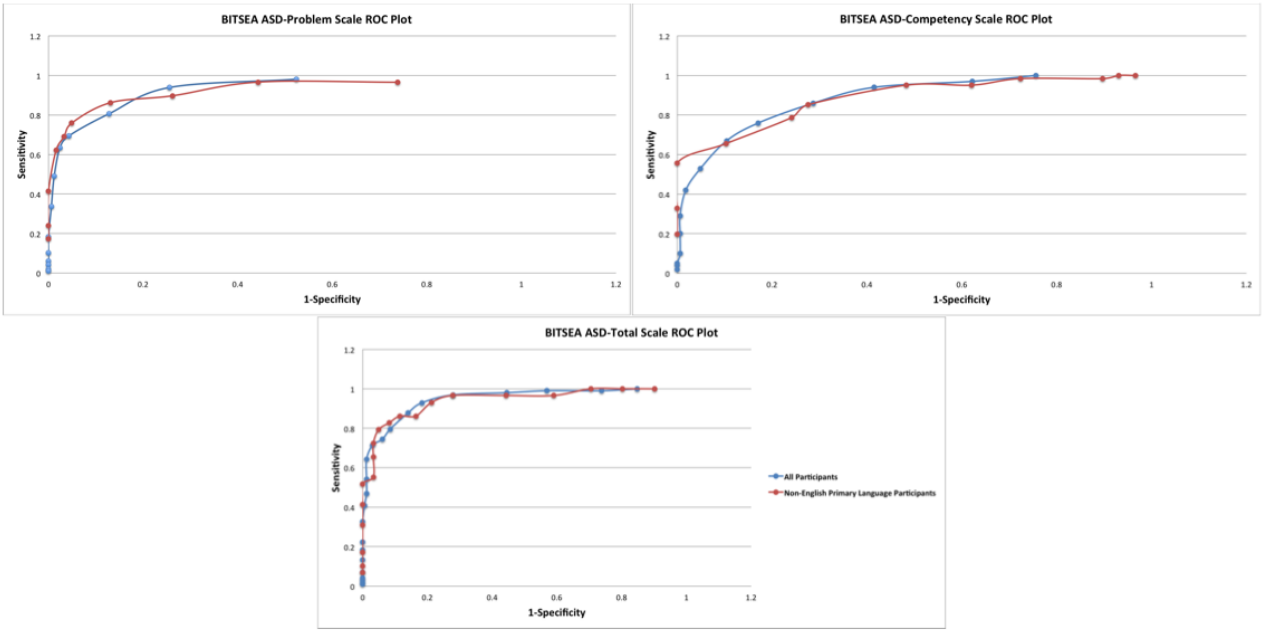
10:55 **104.002** Using the BITSEA to Screen for ASD in Young Diverse Populations

***I. Giserman Kiss**, F. Martinez-Pedraza and A. S. Carter, Department of Psychology, University of Massachusetts Boston, Boston, MA*

Background: Retrospective and prospective studies confirm that symptoms of ASD emerge during the first two years of life (Ozonoff et al., 2011). Yet, the national average age of diagnosis is above 36 months (CDC, 2012), with a greater delay for children from minority backgrounds, non-native English speaking families, and low socioeconomic statuses (Valicenti-McDermott et al., 2012). With increasing evidence that early intervention (EI) significantly improves outcomes for children with ASD, early detection and diagnosis is critically needed (Seida et al., 2009). The AAP and CDC recommend administering developmental screeners at routine visits; universal screening can potentially ameliorate health disparities regarding age of diagnosis. The Brief Infant Toddler Social Emotional Assessment (BITSEA) (Briggs-Gowan & Carter, 2006) is a screening tool designed to identify toddlers with social-emotional/behavioral problems and/or delays/deficits in social-emotional competencies. Eighteen of the 42 items on the BITSEA reflect behaviors consistent with ASD symptoms. In previous work, we determined that the BITSEA ASD scales were highly effective in identifying children with ASD in a sample of 436 toddlers (mean age: 29 months), with sensitivity, specificity, and PPV rates all over 80% for the optimal cut-point.
Objectives: The goals of this study included: determining how the BITSEA functioned in a younger sample of toddlers with diverse backgrounds, and exploring possible health disparities in the utility of the screening instrument.
Methods: Data are presented on a diverse sample of 276 toddlers (mean age: 25 months, 55% male, 41% diagnosed with ASD) enrolled in EI services. 53% of toddlers were from historically underserved racial/ethnic minority backgrounds (21% Black/African American, 22% Latino/Hispanic, 4% Asian, and 6% multiracial) and 33% of toddlers came from families with a primary language other than English (16% Spanish, 17% other). Caregivers completed the BITSEA in either English or Spanish. Analyses

examined the following subscales: ASD-Problem (including nine items focused on ASD negative symptoms), ASD-Competence (including nine items focused on ASD positive symptoms), and ASD-Total (sum of the ASD-Problem and reverse-scored ASD-Competence subscales).
Results: ROC plots were developed for the BITSEA ASD subscales for the entire sample (see attached figure). The ASD-Total subscale with a cut-point of -9.5 was determined as the most effective for identifying children with ASD and demonstrated 93% sensitivity and 82% specificity. To explore health disparities in the utility of the screening instrument, we ran the same analyses for the participants with primary languages other than English (see attached figure), and found comparable results; a cut-point of -9.5 on the ASD-Total subscale yielded 93% sensitivity and 79% specificity in this subsample.
Conclusions: The BITSEA ASD-Total scale appears to be an effective screening measure for ASD in young children from diverse backgrounds. Moreover, the scale was equally effective for children from English and non-English speaking families. These findings suggest universal BITSEA screening in EI could reduce the significant health disparity in age of first diagnosis. Challenges and successes in screening diverse populations will be presented in conjunction in a separate presentation in this panel.

ROC Plots of Effectiveness of BITSEA ASD Scales



11:20 **104.003** Systems-Level Analysis of Implementing a Two Stage Screening Protocol for Autism Spectrum Disorders in a Community-Based Setting

T. I. Mackie[1,2], *R. C. Sheldrick*[3], *C. Tan*[3] *and A. S. Carter*[4], *(1)Institute for Health, Health Care Policy and Aging Research, Rutgers University, New Brunswick, NJ, (2)Department of Health Systems and Policy, School of Public Health, New Brunswick, NJ, (3)Department of Pediatrics, Tufts Medical Center, Boston, MA, (4)Department of Psychology, University of Massachusetts Boston, Boston, MA*

Background:
Disparities in delay to diagnosis of Autism Spectrum Disorders may be effectively addressed by implementing evidence-based screening protocols in community based settings, such as Early Intervention (EI). Optimizing the efficiency of screening protocols among underserved populations can benefit by engaging implementation and systems sciences to examine factors influencing administration of ASD screening tools.
Objectives:
We present the development, validation and evaluation of a process map—a systems-level visualization of the process logic and flow for screening implementation. We use process maps as the basis for analyses of organizational, administrator, and client characteristics that influence administration of the two-stage ASD screening process at an EI site. This case study emphasizes the value of process evaluation when assessing implementation of complex interventions.
Methods:
To examine process efficiency of a two-stage screening for ASD, we employ multiple qualitative methods to examine administration, scoring, and informing families of findings for each of the instruments used in the two stage screening process. To improve the validity of process maps, we utilized respondent triangulation through inclusion of multiple samples. To date, these include: (1) trainers who provided support for implementation (n=10) and (2) EI service providers who administered the two stage screening (n=15). All participants were asked to develop a process map of the screening process from point of initiation until time of completion. For trainers, we conducted two concurrent focus groups to develop independent process maps and a subsequent member-checking focus to reconcile differences and validate findings. For EI providers, process maps were created during semi-structured interviews. Once collected, we individually analyzed EI provider and trainer process maps, coded associated discussions, and examined findings in regard to process efficiency.
Results:
We highlight three notable findings. First, clinical judgment played a significant role in process efficiency. For example, EI service providers described time delays to screen families that were driven by their ascertainment of families' 'readiness to screen' for ASD. Second, departures from protocol resulted in both negative "drift" from fidelity of administration, but also positive "adaptation" that supported provider's ability to follow protocols. For example, respondents articulated unique challenges in administering screening given the educational, linguistic and cultural diversity of clients served. Respondents identified both positive adaptations, such as hiring additional staff to support screening, but also possible "drift," such as adaptation of screening protocols in an attempt to facilitate understanding. Third, the unique roles of the trainers and EI providers led to work flows that are 'invisible' to other stakeholders unless careful efforts are undertaken to assess and monitor process.
Conclusions:
Our findings suggest that implementation of ASD screening in community-based settings to reach racial and ethnic minorities requires careful documentation of the variation that may emerge to accommodate the organizational setting, administrator priorities, and the unique characteristics of the populations being served. Moreover, these points of variation may remain 'invisible' to the trainers and implementation team if efforts are not taken to engage other stakeholders in assessment of implementation.

11:45 **104.004** Service Providers' Perspectives of Obstacles to ASD-Specialized Services

E. A. Karp, *L. V. Ibanez, S. R. Edmunds, C. M. Harker and W. L. Stone, Department of Psychology, University of Washington, Seattle, WA*

Background: Children's early access to ASD-specialized intervention is associated with better long-term outcomes. However, access to ASD-specialized intervention is often impeded by delays in referral and long waitlists for diagnostic confirmation. This study analyzed service providers' perceptions of obstacles that families face as they navigate three stages of the service delivery system: (1) obtaining a referral for an ASD diagnostic evaluation; (2) obtaining the diagnostic evaluation; and (3) obtaining ASD-specialized intervention.
Objectives: To identify: (1) prominent obstacles to each stage of service delivery; and (2) the extent to which county demographics (i.e., percentage of the population living below the Washington State [WA] poverty line, percentage of the population that is Hispanic, and whether the county is rural or urban) predict obstacles at each stage of service delivery.
Methods: Service providers (*n*=128) from 12 demographically diverse WA counties attended one-day workshops on the use of an ASD-specialized intervention. Providers responded to open-ended questions about obstacles that families face at each stage of the service delivery system. Grounded theory was used to identify themes that emerged for each stage. Responses were grouped into system-level obstacles (e.g., limited capacity within the service delivery system) and family-level obstacles (e.g., parental knowledge about ASD) for each stage (Table 1). Six hierarchical linear regressions were conducted to examine the effects of the three county-level predictors on system- and family-level obstacles.

Results: Six identical obstacles emerged for the referral and diagnostic evaluation stages, and 7 obstacles emerged for the intervention stage (Table 1). For the referral stage: (1) system-level obstacles were associated with counties that were rural (β=-.47, p<.01), had larger Hispanic populations (β=.30, p=.03), and had lower levels of poverty (β=-.47, p<.01), R^2 =.15; and (2) family-level obstacles were associated with urban counties (β=.28, p<.01), R^2 =.08. For the diagnostic evaluation stage: (1) system-level obstacles were associated with counties that had larger Hispanic populations (β=.19, p=.04), R^2 =.03; and (2) family-level obstacles were associated with urban counties (β=.33, p<.01), R^2 =.10. For the intervention stage: (1) system-level obstacles were associated with higher levels of poverty (β=.18, p<.05), R^2 =.03; and (2) family-level obstacles were associated with urban counties (β=.31, p<.01), R^2 =.10.
Conclusions: Limited capacity of the service delivery system, as well as family factors such as knowledge about ASD, hesitance to acknowledge a problem, culture, and finances were reported as obstacles for all three stages, suggesting that these areas may be particularly salient for families navigating ASD service delivery systems. At the intervention stage, additional barriers related to complex, difficult-to-navigate systems and family logistical constraints. At all stages, family-level obstacles were generally associated with urban counties, and system-level obstacles were associated with counties with either large Hispanic populations or high levels of poverty. Hispanic ethnicity was associated with system-level challenges at the referral and evaluation stages but not the intervention stage. These findings suggest that multiple contextual factors must be considered when supporting families attempting to navigate service delivery systems for children with possible ASD.

Table 1. System-level and family-level obstacles reported for each stage of the service delivery system.

Referral & Diagnostic Evaluation Stages
System
Limited capacity of the service delivery system
Limited provider knowledge and training regarding early signs of ASD
Family
Limited parental knowledge about early signs of ASD
Hesitance about accepting a possible problem
Cultural differences
Families' economic resources
Intervention Stage
System
Limited capacity of the service delivery system
Complicated service delivery system that is difficult to navigate
Family
Limited parental knowledge about ASD interventions and referral follow-through
Logistical constraints (e.g., scheduling treatment sessions)
Hesitance about accepting a possible problem
Cultural differences
Families' economic resources

Panel Session
105 - Outcome Measures for Early Intervention Studies in Autism Spectrum Disorder
10:30 AM - 12:30 PM - Room 309

Panel Chair: Catherine Lord, *Weill Cornell Medical College, White Plains, NY*

Discussant: Tony Charman, *Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom*

The field of ASD intervention research is in dire need of treatment response measures that adequately capture subtle changes in social communication behaviors. This panel presents recent findings from different research groups, introducing several advances in the development of outcome measures. We open with a presentation that reviews early intervention literature and underscores the need for the development of outcome measures. The next two presentations provide initial validity of a newly developed treatment response measure known as the Brief Observation of Social Communication Change (BOSCC) in two independent samples. We close with a presentation that extends this work to explore whether automated analyses of child vocalizations using the LENA voice recorder can be useful in identifying treatment response. Together this panel provides both an overview of our current challenges and of initial cutting-edge results for future researchers to expand upon. Implications for intervention research, behavioral phenotyping, and clinical practice will be discussed.

10:30 **105.001** Evidence Synthesis: Outcome Measures for Early Intervention Studies in ASD
H. McConachie, *Institute of Health and Society, Newcastle University, Newcastle upon Tyne, United Kingdom*

Background: One problem for researchers evaluating early intervention, and for providers of services for young children with autism spectrum disorder (ASD), is the multitude of outcomes assessed and tools used to measure children's progress. How can we best decide what outcomes to measure and how to measure them?
Objectives: To synthesise the evidence about tools used to measure outcomes in children with ASD up to age 6. Further, to explore how to identify what outcomes to prioritise, and report outcome areas in which robust tools are lacking.
Methods: A number of steps were completed as part of evidence synthesis:
A: Recent summary papers about outcome measurement for young children with ASD were reviewed.
B: Ways of working towards defining a core outcome set for early intervention studies in ASD were reviewed.
C: The methods and findings of the MeASURe review (McConachie et al 2015) were considered. MeASURe identified tools used in ASD early intervention and longitudinal studies, and systematically reviewed papers addressing the measurement properties of the tools when used with young children with ASD, using the COSMIN checklist (Consensus-based Standards for the selection of health Measurement Instruments).
D: Synthesis of evidence and identification of gaps in the tools available to measure outcomes.
Results: Recent papers have considered the 'best' tools for measurement of repetitive behaviours, anxiety and social-communication, usually by expert consensus. Others proposed batteries of tests. No fully systematic process for identifying how best to measure outcomes has been agreed.
Conceptual frameworks for deciding what to measure have been proposed, based on the International Classification of Functioning, Disability and Health, including domains of 'impairments', 'activity limitations', 'participation restrictions', and family measures. Ways of integrating the differing perspectives of the autism community, clinicians, educators and researchers have been proposed.
In the MeASURe review, 129 tools were identified. 2,793 papers on the measurement properties of tools were sifted and data extracted from 128 concerning 52 (40%) tools; for 60%, no measurement properties study including children with ASD was found. The most robust 12 tools were identified, and gaps in the evidence and array of tools

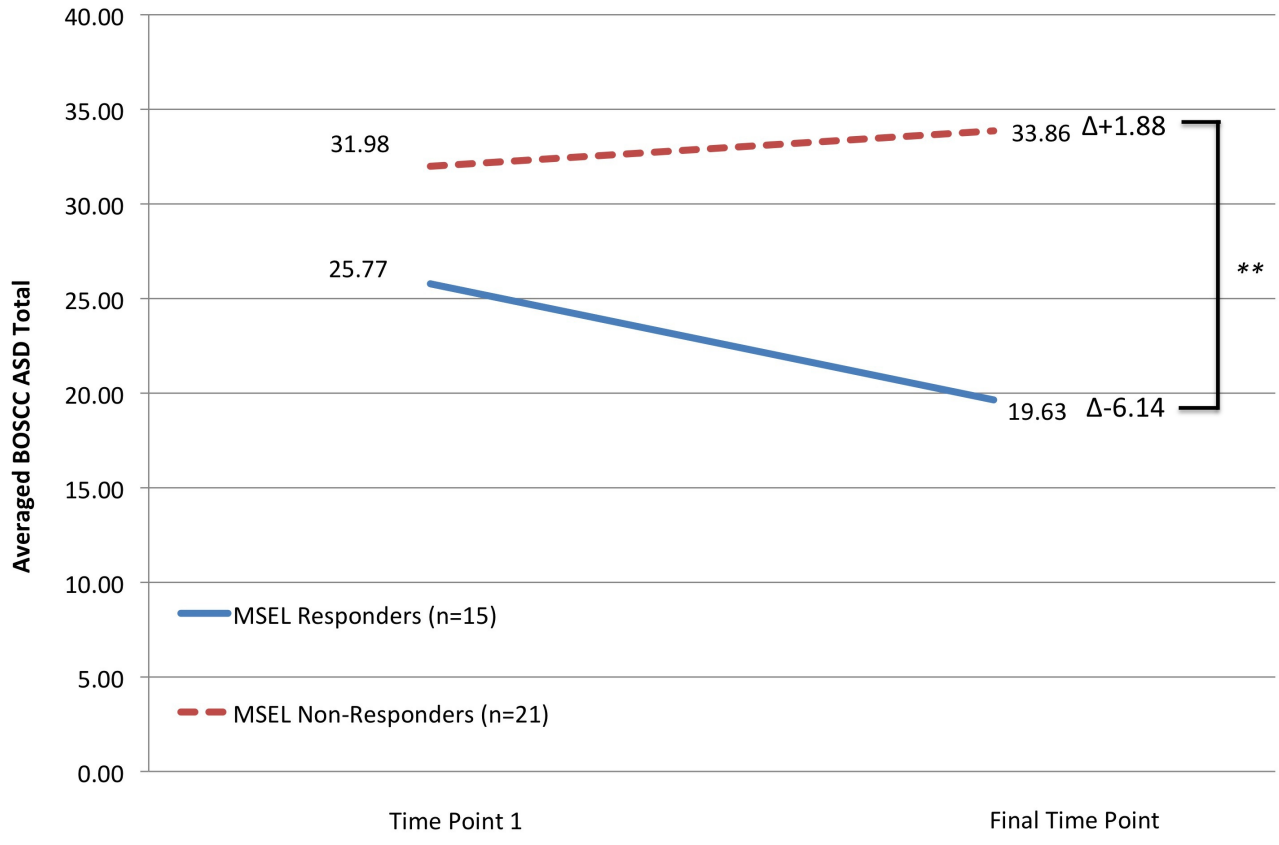
pinpointed, such as measurement of wellbeing and participation outcomes for children. The lack of a reliable and valid tool to measure core autism impairments, with proven responsiveness to treatment, is a clear hindrance to early intervention research.
Conclusions: An agreed core set of outcomes, and battery of robust tools, are goals for the future; in the interim a process for reaching such conclusions could be agreed. For some important outcome areas, good tools are lacking. Further review of established and newer tools is still required, with input from parents and other stakeholders, before consensus can be reached about a recommended battery to be used by researchers and service providers.
This presentation includes evidence synthesis commissioned by the National Institute for Health Research (NIHR) under the Health Technology Assessment programme (HTA Project:11/22/03). The views expressed are those of the author and not necessarily those of the National Health Service, NIHR or Department of Health.

10:55 **105.002** Preliminary Reliability and Validity of the Brief Observation of Social Communication Change (BOSCC)

R. Grzadzinski[1], *C. Carberry*[2], *A. Hamo*[2], *K. M. Frost*[3], *M. Heyman*[4], *C. Dick*[4], *S. Manevich*[5], *N. Hong*[5], *A. Pickles*[6] *and C. Lord*[2], *(1)Center for Autism and the Developing Brain, New York, NY, (2)Weill Cornell Medical College, White Plains, NY, (3)Center For Autism and the Developing Brain, White Plains, NY, (4)Center for Autism and the Developing Brain, White Plains, NY, (5)Psychiatry, Center for Autism and the Developing Brain, White Plains, NY, (6)Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom*

Background: The field of ASD intervention research lacks adequate outcome measures to assess the utility of treatments (Anagnostou et al., 2015). Although standard measures of social communication behaviors exist, these measures are often not sensitive enough to subtle changes over short periods of time (e.g., the Autism Diagnostic Observation Schedule; ADOS), capture only very specific behaviors (e.g., Early Social Communication Scales), or rely on parent report leading to potential reporter bias. To address these limitations, our group developed the Brief Observation of Social Communication Change (BOSCC), an observation-based measure coded by a blind researcher/clinician that is intended to be sensitive to slight changes in social communication and restricted, repetitive behaviors.
Objectives: To provide preliminary reliability and validity for the BOSCC.
Methods: The BOSCC coding scheme was applied to 177 parent-child free-play videos from 56 toddlers and pre-schoolers with diagnoses of Autism Spectrum Disorder (ASD). All children were using phrase speech or less and were participating in various intervention trials active at two sites. Exploratory Factor Analyses (EFA) were conducted, providing BOSCC domains, as well as intraclass correlations (ICCs) for Test-Retest (TRT) and Inter-rater reliability (IRR). Growth curve models were fit to all available data for each child's BOSCC score and ADOS Calibrated Severity Score (CSS). Exploratory analyses were also conducted comparing BOSCC scores in children who did and did not demonstrate changes on metrics that have successfully measured change in other research (Wetherby et al., 2014) including the Vineland Adaptive Behaviour Scales- Communication domain (VABS) and Mullen Scales of Early Learning Receptive Language domain (MSEL).
Results: EFA results support a two-factor model, consistent with the social communication and Restricted, Repetitive Behavior (RRB) domains seen in the ASD symptom literature. ICCs computed for TRT and IRR data ranged from 0.79-0.91 and 0.94-0.96, respectively. Results of whole sample (including responders and non-responders) random effects analyses indicate that the average rate of change each month in the ADOS CSS score was 0.055, which corresponded to an effect size of -0.026 per month. The average rate of change in the BOSCC ASD total score was -0.711 corresponding to a substantially larger, though small effect size for the rate of change of -0.068 per month. However, compared to children who did not show improvements on the VABS and MSEL, children who showed improvements (increases) on the on VABS and MSEL also demonstrated significantly larger decreases in BOSCC scores (see Figure 1).
Conclusions: This work provides preliminary evidence for the utility of the BOSCC as a treatment response measure. The BOSCC demonstrates more change than the ADOS CSS over the course of months of intervention. The BOSCC may be an additional tool which is sensitive enough to capture slight changes and also standard and flexible for use across studies. We hope that the BOSCC can aid in identifying efficacious treatments, monitoring progress, and tailoring individualized treatment plans for children with ASD.

Figure 1. BOSCC ASD Total Across Time Points for Responders and Non-Responders (defined by improvements in MSEL Receptive Language).
[MSEL Receptive Language Standard Score increase ≥5= Responders (n=15), Non-Responders (n=21)]



11:20 **105.003** A Preliminary Evaluation of the Brief Observation of Social Communication Change (BOSCC) As Candidate Outcome Measure in an Independent Dutch Sample

M. K. J. Pijl[1,2], *J. K. Buitelaar*[2,3], *N. N. J. Rommelse*[2,4] *and I. J. Oosterling*[2], *(1)Cognitive Neuroscience, Radboud University Medical Centre, Nijmegen, Netherlands, (2)Karakter Child and Adolescent Psychiatry University Centre, Nijmegen, Netherlands, (3)Radboud University Medical Centre, Nijmegen, Netherlands, (4)Department of Psychiatry, Radboud University Medical Centre, Nijmegen, Netherlands*

Background: The Autism Diagnostic Observation Schedule (ADOS) is commonly used as outcome measure. However, it has not primarily been designed for measuring change. A recently developed measure that is aimed to detect change in ASD symptoms, the Brief Observation of Social Communication Change (BOSCC), may be more apt for such purposes. The current study includes a head to head comparison between both measures, comparing ability of detecting behavioral change based on a 10-minute

unstructured parent-child interaction (BOSCC) versus a 40-60 minute standardized semi-structured examiner-child interaction (ADOS).
Objectives: To evaluate the usefulness of the BOSCC in detecting ASD symptom change in comparison to the ADOS, focusing on 1) inter- and intra-rater reliability; 2) construct validity; and 3) sensitivity to capture change.
Methods: Participants encompassed 48 toddlers diagnosed with ASD who were involved in an early intervention study (Oosterling et al., 2010). In that study an intervention was tested in a randomized controlled trial; parents in the experimental group received parent (Focus) training in addition to care-as-usual, whereas parents in the control group received care-as-usual alone. The current study conducted a secondary analysis; applying the BOSCC coding scheme on 96 videotaped parent-child dyads. At baseline and after one year of intervention the ADOS, non-verbal IQ, MacArthur-Bates Communicative Development Inventory (MCDI) and Child Behavior Checklist (CBCL) were also assessed. The Autism Diagnostic Interview (ADI-R) was only applied at baseline. Group-based and individual analyses were done.
Results: 1) Excellent inter-and intra-rater reliability was obtained for total and sub scores of the BOSCC; intraclass correlations were 0.96–0.99 and 0.77–0.98, respectively. This is comparable to the established reliability of the ADOS. 2) With regard to convergent validity, the BOSCC total score showed a moderate Spearman's correlation with the ADI-R (r_s=0.46), whereas the ADOS total score showed a weak correlation with the ADI-R (r_s=0.39). With regard to discriminant validity, weak correlations were found between the BOSCC and CBCL scores (r_s=-0.04–-0.30), whereas the ADOS showed weak to moderate correlations (r_s=-0.05– -0.41). In contrast, for both the BOSCC and ADOS moderate to strong correlations were found with non-verbal IQ (BOSCC: r_s= -0.44–-0.57; ADOS: r_s=-0.54–-0.60) and MCDI scores (BOSCC: r_s=-0.41–-0.60; ADOS: r_s=-0.50–-0.65). However, overall, construct validity of the BOSCC and the ADOS did not significantly differ. 3) Both the BOSCC and the ADOS total scores were significantly lower at follow-up than at baseline. When considering the clinical reliability of change for each individual separately, using Reliable Change Indexes, the BOSCC was able to capture more reliable change (29% showed significant change on the BOSCC compared to 10% on the ADOS). Change measured by the BOSCC was weakly correlated with change on the ADOS, and with change on other measures.
Conclusions: Our preliminary results indicate that the BOSCC, used in a naturalistic setting to measure change in social communicative behavior, seem to be a promising outcome measure, and has greater potential in measuring individual change as compared to the ADOS. Explanations for findings and recommendations for future research will be discussed.

11:45 **105.004** The LENA System in Clinical Trials: Evidence from Pivotal Response Treatment Studies

***A. Y. Hardan**, Stanford University, Stanford, CA*

Background: Treatment research in autism spectrum disorder (ASD) has been limited by the lack of objective indicators of symptom improvement. Thus, there is a critical need to develop validated, objective outcome measures for assessing treatment-mediated changes in core autism symptoms. The Language ENvironment Analysis System collects large samples of speech from the child's natural environment and automates analysis of child utterances and conversational turns. This system is ideal to assess any changes in clinical trials involving interventions that aim at assessing language improvement in ASD.
Objectives: This presentation will review data from two different clinical trials examining the effectiveness of two pivotal response treatment (PRT) programs in targeting language deficits in minimally verbal young children with ASD between the ages of 2 and 6 years.
Methods: The first dataset was obtained from an uncontrolled trial examining the effectiveness of a group parent training in PRT (PRTG) in children with ASD between the ages of 2 and 6 years. The second dataset is being collected as part of a randomized controlled trial of a PRT package treatment (PRT-P), which combines parent training with clinician-delivered in-home treatment. PRT-P is being compared to a delayed treatment group (DTG) that is receiving community services. In both trials, LENA recordings were obtained at baseline and post-treatment.
Results: Eleven children with ASD participated in the first study. Preliminary analyses revealed improvement in language abilities with increases in child vocalization during structured laboratory observation (SLO) with increase in the number of utterances between baseline (32 ± 21) and post-treatment (51 ± 26; t= -3.572, p=.009). This improvement was associated with changes in the average frequency of child vocalization per hour as assessed by in-home LENA recordings (Baseline= 205 ± 77; Post-treatment=244± 96; t= -1.882, p=.089). Data is available from 25 participants in the PRT-P trial, and preliminary analyses revealed significant improvement in language deficits as measured by the clinical global impression scale-improvement (CGI-I) (N=16; PRT-P= 9; DTG = 7; X^2= 9.363; p=0.025), and the MacArthur-Bates Communicative Development Inventories with the active group showing more improvement than the control group on the words produced out of 680 (PRT-P: 10; Baseline=126.6 ± 111.2; week 24: 281.0 ± 194.3; DTG = 7; BL: 111 ± 110; Week 24: 140 ± 148; F=5.267; df (1;15); p=0.037). LENA recording were also obtained and findings from a small subset of participants, revealed a non-significant increase in the conversational turn count in the active group (N=11; Baseline 144.7 ± 94.1; Week 24: 149.0 ± 97.3). Additional LENA data will be available and further analyses will be completed.
Conclusions: These preliminary findings illustrate the value of including objective measures obtained in the natural environment using the LENA system in assessing improvement in language in response to two different PRT programs. Potential benefits and challenges of the LENA system will be discussed in comparisons to structured laboratory observation and standard language measures.

Panel Session
106 - Behavioral Interventions for Adults with ASD
10:30 AM - 12:30 PM - Room 310

Panel Chair: Caitlin Conner, *Department of Psychology, Virgina Tech, Blacksburg, VA*

While research on adult outcomes in ASD has been an area of recent focus, intervention research has not kept pace, leaving the field fairly uninformed regarding best practices. There is a critical need for treatment research given outcome data suggesting that adults often struggle with psychiatric comorbidity, unemployment and underemployment, and overall diminished quality of life. In this panel, four clinical scientists from different institutions present original research on intervention studies for adults with ASD with diverse targets. McVey and colleagues present data on a replication of the PEERS-Young Adult social skills intervention and investigate how the program affects related issues such as anxiety. Eack and colleagues present data on an RCT of Cognitive Enhancement Therapy, where social and nonsocial cognitive rehabilitation is conducted, and have found effects in both neurocognitive and social domains. Next, Schall and her colleagues present outcome data from Project Search, an intervention focusing on training and maintaining vocational work. Lastly, Conner presents data on an adapted mindfulness-based intervention for young adults with ASD focusing on emotion dysregulation. Together, these presentations present preliminary results of wide ranging intervention foci and implementation approaches. Collectively, the studies suggest that clinically significant change is possible for adults.

10:30 **106.001** A Replication and Extension of the UCLA PEERS® for Young Adults Social Skills Intervention

***A. McVey**, B. Dolan, K. A. Schohl, C. Caiozzo, E. Vogt and A. V. Van Hecke, Marquette University, Milwaukee, WI*

Background:
Research shows that the UCLA PEERS® for Young Adults social skills intervention is effective at helping young adults with ASD make and keep friends (Gantman, Kapp, Orenski, & Laugeson, 2012; Laugeson, Gantman, Kapp, Orenski, & Ellingsen, 2015), however, these findings have not yet been replicated outside of the site of development. Further, the developers utilized relatively small sample sizes, limited diagnostic criteria for ASD, and did not evaluate the intervention's impact on social anxiety.
Objectives:
The objectives of this study were to examine the effectiveness of the PEERS® for Young Adults intervention by conducting a direct replication and extension by recruiting a larger sample size, utilizing more stringent diagnostic criteria, and examining social anxiety outcomes.
Methods:
Forty-seven young adults with high functioning ASD (N = 47; 38 male) between the ages of 17 and 28 participated in this study. Participants were screened using the Autism Diagnostic Observation Schedule (ADOS-G; Lord, Rutter, DiLavore, & Risi, 2002) as it represents the gold-standard in ASD evaluation. Participants were randomly assigned to either the Experimental Treatment Group (EXP) or the Waitlist Control Group (WL). All participants and parents/caregivers completed a battery of questionnaires to assess social skills behavior, social responsiveness, social skills knowledge, quality of socialization, empathy, loneliness, and anxiety at two time points (pre- and post-intervention for the EXP group) approximately 15 weeks apart.
Results:
Young adults in the EXP group demonstrated significant improvements in social skills, specifically problem behavior (SSIS-RS Competing Problem Behavior, $F(1, 45)$ = 11.952, p = .001, partial η^2 = .210), social responsiveness (SRS, $F(1, 45)$ = 7.651, p = .008, partial η^2 = .145), social skills knowledge (TYASSK, $F(1, 45)$ = 92.010, p =.001, partial η^2 = .672), and empathy (EQ, $F(1, 45)$ = 6.960, p =.011, partial η^2 = .134) compared to the WL group at post-intervention. Quality of socialization, as measured by the number of direct peer interactions, approached significance (QSQ-YA, $F(1, 45)$ = 3.449, p = .070, partial η^2 = .071). Improvements were seen for social and emotional loneliness (SELSA), but they did not reach significance. Exploratory analysis uncovered a significant improvement in social anxiety over time (LSAS, $F(1, 45)$ = 9.302, p = .006, partial η^2 = .297). Social phobia (SPIN) improved as well, but not to the point of significance.
Conclusions:
Results provide further support for the effectiveness of the UCLA PEERS® for Young Adults intervention, specifically in the domains of social skills behavior, social responsiveness, social skills knowledge, and empathy. Further evaluation is merited to examine the effects of the intervention on social and emotional loneliness and anxiety, though trends demonstrate improvement in these areas as well. These results have important implications for the overall mental health and well being of young adults with

ASD. Improvements in social skills are likely to relate to improvements not only in the development of social relationships, but also mood, adaptive functioning, and self-efficacy.

11:00 **106.002** Cognitive Enhancement Therapy for Adults with Autism Spectrum Disorder: Results from an Ongoing Randomized-Controlled Trial

S. M. Eack[1,2], *D. P. Greenwald*[2], *S. S. Hogarty*[2], *M. Y. Litschge*[2], *S. S. Porton*[2], *C. A. Mazefsky*[2] *and N. J. Minshew*[2,3], *(1)School of Social Work, University of Pittsburgh, Pittsburgh, PA, (2)Department of Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA, (3)Department of Neurology, University of Pittsburgh School of Medicine, Pittsburgh, PA*

Background: Adults with autism spectrum disorder (ASD) experience significant disability due to pervasive social and non-social cognitive impairments. Cognitive rehabilitation has emerged as an effective set of approaches for addressing cognitive deficits in numerous neurological and psychiatric populations, yet little is known about their efficacy in adults with ASD.
Objectives: The purpose of this research was to conduct the first adequately-powered randomized-controlled trial of Cognitive Enhancement Therapy (CET) in adults with ASD. CET is a promising social and non-social cognitive rehabilitation intervention that has shown significant benefits in patients with schizophrenia and in preliminary uncontrolled studies in adult autism.
Methods: Verbal adults with ASD were randomized to an 18-month controlled trial of CET or an active Enriched Supportive Therapy (EST) comparison treatment, which addresses psychoeducation, stress management, and emotion regulation. Comprehensive measures of cognitive and behavioral outcomes were collected prior to treatment and at 9 and 18 months of treatment by raters who were blind to treatment assignment.
Results: Analyses of the first 40 adults randomized to this trial are indicating significant and medium-to-large levels of differential improvements in neurocognitive and social-cognitive functioning favoring CET. The greatest domains of neurocognitive improvement in CET have included visual learning and processing speed, and the greatest area of social-cognitive improvement has been in the domain of facial emotion perception. Most importantly, these cognitive gains observed in CET are translating into large improvements on blinded measures of adaptive function, particularly major role and vocational functioning. Significant improvements in anxiety and depressive symptomatology, as well as functional outcome are also being observed in EST.
Conclusions: Cognitive rehabilitation may be an effective avenue for addressing core cognitive deficits that limit adaptive function in adults with ASD. CET represents a comprehensive and promising approach to cognitive rehabilitation in adult autism that may be able to significantly improve neurocognitive and social-cognitive information processing, with considerable benefits to real-world adaptive function. EST alone or in combination with CET also represents a feasible and potentially effective individual approach for improving symptom and functional outcomes in adults with ASD.

11:30 **106.003** The Impact of Project Search Plus ASD Supports on Employment and Social Responsiveness in 18 to 21 Year Old Youth with ASD

C. M. Schall*, Virginia Commonwealth University, Richmond, VA*

Background: For most individuals with autism spectrum disorder (ASD), graduation from high school represents a time of worry with few future options and a lack of hope for college or post high school employment (Wehman, Schall, Carr, Targett, et al., 2014). Adolescents with autism aging out of high school are unemployed and under employed at higher rates than other similar disability groups (Howlin et al., 2013; Newman et al., 2011; Roux et al., 2013; Schall et al., 2014; Shattuck et al., 2011). Unfortunately, for the most part, they remain unemployed, underemployed, or chronically change low wage jobs through adulthood (Cimera and Cohen, 2009; Cimera et al., 2012; Henninger and Taylor, 2013; Schall, et al., 2014; Shattuck et al., 2011, 2012). Further, families, individuals with ASD, health care professionals, and educators are unclear about their future with limited employment options on the horizon (Holwerda et al., 2012, Schall et al., 2013, 2014; Shogren and Plotner, 2012; Watson et al., 2013; Wehman, Schall, Carr, et al., 2014). While this situation is likely to grow in intensity due to the increasing prevalence of ASD, few intervention studies have addressed this tremendous treatment need (Buescher et al., 2014; Hansen et al., 2015).
Objectives: The objective of this study was to measure the impact of Project SEARCH plus ASD Supports (PS-ASD) on the social communication, behavioral, and employment outcomes of youth with ASD across three vocational domains (employment status, wage, number of hours worked per week) and three personal domains (social responsiveness, physical and mental health, and self-determination).
Methods: This is a randomized controlled study of the efficacy of the PS-ASD Model in 82 adolescents and young adults aged 18 to 21 with autism spectrum disorder across four different sites. Of the 82 enrolled subjects, 42 were randomly assigned to the control group, while 40 were assigned to the treatment group. Data collection is ongoing and will be updated as it is collected.
Results: There were no differences between the groups on demographic variables of age, gender, ethnicity, or medical diagnosis. The majority of both groups were individuals with a diagnosis of autism. Outcomes were significantly different as measured on employment where 84% of the treatment group were employed within a year of graduation from high school and earned a mean wage of $8.44 per hour for a mean of 20.2 hours per week. The control group, on the other hand, were employed at much lower rates with only 11% were employed within one year of graduation and earned a mean wage of $8.99 per hour while working a mean of 12 hours weekly. Significant differences were observed on supports intensity, social responsiveness, and psychological empowerment with employed participants demonstrating more independence, increased social responsiveness, and greater psychological empowerment than those who were unemployed.
Conclusions: Employment outcomes were excellent and follow up data highly promising as was the concomitant independence, self-determination, and social responsiveness of students in the treatment group. This data suggests there may be treatment benefits associated with employment for youth with ASD.

12:00 **106.004** Mindfulness-Based Therapy for Adults with Autism Spectrum Disorder: A Pilot Study

C. M. Conner[1,2] *and S. W. White*[3], *(1)Department of Psychology, Virgina Tech, Blacksburg, VA, (2)Department of Psychology, Virginia Tech, Blacksburg, VA, (3)Virginia Polytechnic Institute and State University, Blacksburg, VA*

Background:
Prior research has shown that individuals with ASD experience difficulties in emotional functioning and emotion regulation (ER). Furthermore, aggression, irritability, anxiety, and tantrum-like behaviors are common among individuals with ASD (Mazefsky et al., 2013; Samson, Huber, & Gross, 2012). MA-based interventions have been shown to be beneficial in targeting ER difficulties (e.g., inflexibility, rumination, or reappraisal and perspective taking) frequently seen in individuals with ASD (Eack et al., 2013; Rieffe et al., 2011; Samson et al., 2013).
Objectives:
Given high levels of ER difficulties among individuals with ASD, the development of effective interventions is imperative. The purpose of the current study was to determine the feasibility of a new, mindfulness-based intervention targeting ER difficulties in ASD.
Methods:
Nine young adults aged 18-25 years (mean= 19.56; 7 males= 77.78%) participated. All had ADOS-2 confirmed ASD diagnosis and IQ> 80. After eligibility determination, participants were randomly assigned to a three- or four-week baseline period, then completed six hour-long weekly individual therapy sessions where Mindfulness-based Cognitive therapy (MBCT) techniques and ER strategies were covered. Participants completed the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) and the Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985) at eligibility and endpoint. Reliabile Change Indices (RCI; Jacobson & Truax, 1991) and clinically meaningful change scores were used to assess within-person change over the course of intervention.
Results:
On the DERS, two of the nine participants had RCI scores above the cutoff of +/- 1.91, while an additional participant had a clinically meaningful change score from eligibility to endpoint. Four participants were below clinical cutoffs at eligibility and remained below cutoffs at endpoint, and two participants remained above clinically significant cutoffs. Seven of the nine participants' DERS scores decreased, indicating improving ER, from eligibility to post-treatment.
For the SWLS, none of participants demonstrated a significant RCI; however, one of the participants displayed meaningful change from pre- to post-treatment. Three other participants remained above the meaningful change cutoff throughout treatment.
Conclusions:
Results indicate that mindfulness-based intervention significantly lowers ER difficulties for adults with ASD who reported elevated ER difficulties prior to beginning intervention. The intervention did not have a significant effect on quality of life for most of the participants. Further research on ER and mindfulness-based interventions for ASD is warranted. Clinical implications related to ER and these interventions for ASD will be discussed.

Poster Session
107 - Brain Function (fMRI, fcMRI, MRS, EEG, ERP, MEG)
11:30 AM - 1:30 PM - Hall A

1 **107.001** 22q11.2 Deletion Syndrome Is Associated with Altered Resting State Networks

C. M. Pretzsch[1], *E. Daly*[2], *C. M. Murphy*[2], *C. Ecker*[2], *G. M. McAlonan*[3], *M. Gudbrandsen*[2], *R. H. Wichers*[2], *L. Kushan*[4], *C. Bearden*[5], *M. Craig*[2] *and D. G. Murphy*[2], *(1)Department of Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom,*

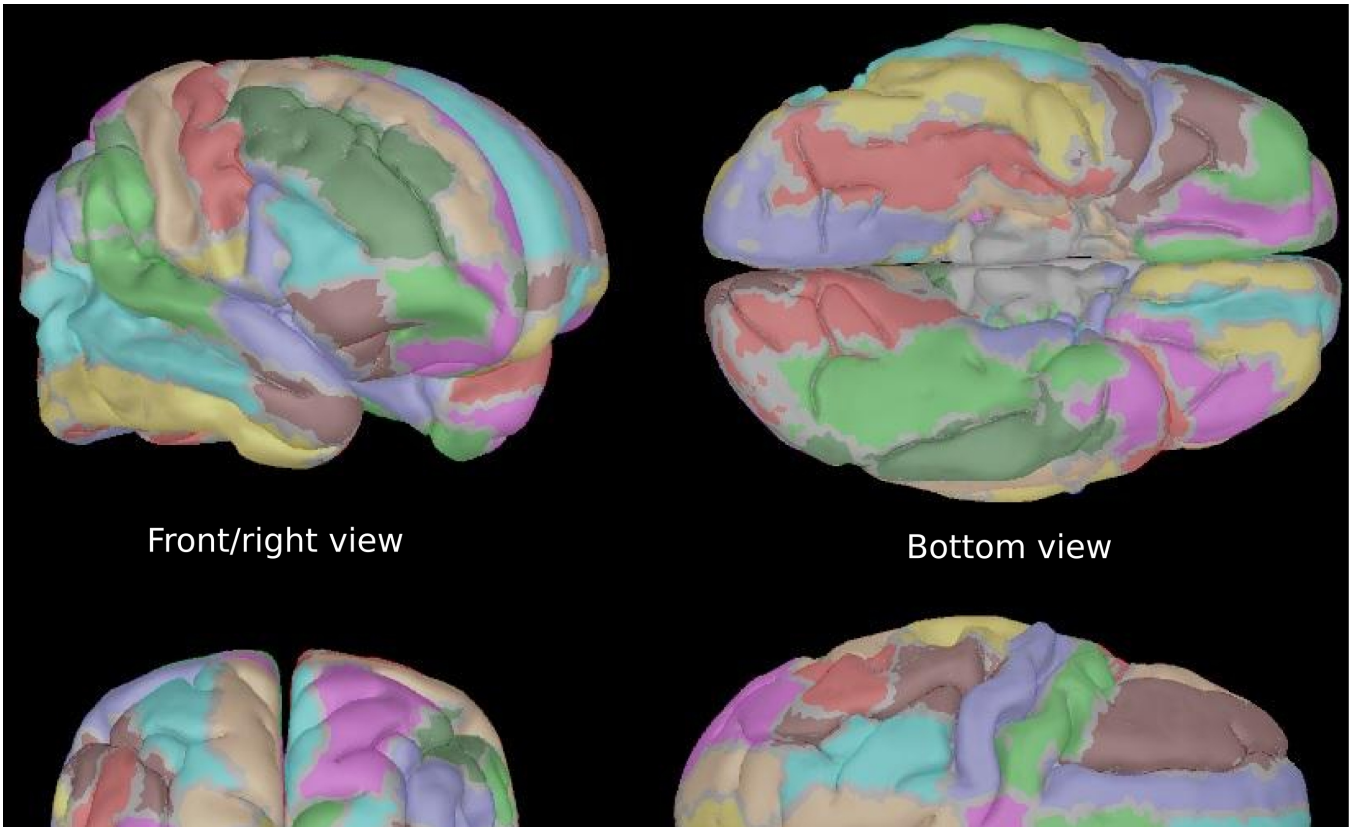
(2)Sackler Institute for Translational Neurodevelopment, Department of Forensic and Neurodevelopmental Sciences,, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (3)Department of Forensic and Neurodevelopmental Science, IoPPN, KCL, London, United Kingdom, (4)Semel Institute for Neuroscience and Human Behavior, UCLA, Los Angeles, CA, (5)Psychiatry and Biobehavioral Sciences, UCLA, Los Angeles, CA

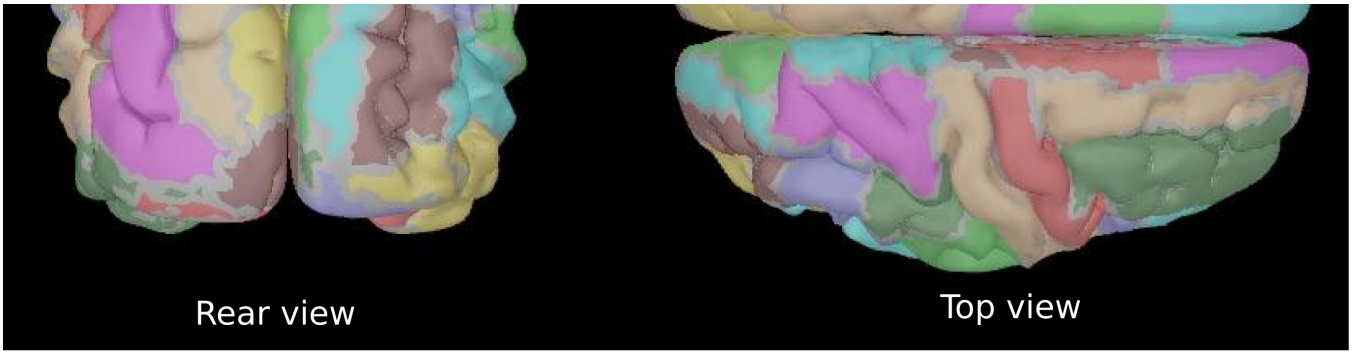
Background: The biological basis of Autism Spectrum Disorder (ASD) is still not fully understood. The study of conditions with a clearly identified genetic risk for neurodevelopmental disorders, such as 22q11.2 deletion syndrome (22q11DS), may help identify important biological pathways which are intermediate between risk genes and disorder. Therefore, we tested the hypothesis that the 22q11.2 deletion would impact upon the functional integrity of core resting state networks in brain.
Objectives: Functional magnetic resonance imaging (fMRI) was used to investigate neural resting state networks (RSNs) in the brain at rest in individuals with and without 22q11DS. This study had two aims: (1) To identify RSNs shared among individuals with 22q11DS and healthy controls: These RSNs were predicted to be in line with those established by previous research. (2) A between-group comparison of RSNs: Significant group-differences across widespread RSNs were predicted.
Methods: Thirteen individuals with 22q11DS and 34 healthy controls matched for age and sex underwent resting state fMRI. The data were analysed using spatial independent component analysis (Infomax algorithm). One-sample and two-sample t-tests were used to identify across-group networks and between-group differences, respectively. Although groups were matched on age, as brain maturation trajectories can be quite distinct in neurodevelopmental disorders, beta-values from regions of significant group-differences were also extracted and potential correlations with participants' ages were explored.
Results: Recognised RSNs were identified in all participants, including the Anterior Salience, Auditory, Default Mode (dorsal and ventral part), Higher Visual, Language, Left Executive Control, Primary Visual, and Visuospatial Network. All RSNs except for the ventral part of the Default Mode Network showed significant between-group differences, which were similar to differences reported in studies of idiopathic neurodevelopmental conditions. There was no effect of age in either group.
Conclusions: 22q11DS alters RSNs. This may constitute an intermediate phenotype and further analyses will examine the possible clinical correlates of these differences.

2 **107.002** A New Open-Source Tool for EEG Source Reconstruction in Infants

C. O'Reilly[1], *M. Elsabbagh*[2] *and T. B. Team*[3], *(1)Blue Brain Project, École Polytechnique Fédérale de Lausanne, Geneva, Switzerland, (2)McGill University, Montreal, PQ, Canada, (3)Birkbeck, University of London, London, United Kingdom*

Background: EEG studies in autism have been so far limited to scalp signals even though this kind of analysis has known limitations (e.g., noisier patterns, impossibility to relate observations to brain structures). Tools for performing cortical source estimation are now widely available. However, limited availability of structural recordings of the infant's head is among the factors hindering the adoption of latter techniques.
Objectives: With increasing availability of EEG recordings from infants at-risk for autism, our goal was to develop novel tools allowing progress in this area. We developed a population-averaged template allowing source reconstruction in one year-old infants without the need for individual participant MRI.
Methods: We used the BrainVisa pipeline to estimate a mesh surface of the cortical ribbon and some deep structures (e.g., the thalami) from the dataset of Shi et al. (2011) [PLoS One, 6(4), e18746] which contains an MRI template (average from 90 infants recorded at 1 year), tissue probability maps, and brain parcellation [Tzourio-Mazoyer, et al., (2002). NeuroImage, 15(1), 273-289]. Poor gray/white matter discriminability (typical for MRI at this age) and fuzziness due to inter-participant averaging of MRI volumes required additional manipulations to guide BrainVisa. Thus, a gray/white matter mask was computed using a Python toolbox (NiBabel) to merge the information from the gray and white matter probabilistic maps (voxels intensity < 25% of maximal intensity were set to 0; remaining voxels were classified as gray or white matter depending on the respective maps where their intensity was higher). The MRI-space Tzourio-Mazoyer parcellation was propagated to the cortical and subcortical mesh by coregistering every vertex with the corresponding voxel. BrainVisa provided a poor skull reconstruction, so Brainstorm was used for that purpose. As suggested by experimental results showing skull thickness of 1.5 to 4 mm in one year-old infants [Li et al., (2015) PLoS One, 10(5), e0127322], an 2.75 mm skull thickness was used for reconstructing the scalp, outer skull interface, and inner skull interface with boundary-element method.
Results: The resulting template is available online in the Matlab Brainstorm package and can freely be used for EEG source analysis of high-density EEG recordings.
Conclusions: Availability of these new tools will promote analyses of topologically-resolved functional connectivity in the study of autism through the estimation of EEG sources. Moreover, as data from large scale MRI studies of infants at-risk becomes available, it will be possible to improve validity of these EEG tools for infants across the first three years of life.





Reconstructed surfaces along with the projected regions of the Tzourio-Mazoyer, et al. (2002) altas.

3 **107.003** A Pharmacological MRI Study of Response Inhibition in Autism Spectrum Disorder Using Tianeptine

R. H. Wichers[1], *J. L. Findon*[1], *E. Daly*[1], *K. Rubia*[2], *C. Ecker*[1] *and D. G. Murphy*[1], *(1)Sackler Institute for Translational Neurodevelopment, Department of Forensic and Neurodevelopmental Sciences,, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (2)Institute of Psychiatry Psychology and Neuroscience, King's College London, London, United Kingdom*

Background:
Hyperserotonaemia is frequently reported in autism spectrum disorder (ASD). However, current drug treatments with selective serotonin reuptake inhibitors (SSRI's) further increase brain serotonin, and it is controversial whether they are effective. We recently demonstrated that an alternative approach – reducing brain serotonin using tryptophan depletion (ATD) - 'normalizes' fronto-cerebellar dysfunctions in ASD during tasks of inhibitory control that were associated with restricted, stereotyped and repetitive behaviours (Daly et al. 2014). Hence, repurposing existing drugs that reduce brain serotonin may offer a new therapeutic opportunity that can be rapidly translated to the clinic.
Objectives:
This study aimed to test the effect of the selective serotonin reuptake enhancer (SSRE) tianeptine, on inhibitory control networks in ASD.
Methods:
We included 10 right-handed adult males with ASD and 10 age- and IQ- matched controls. Pharmacological magnetic resonance imaging (phMRI) was used to compare brain activity during a Go/No-Go task under an acute dosage of 12.5 mg tianeptine and placebo in a randomised, double blind procedure. The fMRI data were analysed using a nonparametric approach to minimize assumptions (c.f. http://brainmap.it) and significance was defined as $p < .05$ corrected for multiple comparisons.
Results:
Following tianeptine dosage, adults with ASD showed a significant increase in activation compared to placebo in key inhibitory regions including left medial prefrontal gyrus, right cerebellum and right cuneus.
Conclusions:
We report proof of concept that tianeptine modulates abnormal brain activation during response inhibition in ASD. Further work is required to determine if it can be repurposed to reduce repetitive behaviours.

4 **107.004** Aberrant Brain Network Dynamics in Childhood Autism and Its Relation to Behavioral Inflexibility

K. Supekar*, S. Ryali and V. Menon, Stanford University School of Medicine, Stanford, CA*

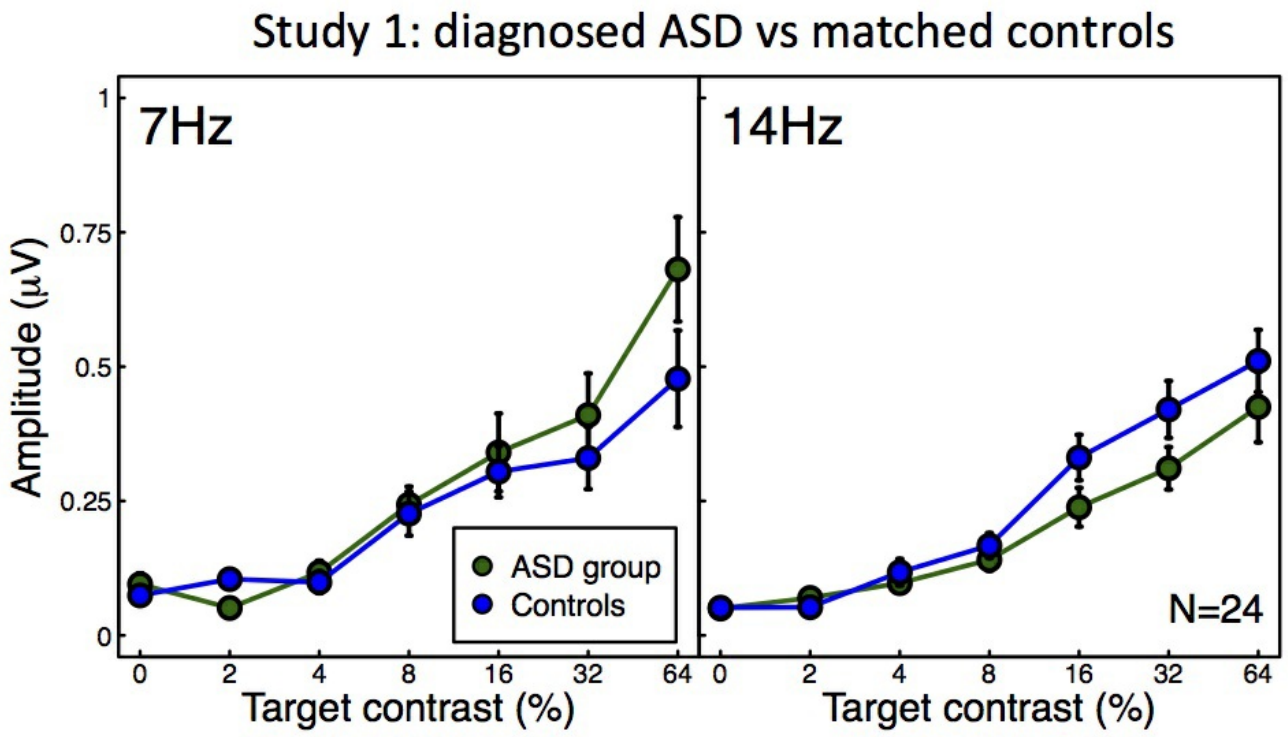
Background:
There is a growing consensus that the underlying neurobiological disturbance associated with autism spectrum disorder (ASD) is aberrant large-scale brain networks. Remarkably, to date, there have been no systematic attempts to characterize dynamic/time-varying functional interactions among these networks in children with ASD, work that is critical for understanding the etiology of this complex neurodevelopmental disorder.
Objectives:
To characterize dynamic functional interactions within a triple-network saliency model, and test the hypothesis that dynamic functional interactions among the salience (SN), central executive (CEN), and default mode (DMN) networks are dysregulated in children with ASD. We also determine whether dynamic network dysregulation measures can differentiate children with ASD from typically-developing (TD) children and predict clinical symptoms.
Methods:
One cohort of 40 children (ASD=20,age:10.1±1.6;TD=20,age:10±1.6) and a second cohort of 60 children (ASD=30,age:10.3±1.8;TD=30,age:10±1.7) participated in the study. Task-free fMRI was acquired from both cohorts.
Regional fMRI timeseries were extracted from six key network-nodes: right anterior insula and anterior cingulate cortex (SN); right posterior parietal cortex and right dorsolateral prefrontal cortex (CEN); posterior cingulate cortex and medial prefrontal cortex (DMN). We developed a novel Hidden Markov (HMM)-based method that overcomes limitations of existing approaches for estimating dynamic/time-varying functional interactions between distributed brain regions. For each participant, we applied the HMM method to the regional timeseries to identify brain states and estimate probability of each brain state at each timepoint; each brain state is characterized by distinct intrinsic functional connectivity structure. The states and dwelling times of each state calculated as frequency of occurrence of that state across time, was compared between the two groups. To determine whether the learned HMM models can be used to discriminate children with ASD from TD children, we compared the likelihood of observing the TD data given the ASD model and vice-a-versa. Lastly, we measured the relationships between the state dwelling times and the ASD symptom severity.
Results:
In Cohort 1, in both groups we found two prominent brain states: 'segregated state' characterized by strong within-network coupling and no cross-network coupling, and 'integrated state' characterized by strong cross-network coupling. Notably, brain dynamics of ASD children were characterized by less frequent 'integrated state', than TD children. HMM-based classifiers differentiated children with ASD from TD children with 84% accuracy. ASD children who showed the lowest dwelling time in the 'integrated state' had the most severe restricted/repetitive behavior.
We repeated our entire analysis on the second cohort. In spite of differences in scanner and acquisition protocols, results from this analysis replicated our findings observed in Cohort 1.
Conclusions:
Our findings provide not only provide novel evidence that alterations in dynamic coupling among the SN, CEN and DMN networks is a reproducible neurobiological signature of childhood autism but also show a link to core ASD symptomatology demonstrating for the first time that at earlier ages closer to disorder onset, the brain in children with ASD is inflexible in ways that contribute to behavioral inflexibility. More generally, the triple-network model provides a novel, replicable and parsimonious systems neuroscience framework for characterizing childhood ASD and predicting clinical symptoms in affected children.

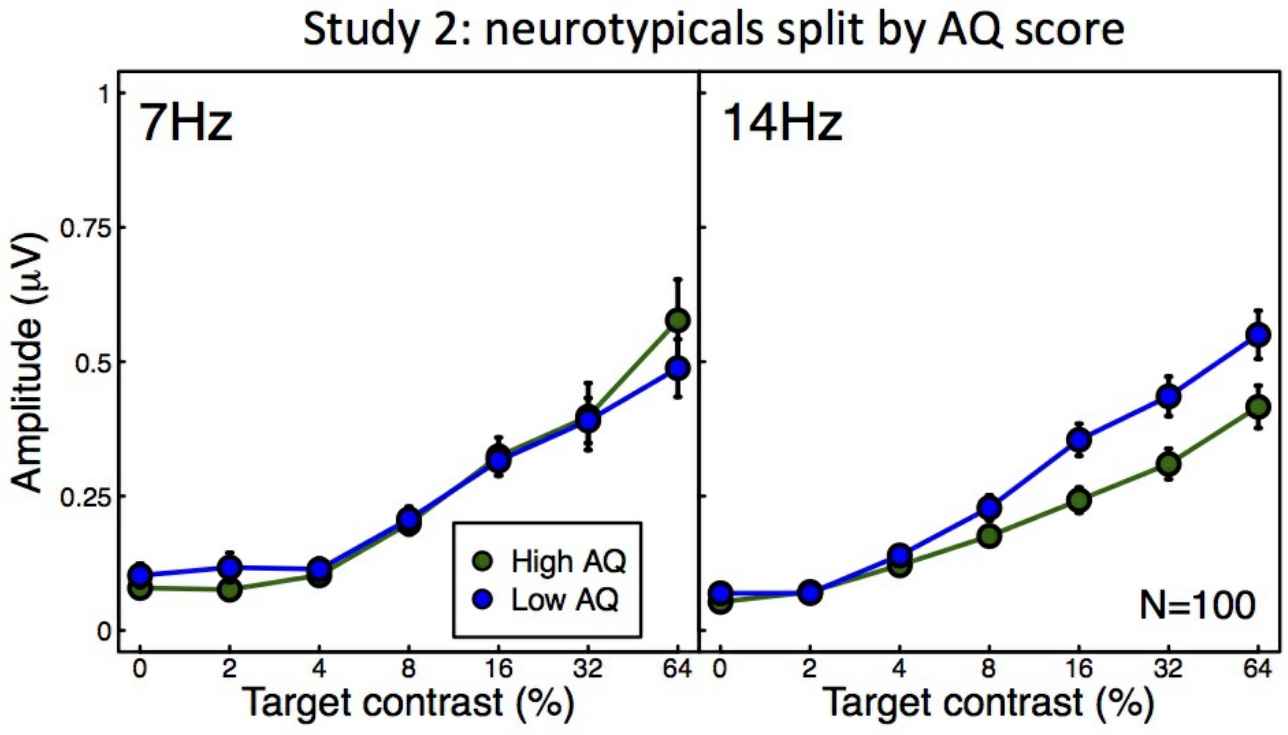
5 **107.005** Abnormalities in the Steady-State Contrast Response of Adults with High-Functioning Autism

D. H. Baker *and G. Vilidaite, Department of Psychology, University of York, York, United Kingdom*

Background:
Individuals with autism spectrum conditions (ASCs) often report hypersensitivity to intense sensory stimuli, such as loud sounds and high contrast patterns. This might be due to an abnormality in the neural transduction of sensory signals, perhaps involving differences in gain control.
Objectives:
Here we looked for objective evidence of atypical contrast responses both in adults with a clinical diagnosis of an ASC, and in the general population as a function of autistic traits.
Methods:
We used a steady-state VEP paradigm, in which observers viewed on-off flickering sine wave grating stimuli of 0.5c/deg at a range of contrasts (0-64%) whilst their EEG activity was recorded from 64 scalp electrodes. The dependent variable was the EEG amplitude at the target frequency (7Hz) or the second harmonic of the target frequency (14Hz). In study 1, 12 adult participants (1 female) had a clinical diagnosis of an ASC, and 12 participants were age- and gender-matched controls. Clinical diagnoses of ASC were confirmed by an ADOS interview, which was also completed on control participants. In study 2, 100 neurotypical adults completed the same EEG paradigm. Participants

also completed the autism quotient (AQ) (study 1) or short-AQ (study 2) questionnaire, and stated that they did not suffer from epilepsy.
Results:
In study 1, a 2x2x7 mixed ANOVA revealed a significant frequency by group interaction. Individuals with a clinical diagnosis of an ASC (mean AQ 31) had increased responses at the first harmonic, but weaker responses at the second harmonic frequency ($F_{1,22}$=4.41, p<0.05), compared with controls (mean AQ 17). These effects emerged at higher stimulus contrasts, and were not evident at baseline. In study 2, we performed a median split by AQ score. There was again a significant interaction between frequency and group ($F_{1,98}$=5.59, p<0.05), with the high AQ group (mean AQ 21) having lower amplitudes at the second harmonic than the low AQ group (mean AQ 10). This was confirmed by a significant negative correlation between AQ and the second harmonic amplitude at the highest contrast tested (r=-0.21, p<0.05).
Conclusions:
In two studies, we found a reduction in the amplitude of the second harmonic response that was associated with both clinically diagnosed autism, and higher levels of autistic traits. Second harmonic responses are believed to originate from complex cells in primary visual cortex that code for changes in contrast. This finding might therefore explain the poorer performance of children with ASC on a contrast discrimination task (Greenaway et al., 2013, *Neuropsychologia*). We also observed increased first harmonic responses in individuals with an ASC diagnosis. This is similar to findings in individuals with epilepsy (though none of our participants had ever experienced a seizure), and may be related to feelings of discomfort elicited by intense visual stimuli. In a companion study, we have found analogous effects in a fly genetic model of ASC, involving mutations of the sodium-hydrogen exchanger gene, Nhe3. This suggests that the cellular processes mediated by this gene might be responsible for sensory abnormalities commonly experienced in autism.





6 **107.006** Adaptive Neural Mechanisms in Individuals with Autism for Integrating Multisensory Real-World Stimuli

P. J. Webster[1], *C. Frum*[1], *C. Bauer*[1], *A. Kurkowski-Burt*[2], *N. Mardmomen*[3], *M. Gray*[4] *and J. W. Lewis*[1], *(1)Neurobiology & Anatomy, West Virginia University, Morgantown, WV, (2)Occupational Therapy, West Virginia University, Morgantown, WV, (3)Biology, West Virginia University, Morgantown, WV, (4)Psychology, West Virginia University, Morgantown, WV*

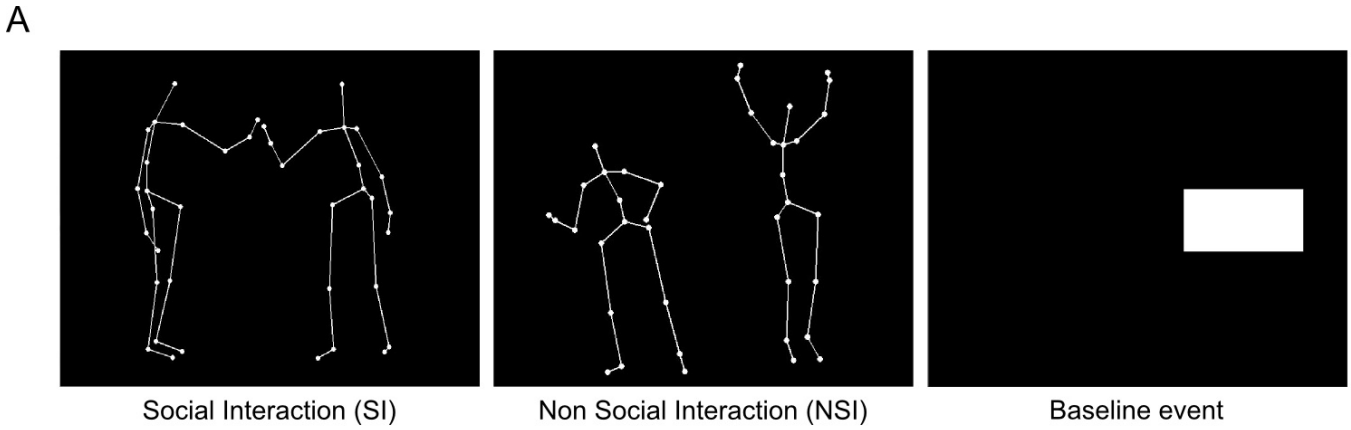
Background: Individuals on the autism spectrum can over respond or under respond to every-day sights, sounds, smells, etc. This sensory processing dysfunction is a pervasive aspect of autism that increases anxiety and negatively impacts language development and social interactions. The ability to appropriately process sensory

information is developed early in life based upon our experiences. After birth our brain learns to integrate what we see and hear so that information comes together in the correct timeframe, e.g. listening to someone speak while watching their mouth move. It is critical that the brain processes auditory information in synch with the visual information as this increases attention and is crucial for language development. Individuals with autism have been shown to integrate sensory information, but over a wider timeframe than their peers. This wider temporal binding window can impact their brain's ability to benefit from multiple sensory inputs and may contribute to aberrant sensory processing. Exactly how the brain can be re-organized to process audiovisual interactions remains unresolved.
Objectives: We are using functional magnetic resonance imaging (fMRI) to characterize adaptive cortical mechanisms for processing audiovisual information in high-functioning individuals with autism. Neuroimaging results will be correlated with behavioral measures of sensory processing and integration. We also sought to use socially relevant stimuli in order to more precisely examine how the brain responds when processing real-world events in the environment.
Methods: While in the 3T MRI scanner, participants watched a video of someone bouncing a basketball (a socially relevant stimulus). Their task was to press a button when they perceived the ball to touch the ground. The video included an audiovisual condition (bi-modal; see and hear the action), a visual only condition (uni-modal; only see the ball dribbled), and a resting condition (baseline control; actor holding basketball). Participants included high-functioning individuals with autism (aged 18-28 years) as well as individuals without autism matched for age and gender. Brain regions activated during the unimodal and bimodal conditions, relative to the baseline condition, were modeled using multiple linear regression analyses (NIH AFNI software). Individual datasets were transformed into Talairach coordinate space, and groups were compared and contrasted across conditions using t-tests.
Results: Both groups showed similar activation in primary auditory and primary visual cortices when processing audiovisual information. However, differences were seen between the two groups across the two conditions (uni-modal vs. bi-modal; $p<0.01$, corrected). The group with autism revealed increased activation in portions of cingulate cortex and middle temporal gyrus compared to individuals without autism. Conversely, individuals without autism showed increased activation in left inferior medial-posterior insula, which persisted in all individual datasets.
Conclusions: The functional roles of the cortical regions differentially activated provide important clues as to possible adaptive mechanisms that high-functioning adults with autism are using at a systems level to cope with audiovisual interactions. Correlations between neuroimaging results and sensory profile sub-scores may reveal autism subtypes that can be explored further.

7 **107.007** Altered Connectivity Between Brain Regions Involved in Social Body Motion (BM) Perception in Adults with Autism: A fcMRI Study

P. Duret[1,2], *M. V. Kujala*[3], *G. Riot*[4], *S. Sonié*[2], *D. Meunier*[2], *N. Georgieff*[4], *M. A. Hénaff*[2], *L. Mottron, M.D.*[1], *P. Fonlupt*[2] *and C. Schmitz*[2], *(1)Centre d'Excellence en Troubles Envahissants du Développement, Montréal, QC, Canada, (2)Lyon Neuroscience Research Center, Lyon, France, (3)Department of Equine and Small Animal Medicine, Faculty of Veterinary Medicine, Helsinki, Finland, (4)CH Le Vinatier, Bron, France*

Background:
Atypical comprehension of, and attention to social communication are core symptoms characterizing the Autism Spectrum (AS). Among other aspects, social communication includes processing information provided by body language, or Body Motion (BM). BM can be depicted using point-light displays, a minimalistic presentation of humans in action. Previous studies evidenced that autistic people were able to recognize simple actions through BM (Paron et al., 2008), but were less accurate when BM carried an emotional or social content (Centelles et al., 2013). Processing Social BM involves a large set of cerebral regions belonging to the mentalizing (MN) and the Mirror Neuron (MNS) systems, the basal ganglia and parts of the cerebellum.
Objectives:
We investigated putative autistic vs non-autistic group differences in regional activity and connectivity, in brain regions involved in BM processing. Altered activity and connectivity were predicted among the components of MN and MNS networks in the AS group, in parallel with superior involvement of the visual regions.
Methods:
Using fMRI, we recorded brain activity when participants watched point-lights videos of two actors either engaged in a Social Interaction (SI) or moving without interacting (NSI). Fifteen AS (diagnosed according to the DSM-IV criteria using the ADI-R and/or ADOS) and fifteen non-AS participants matched on age, IQ and gender performed a SI/NSI recognition task. Groups were compared in terms of behavioral performance, cerebral activity and functional connectivity. The connectivity analysis was performed on regions of interest (ROI) selected in the functional contrasts based on their reported implication in social BM processing. Regions belonging to the MN, MNS, the striatum and the cerebellum were included together with visual areas that are known to be over-implicated in visual social and non-social tasks in autism. Clusters detected in each group were pooled, resulting in one set of ROI which individual time-series were extracted. A General Linear Model was designed to take into account the variations due to the task. Finally, correlation coefficients were extracted for each pair of ROI, for all-task, and for each condition: SI, NSI, BM (SI+NSI) and Control. Non-parametric statistical tests were used and False Discovery Rate correction was applied.
Results:
AS were significantly slightly less accurate than non-AS participants to recognize SI only (93% and 86% correct for non-AS and AS respectively). Functional activations in non-AS were found in expected regions. The AS group showed sparser activation, with a strong implication of the striatum and primary visual cortex, the latter being nevertheless under-connected to the other ROI in the connectivity analysis. We also found evidence of atypical MNS involvement in the task and significant under-connectivity of the medial pre-frontal cortex (MPFC) during social processing. Surprisingly, a striatal over-connectivity was associated with the processing of BM and its social clues in autism.
Conclusions:
By investigating the neural correlates of BM processing in AS, this work evidenced the use of atypical mechanisms by autistic people, who seemed to rely more on the strong implication of striatal and visual systems that might compensate for the under-implication of the MPFC in this task.



8 **107.008** Altered Recruitment of the Brain's Reading Network in Children with Autism

H. Bednarz, *J. O. Maximo, D. Murdaugh and R. K. Kana, University of Alabama at Birmingham, Birmingham, AL*

Background: Autism spectrum disorders (ASD) are characterized by language deficits, which often entail difficulties in reading comprehension. Reading consists of decoding (the ability to translate letters into spoken language) and comprehension (the ability to understand what spoken words mean). While a proportion of children with autism show intact decoding skills, many exhibit significant deficits in comprehension (Nation et al, 2006). Such deficits may underlie altered recruitment of the language association cortex. Only a few neuroimaging studies have examined reading comprehension and its underlying neurobiology in autism.
Objectives: To examine the functional integrity of the brain's reading network in children with ASD and to relate it to their neuropsychological profile.
Methods: Nineteen high-functioning children with ASD and 16 typically developing (TD) control children participated in this study. The participants were matched on age (8-13 years), gender, handedness, full-scale IQ, verbal IQ, and fluency/decoding. Children completed a word similarities task in the scanner, in which they read a set of four words and determined whether the fourth word was similar to the previous three words presented (e.g. *orange, apple, mango,* table). fMRI data collected on a 3T Siemens Allegra scanner were analyzed using SPM12. Brain activation in regions within a previously identified reading network (Koyama et al., 2011) was examined.
Results: A 2-sample t-test revealed significantly decreased activity in ASD children, relative to TD children, in the left superior-temporal gyrus (LSTG), left supramarginal gyrus/angular gyrus (LSMG/AG), and middle occipital area ($p<0.05$, 300 voxels). ASD participants had significantly lower reading comprehension scores ($M = 77.6$, $SD = 13.3$) than TD controls ($M = 99.7$, $SD = 14.1$); $t(33) = 4.74$, $p<.001$, as measured by the Gray Oral Reading Test (GORT-4). In addition, the GORT comprehension scores predicted activation patterns in ASD participants in bilateral frontal and thalamic regions, a trend not seen in TD participants. Similarly, the accuracy of ASD children in the word similarities task was positively correlated with their GORT comprehension scores ($r = 0.559$, $p <0.05$).
Conclusions: Reduced activation in LSTG and LSMG/AG in ASD children may suggest difficulty in phonological as well as semantic processing (Bigler et al, 2007; Buchsbaum, 2001; Hickok & Poeppel, 2007). Since fluency was relatively intact in our sample, it is possible that ASD subjects used alternate methods to decode the words (e.g. memorization of words, pattern recognition). The relationship between GORT comprehension and bilateral frontal and thalamic activation in ASD children in our study may suggest a moderating effect of the thalamus on language comprehension in ASD (Klostermann, Krugel, & Ehlen, 2013). Thus, the results of this study provide evidence for altered recruitment of language areas in ASD children with intact fluency accompanied by poor comprehension; this may underlie differences in phonological and semantic processing. These findings have important implications for developing neurobiologically informed and targeted reading interventions in ASD.

9 **107.009** Altered Timing of Event Related Potentials in the Praxis Network of Children with High Functioning Autism

D. McAuliffe[1], *T. L. Johnson*[2], *M. Hallett*[3], *N. E. Crone*[4], *A. Pillai*[1], *S. H. Mostofsky*[5] *and J. B. Ewen*[6], *(1)Kennedy Krieger Institute, Baltimore, MD, (2)Neurology and Developmental Medicine, Kennedy Krieger Institute, Baltimore, MD, (3)National Institute of Neurological Disorders and Stroke, Bethesda, MD, (4)Neurology, Johns Hopkins University School of Medicine, Baltimore, MD, (5)Johns Hopkins School of Medicine, Baltimore, MD, (6)Kennedy Krieger Institute/JHUSOM, Baltimore, MD*

Background: Autism Spectrum Disorders (ASD) cardinally affect social and cognitive function, but motor domain deficits are also prominent and offer a well characterized window to observe altered brain physiology. Performance of learned skill movement – praxis – is deficient in children with ASD and is correlated with deficiencies across other domains. Altered connectivity hypotheses suggest information transmission may be impaired in ASD; specific hypotheses, such as *slowed* transmission, however, have rarely been tested directly. EEG can shed light on the timing and activation of left central and parietal regions that constitute the praxis network.
Objectives: To identify timing differences in various components of the praxis network in ASD, during tool-use motor preparation and pantomime (execution), using event-related potentials (ERPs).
Methods: 25 children with high functioning autism (HFA) and 33 typically-developing (TD) controls, aged 8-12 years, pantomimed the use of tools while EEG was recorded. Each participant observed a picture of a tool for 3 seconds and then was signaled to pantomime the tool use for 3 seconds. Event related potentials (ERPs) were time locked to the onset of stimulus picture, with the Prepare phase computed at 0-1s and the execution phase at 3-4s relative to the stimulus picture onset. The signal was analyzed in 2 channels each from left parietal (LP1, LP2) and 2 from left central (LC1, LC2) scalp regions. Timing of ERPs was assessed using rectified area latencies, calculated using time to reach 50% of total area within the praxis tool Prepare and Execution windows. *Post hoc*,we examined relative latencies between parietal and central regions.
Results: We first examined group differences in mean latencies of each of the 4 channels, separately in both Prepare and Execution phases. Only one of the left central channels (LC1) showed significant group differences, and only during Execution: children with HFA showed slower activation by an average of 67ms ($p = 0.03$). *Post hoc,* we found that LC1 activation followed LP1 (77ms, $p = 0.04$) activation significantly during the Execution in the HFA group. No parietal-central lag differed from zero in the TD group.
Conclusions: In children with HFA, activation of central, motor regions during tool-use gesture pantomime was delayed compared with controls. Further, controls showed zero-lag parietal-central activation, whereas children with HFA showed a significant delay in central activation compared with parietal regions. These findings are consistent with the literature that suggests slowed transmission in the central nervous system in ASD. These findings motivate further studies of information transfer characteristics in ASD and their relationship to clinical findings.

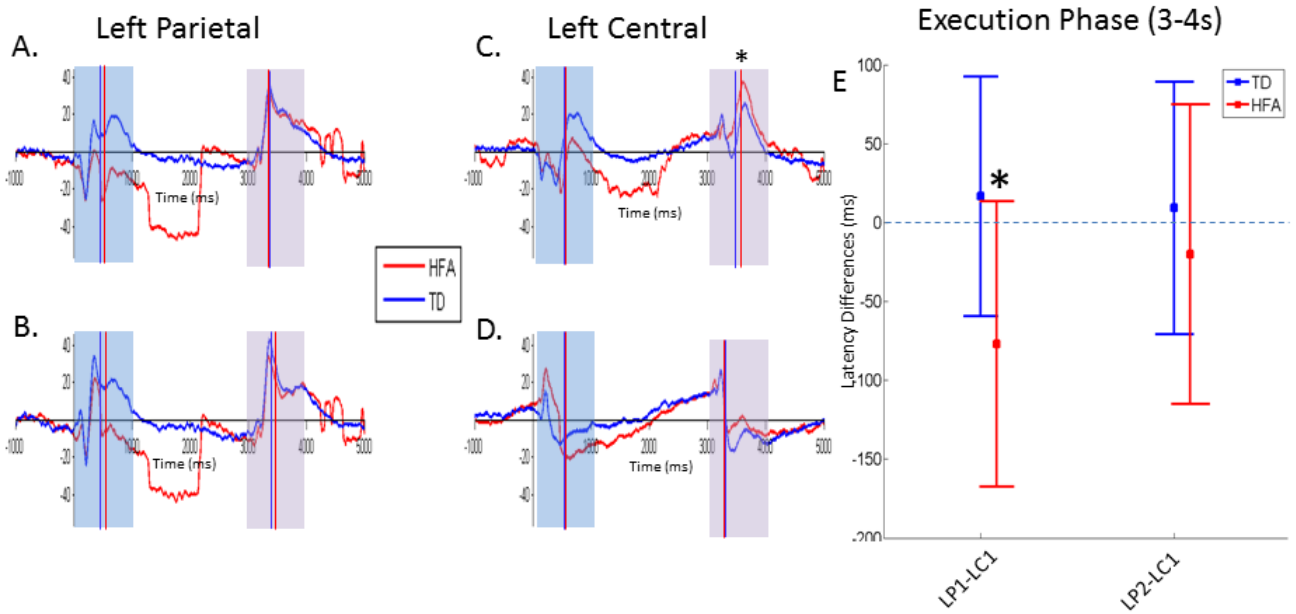


Figure 1: Panels A-D show the grand averaged ERP for the left parietal (LP1, LP2) and left central (LC1, LC2) channels. The vertical bars indicate the measured mean 50% fractional area latency. Highlighted regions are the Preparation phase (blue, 0-1s) and the Execution phase (purple, 3-4s). The only group difference was in LC1, with HFA showing significantly delayed activation in this central channel in Execution, compared with controls.

Panel E shows the relative latency differences between the significant central channel (LC1) and the two parietal channels (LP1, LP2). LC1-LP1 in the HFA group was significantly different from zero lag. * Indicates significance $p<0.05$.

10 **107.010** Atypical Working Memory-Related Brain Activation and Connectivity in Adolescents with Autism Spectrum Disorders

K. R. Bellesheim[1], *J. P. Stichter*[2], *K. E. Bodner*[1,3], *J. L. Sokoloff*[1] *and S. E. Christ*[1], *(1)University of Missouri, Columbia, MO, (2)Department of Special Education, University of Missouri, Columbia, MO, (3)Department of Health Psychology, Thompson Center for Autism and Neurodevelopmental Disorders, Columbia, MO*

Background: Recent studies have reported atypical functional brain connectivity (i.e., correlations in neural activity between brain regions) in individuals with autism spectrum disorder (ASD; Koshino et al., 2005; Cherkassky et al., 2006). Research on healthy non-ASD individuals suggests that the degree of functional connectivity between brain regions is often not static but rather varies as a function of the task being performed. For example, when transitioning from a period of rest to the performance of a working memory task, the synchronization of activity within the 'working memory' network of brain regions may increase. One such working memory-related region is the left intraparietal sulcus (IPS), which previous research suggests is a 'core' critical region for working memory (Cowan et al., 2010).
Objectives: The goal of the present study was to evaluate potential ASD-related disruptions in patterns of rest-based and task-based activation and interrelations involving the left IPS. To accomplish this, functional activation and psychophysiological interaction (PPI) connectivity analyses were utilized in individuals with and without ASD during rest and during performance of a non-verbal working memory task.
Methods: A sample of 19 adolescents with ASD (mean age = 13.1 yrs; range: 11-15 yrs) and 21 typically developing adolescents without ASD (mean age = 13.2 yrs; range: 11-16 yrs) participated. Functional MRI scans were obtained while participants completed two conditions (2-back and 0-back) of an *n*-back non-verbal working memory task using a series of novel face stimuli. Each participant completed two functional runs, with each including 6 counterbalanced task epochs (3 per condition). PPI connectivity analysis was conducted to assess for differences in patterns of functional connectivity between a seed region, the left IPS, and the rest of the brain during task versus rest periods.
Results: Whole brain analysis revealed several regions-of-interest (ROIs) demonstrating significant condition (0-back and 2-back) x group (ASD and non-ASD) interactions in neural activation. ROIs included the left IPS, left ventrolateral prefrontal cortex, right superior temporal cortex, and left fusiform gyrus [$F(1,38) > 7.94$, $p < .005$ cluster-thresholded, in all instances]. A significant PPI was observed between the left IPS and the anterior cingulate cortex (ACC) [$F(1,38) = 14.59$, $p< .005$ thresholded]. Whereas the non-ASD group showed a decrease in functional connectivity between the aforementioned regions during task performance compared to rest, the ASD group showed the opposite pattern (increased connectivity during task compared to rest).
Conclusions: Consistent with past neuroimaging studies, individuals with ASD demonstrated altered neural activation and functional connectivity compared to individuals without ASD both during a non-verbal working memory task and during resting period. Results of the current analysis further suggest ASD-related disruptions in the extent to which connectivity between regions changes as a function of task demands. Further analyses will examine the potential relationship between this phenomenon and cognitive, social, and behavioral functioning.

11 **107.011** Amygdala Hyperconnectivity during Adaptive Executive Control of Social Information Processing in Autism Spectrum Disorders (ASD) Children

J. B. Cherry[1], *X. You*[2], *R. Ludlum*[3], *W. D. Gaillard*[2], *L. Kenworthy*[4] *and C. J. Vaidya*[5], *(1)Psychology, Georgetown University, Washington, DC, (2)Children's Research Institute, Childrens National Medical Center, Washington, DC, (3)Department of Psychology, Georgetown University, Washington, DC, (4)Children's Research Institute, Children's National Medical Center, Rockville, MD, (5)Georgetown University, Washington, DC*

Background:
Social communication, an area of impairment in ASD, involves dynamic interaction between social information processing (e.g., eye gaze) and flexible executive control of actions in the service of goals. We have reported that ASD children engage a more widespread network of regions connected to the amygdala during executive control of social cues in a novel Stroop-like interference task, suggesting difficulty suppressing emotional reactivity during executive control (Murphy et al., 2012). Here, we examine *context-adaptation* reflecting dynamic executive control of social cues, manifested in trial-to-trial adjustments in control evoked by variable proportion of incongruent and congruent trials – higher adjustment is needed in a block of 25% incongruent and 75% congruent trials relative to a block with 75% incongruent and 25% congruent trials. Such adaptive executive control is reflective of real-world social interaction.
Objectives:
To examine amygdala functional connectivity during adaptive executive control of socially significant information processing in 7-14 year-old ASD and control children.
Methods:
Imaging was performed at 3T in 73 children (age, gender, and IQ matched 38 ASD, 35 controls) during 2 runs of the Stroop-like task requiring a left/right handed response to the direction indicated by a word (LEFT or RIGHT) positioned on the nasion of faces appearing in color with neutral facial expression. Across trials, eye-gaze direction varied such that relative to the target word, it was either congruent (leftward gaze and "LEFT" word) or incongruent (leftward gaze and "RIGHT" word). Unbeknownst to the subjects, the proportion of incongruent (I) and congruent (C) trials varied across blocks (25I-75C%; 50I-50C%; 75I-25C%) with jittered trials within blocks to allow selective averaging of incongruent and congruent trials.
Images were slice-time and motion-corrected, normalized and resliced to 3mm, smoothed with 8mm FWHM and using stringent motion-criteria retained 38 children (16 ASD, 22 controls). Functional connectivity was analyzed using psychophysiological interaction in SPM8, for right and left amygdala ROIs based on the AAL brain atlas, separately

for Incongruent and congruent trials. Regions showing differences between ASD and control groups for 25I-75C% vs. 75I-25C% contrast were identified with a whole-brain ANOVA in SPM 8 (p < .05 Monte Carlo corrected; p<.001, k=24 voxels).
Results:
Performance was slower for incongruent than congruent trials indicating interference suppression associated with greater executive control. Interference was higher for 25I-75C% relative to 75I-25C% blocks but did not differ by group. For both left and right amygdala, connectivity was greater in ASD than control children for incongruent trials, with right superior temporal sulcus and precuneus, important for gaze processing. Additionally, left amygdala also had greater connectivity with bilateral supplementary motor and striatal regions, involved in response inhibition and superior and inferior parietal cortex involved in spatial attention. Connectivity for congruent trials did not differ between groups for the left amygdala, but was greater with the left lingual gyrus, a visual processing region in ASD than control children.
Conclusions:
These findings draw attention to hyperconnectivity of the amygdala with striatal and temporo-parietal regions as loci of network disturbances contributing to social interaction difficulties in ASD.

12 **107.012** An Analysis of Resting EEG Data in Infants at High-Risk for Developing ASD

***T. Y. Kim**, A. Naples, M. Rolison and J. McPartland, Child Study Center, Yale School of Medicine, New Haven, CT*

Background:
Clinical diagnoses of autism spectrum disorder can be made as early as two years of age, but experimental evidence suggests that atypical patterns of attention and brain activity in infants who later develop autism may be present in the first months of life. Measurement of EEG in infancy provides a direct, non-invasive measure of cortical activity. Differences in EEG spectral power during rest have successfully discriminated children with ASD from controls and have been shown to correlate with clinical characteristics. Recent studies suggest that ASD can be characterized by atypical neural oscillations, such as decreased alpha power and increased theta power in adults relative to children. By measuring resting brain activity in infants at high (HR; older sibling with ASD) and normal risk (NR; no family history of ASD) for ASD, it may be possible to identify anomalous brain activity preceding emergence of behavioral symptoms.
Objectives:
The current study compared resting EEG spectral power in 6-24 month old HR and NR infants to assess (a) overall oscillatory power differences and (b) patterns of relative power within groups. We further assessed different patterns of age-related change in the EEG between groups.
Methods:
In a longitudinal design, HR (n = 28, 46 sessions) and NR (n = 21, 31 sessions) infants were assessed at 6, 9, 12, and 24-months of age. EEG was recorded for 2 minutes with a 128-channel Hydrocel Geodesic Sensor net while infants observed bubbles blown by an experimenter. Data from electrodes over frontal scalp were processed with Netstation v4.5 through a first-order high-pass filter, a 100 Hz low-pass filter, and segmented into 120 1s epochs hand-edited for artifacts. The cleaned data was subjected to a Hann window and spectral power was estimated using a Fast Fourier Transform.
Results:
Preliminary analyses indicated that the ratio of alpha-to-theta (HR mean = -.4330, NR mean = -.3751, mean difference = .05787, p = .024) and the ratio of alpha-to-beta power (HR mean = .2671, NR mean = .3083, mean difference = .04121 in direction of NR, p = .017) differed between HR and NR infants. In NR infants, power in the beta frequency band was significantly correlated with age (r = .366, p = .043) but not in HR infants (r = .099, p = .513). Ongoing analyses explore patterns of coherence across scalp regions.
Conclusions:
Results indicate different patterns of oscillatory brain activity with different maturational trajectories in HR versus NR infants. HR infants displayed decreased levels of alpha relative to both beta and theta activity. The lack of developmental change in beta activity in HR infants suggests atypical maturation of feedback connectivity in children at a higher risk of ASD. By identifying differences in neural oscillations in early life before behavioral symptoms emerge, differences in oscillatory power have the potential to serve as early biomarkers of ASD, as well as to provide insight into neural mechanisms of ASD that may inform novel forms of early intervention.

13 **107.013** An Effective Connectivity Approach to Autism Spectrum Disorders

***S. Vettori**[1,2,3], D. Marinazzo[2], B. Boets[1,3] and R. Siugzdaite[2,4], (1)Child and Adolescent Psychiatry, KU Leuven, Leuven, Belgium, (2)Data analysis Department, Ghent University, Gent, Belgium, (3)Leuven Autism Research consortium (LAuRes), KU Leuven, Leuven, Belgium, (4)Experimental psychology department, University of Ghent, Ghent, Belgium*

Background:
Many neuroimaging studies indicate that autism spectrum disorders (ASD) are characterized by aberrant functional connectivity. However, the nature and directionality of these aberrant connections remain largely unknown and under-investigated.
Objectives:
With a novel combination of advanced neuroimaging data analysis methods, we aim to understand the directionality of these aberrant functional connections.
Methods:
We used resting state fMRI data of the Autism Brain Imaging Data Exchange database (ABIDE) from 21 participants with ASD and 21 IQ-matched typically developing (TD) children (age range: 7-12 years). First, we used functional connectivity density mapping (FCD), a whole-brain data-driven method, to identify local and global differences in functional connectivity density between resting-state fMRI data of the ASD and the TD group. Then we used partially conditioned Granger causality analysis to investigate the directionality of those connections that showed group differences in functional connectivity density. With this method, a reliable estimate of group differences in directed connectivity was obtained.
Results:
Local and global functional connectivity density mappings reveal clusters with more dense short-range local and global connections in four subcortical and five frontal regions in the ASD group, as compared to the TD group. Granger causality indicates that both the incoming and the outgoing information flow is increased in ASD in 7 of these 9 regions. However, in the right caudate and the left inferior frontal gyrus (two regions known to be involved in ASD), the incoming information flow is higher than the outgoing flow in ASD, while this pattern is reversed in the TD group.
Conclusions: With a novel combination of advanced neuroimaging data analysis methods, we investigated differences in dynamical functional connectivity and in the directionality of information flow between children with ASD and TD controls. For the right caudate and the left inferior frontal gyrus (relevant for respectively sensorimotor control and language processing), we found that children with ASD show more incoming and less outgoing functional connections than TD controls. Accordingly, this may indicate that information from these two regions is less transferred to control other regions in a top-down manner, which may relate to deficits in sensorimotor control and language processing in ASD. We conclude that this pattern of inverted effective connectivity in right caudate and left inferior frontal gyrus in ASD may explain some of the inconsistencies in the literature, and that this novel finding provides important insights in the neurobiological origin of ASD.

14 **107.014** Attention and Brain Response during Simulated Social Interactions in ASD

***A. Naples**, M. Rolison, J. H. Foss-Feig, K. K. Stavropoulos, T. Winkelman and J. McPartland, Child Study Center, Yale School of Medicine, New Haven, CT*

Background:
Difficulties with eye-contact represent some of the earliest observable symptoms of autism spectrum disorder (ASD). While difficulties with eye-contact are clinically diagnostic, experimental investigations of gaze processing have yielded mixed results. Prior work has focused primarily on experiments in which individuals with ASD passively observe faces. Our preliminary work assessing response to mutual gaze has revealed ERP markers of eye-contact. The N170 and P300, temporally early electrophysiological components, show variability in response to shared gaze that track with clinical characteristics. Further, eye movements to interactive faces distinguish between groups and reflect variability in the clinical phenotype.
Objectives:
To investigate neural processing of interactive eye-contact; investigate attention by measuring eye-movements during interaction with an onscreen face; and evaluate the relationship between neural and attentional markers of eye-contact and clinical characteristics.
Methods:
ERPs were recorded from 44 children with ASD (M =14.5 years, mean IQ =103) and 44 controls (M =13.7 years, mean IQ=107) using a 128 electrode Geodesic Net. Eye movements were recorded with an SR-Research Eyelink 1000 integrated with EEG recording. Through co-registered and time-locked ET and EEG, the experiment was controlled by participant gaze. Trials began with a centrally presented face displaying direct or averted gaze. Contingent upon participant fixation, the face responded by either looking at (eye contact) or away (averted gaze) from the participant. ERPs were time-locked to face movement.
Results:
Preliminary analyses of eye-tracking data using linear mixed models indicated that, when initially looking to faces, individuals with ASD show longer gaze latency than controls [B = 83.10, p = .02], but an interaction between condition (gaze direction) and group [B = 49.5 p = 0.08] revealed that control participants looked more slowly to faces showing averted gaze. Region of interest analyses indicated that children with ASD looked less to the left eye of the face [B = 40.0, p = .06]. Analyses of pupil size revealed an interaction [B = 4.1, p = .06], such that individuals with ASD exhibited pupil dilation following direct gaze whereas controls exhibited constriction. Preliminary analyses of

ERP data revealed that averted gaze elicited a more positive P300 in both groups [$p < .05$], although an interaction revealed that increasing levels of anxiety predicted more positive P300s for direct gaze [B = 0.063, $p = 0.06$]. Analyses in progress investigate brain response to mutual gaze and the relationship between attentional dynamics and clinical characterization.

Conclusions:

We demonstrate an electrophysiological marker of reciprocal gaze perception that is sensitive to clinical characteristics and a pattern of attenuated attention, but increased arousal, to direct gaze in individuals with ASD. Our ERP findings suggest that direct gaze perception is associated with anxiety regardless of group assignment. Relationships between pupillary dilation and anxiety suggest that mechanisms of arousal associate with social brain response and reflect meaningful variability in the clinical phenotype. By linking both eye-tracking and EEG during social interactions, we can gain insight into the complex interrelationship between attention and brain response to social information during the course of an interaction.

15 **107.015** Atypical Functional Heterogeneity of the Right Temporo-Parietal Junction in Autism Spectrum Disorders

D. Moraczewski[1] *and E. Redcay*[2]*, (1)University of Maryland, College Park, MD, (2)Department of Psychology, University of Maryland, College Park, MD*

Background:

The right temporo-parietal junction (rTPJ) sits at the border of the dorsal and ventral attention and fronto-parietal networks. This region is associated with increased activation during social-cognitive and attention tasks in neurotypical (NT) individuals, whereas individuals with ASD display atypical activation. Deficits in these behaviors are a core phenotype of ASD, thus the rTPJ is a crucial region to understand the relationship between brain and behavior in this disorder. In NT, the rTPJ displays a heterogeneous organization of distinct sub-regions, each of whom show differential task activation and intrinsic functional connectivity. This functional organization has also been shown to specialize with age. Thus, regional heterogeneity may reflect optimal age-related local and network-wide specialization for efficient task engagement. Atypical specialization of this region in ASD may contribute to the social and attention deficits seen in the ASD phenotype. However the relationship between heterogeneity of the rTPJ and the behavioral deficits in ASD are unknown.

Objectives:

The objectives of the current study are to compare intrinsic rTPJ heterogeneity in NT and ASD. We also examine regional organization for age-related changes and relationships with diagnostic assessment scores in the ASD group.

Methods:

We used a large, multi-site sample (N = 240, 107 ASD) of NT and ASD resting-state data from the Autism Brain Imaging Database Exchange. We started with a rTPJ region defined within the default mode network from the Yeo et al., 2011 functional atlas and progressively dilated the original ROI three times in order to progressively expand the borders into other networks. Then, using principal component analysis, we extracted the percent variance explained by the first eigenvector of time-series at each ROI level as a measure of regional heterogeneity (i.e., reduced percent variance is associated with greater heterogeneity). We expect this measure to be inversely related to ROI size, a pattern that highlights increased heterogeneity as the ROI expands. However, we hypothesize that the ASD group will show less heterogeneity compared to the NT group, suggesting less functional specialization. We then examined regional heterogeneity for age-related changes and relationships with diagnostic scores in ASD.

Results:

A within-group main effect was detected for ROI size ($F(3,948) = 5.04$, $p < .002$), which demonstrates that region dilation yields increased heterogeneity. Between-group differences were only detected at the largest two ROIs (second dilation: $t(240) = 1.95$, $p < 0.05$; third dilation: $t(240) = 2.17$, $p < 0.03$) showing that the ASD group displayed less heterogeneity at the largest two ROI sizes. No relationship was detected with respect to age. Also, no relationships with diagnostic scores were detected, however there was large variability between sites.

Conclusions:

We found that as region size increased, regional heterogeneity decreased in both groups. In addition, the ASD group displayed less heterogeneity than the TD group in the largest two ROI dilations. This suggests that there may be less functional specialization at the network borders surrounding the rTPJ, which could have important implications for understanding brain organization in ASD.

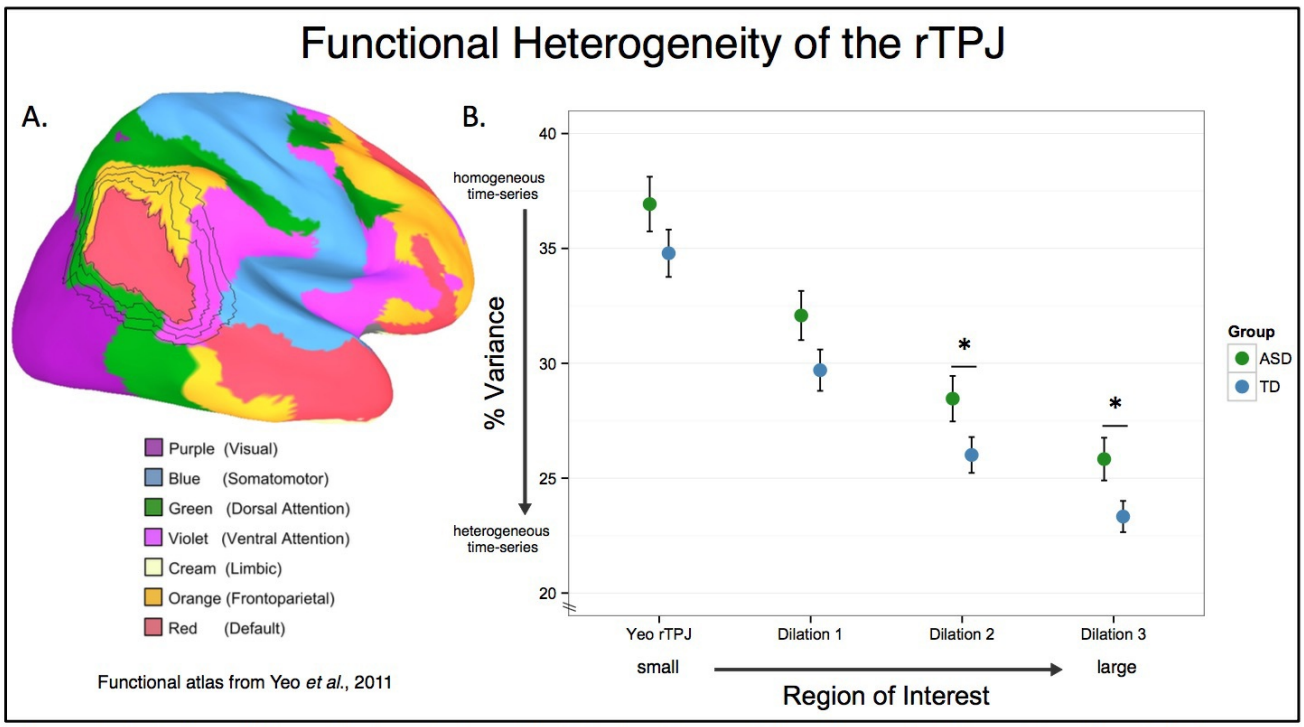


Figure 1: **A**. Starting with the original rTPJ region of the default mode network from Yeo, *et al.*, 2011, we dilated the ROI 3 times (black outlines) in order to capture the borders of other resting-state networks (see color legend for network specification). **B**. Percent variance explained by the first eigenvector of time-series from each ROI is shown by group. Lower variance denotes greater heterogeneity. Bars denote standard error. Significant between-group differences using Welch's *t* are denoted with * (Dilation 2: $t(240) = 1.95$, $p < 0.05$; Dilation 3: $t(240) = 2.17$, $p < 0.03$).

16 **107.016** Atypical Intrinsic Functional Connectivity of Core Face Perception System Is Associated with Symptom Severity in ASD

W. Zhao[1]*, I. Fishman*[2]*, R. J. Jao Keehn*[2] *and R. A. Müller*[2]*, (1)Psychology, San Diego State University, San Diego, CA, (2)San Diego State University, San Diego, CA*

Background: One of the core symptoms of Autism Spectrum Disorder (ASD) is a deficit in social communication. Individuals with ASD have impairments in face processing, a crucial component of reciprocal social interactions, including deficits in gaze processing and face identification. Face processing relies on the core face perception system, which includes the fusiform face area (FFA), occipital face area (OFA), and the posterior superior temporal sulcus (pSTS).

Objectives: Given the observed deficits in face perception in ASD and the prevalent theory that ASD is a disorder of network dysfunction and abnormal brain connectivity, we examined the functional network organization of the core face perception system in children and adolescents with ASD using intrinsic functional connectivity (iFC).

Methods: We performed whole-brain iFC analysis using bilateral FFA, OFA and pSTS as seed regions (Tahmasebi et al., 2012) in 35 children and adolescents with ASD (aged 8-17 years) and 36 typically developing (TD) participants matched for age, gender, IQ, and in-scanner head motion.

Results: Between-group comparisons revealed two main clusters of differential iFC shared across most seeds. Underconnectivity (ASD < TD) with the right IFG, part of the extended face perception system (Fairhall & Ishai, 2007), was found for bilateral FFA, right OFA, and bilateral pSTS seeds. The degree of underconnectivity between right IFG and right FFA, and between right IFG and right OFA was correlated with ADOS-2 Total scores, such that weaker connectivity, compared to TD, was associated with greater symptom severity. Overconnectivity (ASD > TD) with the PCC was found for the bilateral FFA and OFA seeds. Additionally, right FFA seed also yielded overconnectivity in or close to default mode network (DMN) nodes, including the mid orbital gyrus and bilateral angular gyri. The extent of overconnectivity between right FFA and DMN regions was also correlated with ADOS-2 Total scores: Individuals with ASD with greater connectivity between right FFA and DMN regions had more ASD symptoms.
Conclusions: Our findings indicate atypical iFC patterns of core face perception regions in children and adolescents with ASD. Individuals with ASD exhibited reduced segregation between the core face perception system and out-of-network regions, such as the DMN, and reduced integration between the core and extended face perception systems. The link between increased ASD symptomatology and atypical connectivity patterns of the core face perception system suggests that compromised face perception network integrity may contribute to social communication deficits observed in ASD.

17 **107.017** Atypical Novelty Detection ERP Responses Associated with Genetic but Not Idiopathic ASD Etiologies

***C. M. Hudac**, T. DesChamps, S. J. J. Webb and R. Bernier, University of Washington, Seattle, WA*

Background: Recurrent disruptive likely gene disrupting (LGD) mutations such as *CHD8* and *DYRK1A* have been implicated as contributing to approximately 10% of autism spectrum disorders, (ASD; Iossifov et al., 2014). To better describe the known genetic and phenotypic heterogeneity in ASD, recent work has begun to target specific neural phenotypes related to specific genotypes. One such study integrating a "genetics-first" approach with cognitive neuroscience discovered unique social phenotypes related to genetic and idiopathic etiologies of ASD (Hudac et al., 2015). However, it is still unclear how genetic disruptions impact associated aspects of ASD, such as cognitive delay.
Objectives: We aimed to characterize the neural patterns associated with idiopathic and genetic ASD etiologies during an auditory oddball task that is known to capture both attention orientation and novelty processing mechanisms. Recruitment targeted children with ASD who had completed genetic testing in prior studies and either had a known ASD-associated truncated likely gene-disrupting mutation (LGDM; Sanders et al., 2015; Iossifov et al., 2014) or no LGDMs (Idiopathic). Prior studies have found that children with ASD exhibit attenuation of the P3 component in response to novel and infrequent stimuli (e.g., Salmond et al., 2007; Donkers et al., 2015). However, we hypothesized that children with ASD with distinct genetic etiologies may showcase differences in neurophysiological functioning.
Methods: Gender-matched children age 6 to 18 (M=13.5 years, SD=2.5) were enrolled in the LGD Mutation group (n=11, ASD with LGDM), Idiopathic group (n=12, ASD without LGDM), or the Typical development group (n=11, no ASD). During electroencephalography acquisition, children watched a video of a trip to the zoo while passively attending to frequent tones, infrequent tones, and novel sounds (adapted from Salmond et al., 2007). Tone stimuli (1000 or 750 Hz) were counterbalanced between subjects. Maximum amplitude at scalp electrode clusters around C_z and F_z were extracted for the P300 component (180-350 ms). We focused on difference comparisons for attention orientation (infrequent minus frequent) and novelty detection (novel minus frequent).
Results: Repeated measures general linear models (SPSS 19) indicated an interaction between region, condition, and group, $F(2,17)=8.50$, $p=.024$, such that the LGDM group exhibited a reduced P300 novelty detection responses (i.e., a smaller response after accounting for the response to the frequent tone) at C_z compared to TYP children, (difference = 4.26 uV, SD = 1.5, p = .031). There were no significant amplitude differences between the Idiopathic and TYP groups at F_z or C_z for either attention orienting or novelty detection comparisons (p's>.17).
Conclusions: Here, children with idiopathic ASD and those with LGDMs exhibit typical patterns of attention orienting. However, children with ASD and a LGD mutation have reduced novelty detection responses, compared to typically developing children. These results indicate that the contribution of genetic etiology on functional neural mechanisms in ASD may impact specific cognitive functions more so than others.

Figure 1. Event-related potentials waveforms for LGD M, Idiopathic, and Typical development groups at central electrodes for frequent tone (black), infrequent tone (blue), and novel sound (red) conditions for the C_z region.

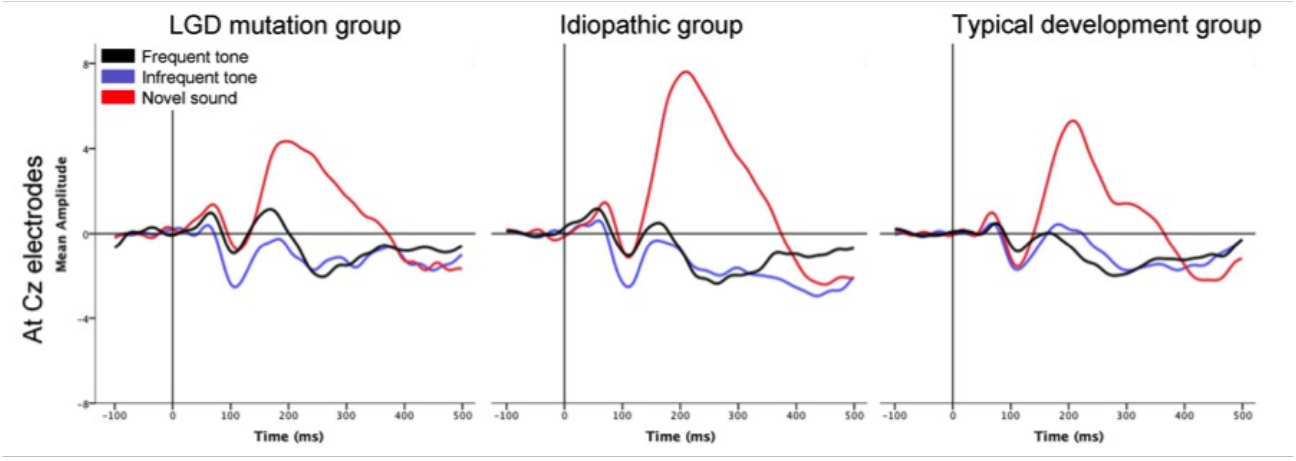
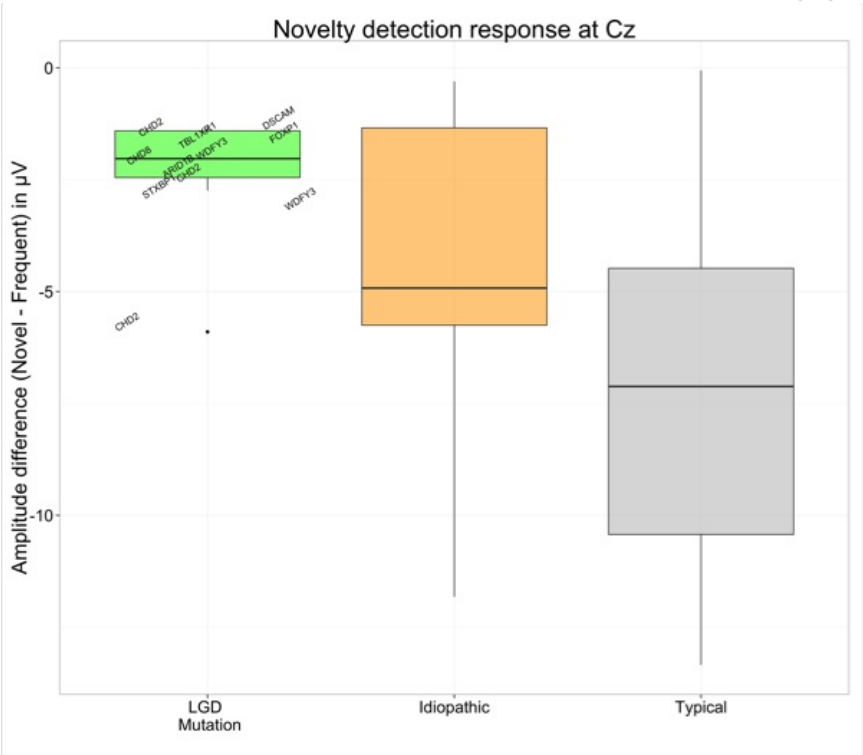


Figure 2. Novelty detection response (novel sounds minus frequent tones) are plotted for each group for the C_z region. Individual responses for children in the LGDM group are annotated with each child's corresponding gene event.



18 **107.018** Atypical Pattern of Frontal EEG Asymmetry to Direct Gaze in Young Children with Autism Spectrum Disorder

A. Kylliainen[1], *T. M. Helminen*[1], *J. Lauttia*[1], *S. Yrttiaho*[1], *K. Eriksson*[2], *J. K. Hietanen*[3] *and J. M. Leppänen*[2], *(1)University of Tampere, Tampere, Finland, (2)School of Medicine, University of Tampere, Tampere, Finland, (3)School of Social Sciences and Humanities / Psychology, University of Tampere, Tampere, Finland*

Background:
It has been suggested that another person's direct gaze is not socially motivating for individuals with autism spectrum disorder (ASD) and therefore they ignore it. This assumption has gained psychophysiological support from previous findings indicating that, contrary to typically developing children, children with ASD did not show greater relative left-sided, approach-related frontal EEG activity to direct gaze in comparison to shut eyes. Relative right- and left-sided asymmetries in the frontal alpha-band EEG activity have been associated with activation of the avoidance- and approach-related motivational brain systems, respectively. The children in the previous study were, however, school-aged and high-functioning children with ASD, leaving it open whether a similar pattern of responses would be observed already at an earlier age, and whether the findings could be generalised to low-functioning ASD.
Objectives:
The aim of the study was to investigate motivation-related brain responses to direct gaze in young, low-functioning children with ASD. In order to ensure that the possible abnormal findings were autism-specific, we also investigated an IQ-matched comparison group of children without ASD in addition to a normative comparison group of age-matched typically developing children.
Methods:
Twenty young (2.5-5.5 years of age) children with ASD, 20 typically developing children and 18 children with developmental delay without ASD participated in the study. The frontal alpha-band EEG (EGI Geodesic 128 channel system) activity was measured whilst the children viewed photos of faces with direct or downcast gaze and cars pictured from front or back view. On each trial, the stimulus was static for the first 2 seconds and then loomed towards the child for 3 seconds, creating an impression of an approaching person (or a car). Frontal EEG asymmetry was analysed separately to the static and moving phases of the stimuli.
Results:
The results showed that the typically developing children showed greater approach-related frontal EEG activity to direct gaze compared to downcast gaze. In children with ASD, the downcast gaze elicited greater approach-related frontal EEG activity compared to the direct gaze. In the children with developmental delay without ASD, there was no significant difference between the gaze conditions in the frontal EEG activity. These patterns of activity were obtained for the moving but not static phases of the stimuli.

Conclusions:
The pattern of frontal EEG activity to direct gaze was different in children with ASD compared to the other groups. The findings suggest that the lack of normative approach-related motivation towards another person´s direct gaze is evident early in the autistic development. It also strengthens the role of eye contact in abnormal social development of children with ASD. Interestingly, the dynamic stimuli seemed to be more sensitive than static stimuli to reveal differences in the motivation-related brain responses.

19 **107.019** Atypical Pupillary Light Reflex in 2 – 6 Year Old Children with Autism Spectrum Disorders

D. M. Dinalankara[1], *J. H. Miles*[2], *T. N. Takahashi*[3] *and G. Yao*[1], *(1)University of Missouri, Columbia, MO, (2)Thompson Center at the University of Missouri, Columbia, MO, (3)University of Missouri Thompson Center for Autism & Neurodevelopmental Disorders, Columbia, MO*

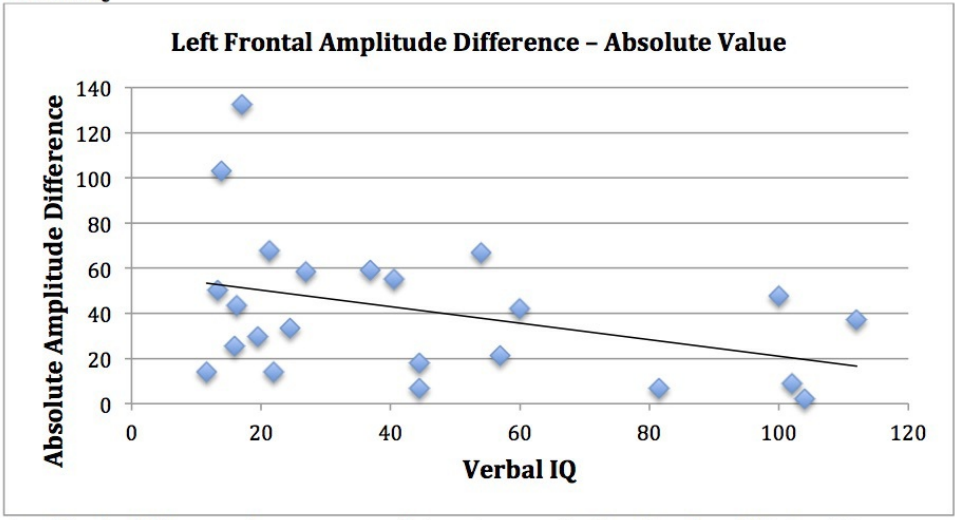
Background: Atypical pupillary light reflex (PLR) was previously observed in children age 6 – 17 years with autism spectrum disorders (ASDs). Abnormal PLR parameters were also reported in “high risk” 10-month-old infants who have siblings diagnosed with ASD. However, the group differences in PLR parameters appeared to be age dependent. To better understand the age effect, there is a need to evaluate PLR in children 2 – 6 years old, which is lacking in the literature.
Objectives: To investigate whether atypical PLR parameters also exist in 2 – 6 year old children with ASD.
Methods: Pupillary light reflex was measured in 55 children with ASD (54.1±16.2 months) and 54 children in the typical development (TD) group (55.0±17.8 months). Tests were conducted using a remote PLR device under two room illuminance levels: 5.6 lux (L1) and 2.7 lux (L2). We measured the following PLR parameters: baseline pupil radius, PLR latency, constriction, and constriction time. In addition, a questionnaire was used to evaluate symptoms related to autonomic nervous system (ANS) and their potential correlations with PLR parameters. A mixed model was used to study the group, age-group, and illuminance level effect on PLR parameters. Linear regression was used to investigate the change of PLR parameters with age.
Results: The mixed model indicated a significant group effect ($F_{1,205}$=31.10, p<0.0001) and age effect ($F_{1,205}$=21.37, p<0.0001) on the PLR latency. Overall PLR latency was longer in the ASD group than in the TD group; the latency in ASD group was 246.17 ± 18.20 ms in L1 and 261.27 ± 15.74 ms in L2 whereas it was 235.76 ± 16.01 ms in L1 and 248.05 ± 12.64 ms in L2 in the TD group. Linear regression confirmed that PLR latency decreased with age in the TD group (r=–0.41, p=0.0026 in L1 and r=–0.31, p=0.023 in L2) and baseline pupil radius increased with age in the TD group (r=0.36, p=0.0084 in L1 and r=0.28, p=0.042 in L2). However these age trends were not observed in the ASD group (p>0.05 in L1 and L2). There was a significant difference between the ASD and TD groups in the averaged ANS score (t_{80}=6.85, p<0.0001). Two-way ANOVA indicated a significant interaction between the group (ASD vs. TD) and abnormal ‘sweat’ symptoms on PLR constriction ($F_{1,100}$ =9.84, p=0.0022 in L1 and $F_{1,102}$=7.63, p=0.0068 in L2).
Conclusions: Atypical PLR parameters were also observed in 2 – 6 year old children with ASD. In the TD group, PLR latency decreased with age and baseline pupil radius increased with age; whereas these trends were not observed in the ASD group. Children with ASD showed more symptoms of autonomic nervous system dysfunction. We observed an association between abnormal sweating and PLR constriction in the TD group but not in the ASD group.

20 **107.020** Auditory Statistical Learning in Children with ASD Relates to Verbal IQ: An ERP Study

C. DiStefano[1], *E. Baker*[2], *J. McCracken*[3] *and S. S. Jeste*[4], *(1)University of California, Los Angeles, Los Angeles, CA, (2)UCLA Center for Autism Research and Treatment, Los Angeles, CA, (3)UCLA Semel Institute for Neuroscience & Human Behavior, Los Angeles, CA, (4)Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA*

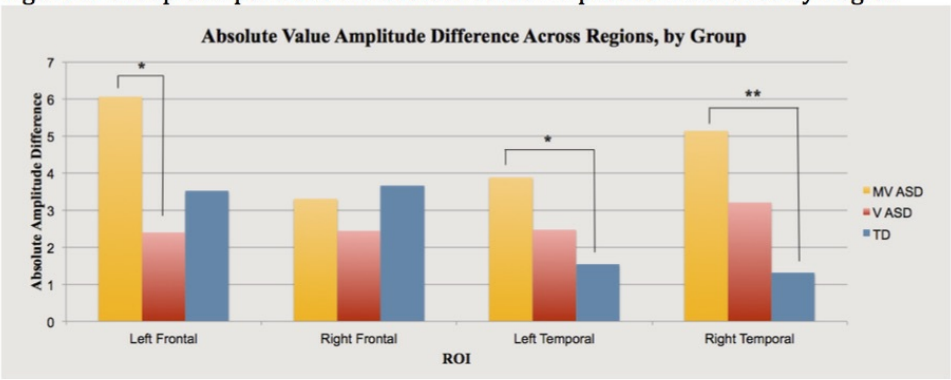
Background:
Approximately 30% of children with autism spectrum disorder (ASD) remain minimally verbal (MV) despite receiving intervention (Anderson et al., 2007). Examining cognitive skills that underlie language learning may help reveal reasons for this impairment. One crucial precursor to language development is auditory statistical learning (ASL), where infants are able to detect word boundaries by determining transitional probabilities between syllables in the speech stream (Kuhl, 2004). Although impaired ASL in high-functioning children with ASD has been documented using fMRI (Scott-Van Zeeland et al., 2010), no studies have examined ASL in minimally verbal children. Electroencephalography (EEG) represents an ideal methodology for studying this population because it gathers information about cognitive processing without requiring overt responses.
Objectives:
Evaluate ERP evidence of ASL in MV and verbal children with ASD, compared with typically developing children. Examine the relationship between ASL and language ability.
Methods:
30 children with ASD (17 MV; age 5-10) and 7 age-matched TD children participated in an ASL event-related potential (ERP) paradigm. Participants heard a 4-minute acoustic stream of 4 pseudo-words (constructed from 12 syllables), followed by a test phase in which pseudo-words (high transitional probabilities between syllables) were interspersed with non-words (low transitional probabilities). The mean ERP amplitude 400-600ms after word offset was calculated for each condition, for 4 regions of interest (ROI; left/right, frontal/temporal). ASD group analysis was performed using repeated measures ANOVA, with correlations to examine relationship between ERP results, verbal and non-verbal IQ. ERP results were directly compared across groups (verbal ASD, MV ASD, TD) using t-tests.
Results:
Repeated measures ANOVA yielded a main effect of region (F=5.01, p=.007) but no condition effect or region-by-condition interaction, indicating that ASD participants as a group did not show ERP evidence of ASL. Group comparisons showed that the MV ASD group showed significantly larger amplitude differences in: left frontal ROI compared with verbal ASD (t=-2.5, p=.02), left and right temporal ROI compared with TD (t=2.23, p=.04; t=3.11, p=.005). There were no significant differences between verbal ASD and TD groups. Amplitude difference was negatively correlated with VIQ (r=.46, p=.01), but was not related to NVIQ or chronological age.
Conclusions:
There is variability across individuals with ASD in the magnitude of their ERP response to an ASL paradigm, where participants with a lower VIQ show more condition differentiation. TD participants performed similarly to verbal ASD participants with neither group differentiating conditions. ASL may be a more immature process, and so not reliably detectable in participants with a higher developmental age. Minimally verbal children with ASD may continue perform this cognitive process but fail to develop other necessary cognitive-linguistic processes. Because ERP evidence of ASL is related to VIQ but not NVIQ, it is likely related specifically to language ability rather than overall developmental level. Research including a mental age matched comparison group as well as longitudinal research is necessary to fully interpret these findings. Further research into ERP correlates of ASL as well as other language-related cognitive processes will further elucidate pathways to language impairment in minimally verbal children with ASD.

Figure 1: Absolute Value Amplitude Difference Between Conditions Related to Verbal IQ



Amplitude difference between conditions is negatively related to VIQ (r=-.50, p=.005) and remains significant when the two participants with the highest difference values (possible outliers) are removed (r=-.46, p=.01).

Figure 2: Group Comparisons of Absolute Value Amplitude Difference By Region



The minimally verbal ASD group showed significantly larger amplitude differences in: left frontal ROI compared with the verbal ASD group (t=-2.5, p=.02), left temporal ROI compared with the TD group (t=2.23, p=.04) and right temporal ROI compared with the TD group (t=3.11, p=.005). There were no significant differences between the verbal ASD and TD groups.

21 **107.021** Baseline EEG Recordings in Young Children with ASD: Stimulus Type Matters

X. A. Tran[1], *E. Baker*[2], *J. Frohlich*[3], *S. Huberty*[4] *and S. S. Jeste*[3], *(1)Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California Los Angeles, Los Angeles, CA, (2)UCLA Center for Autism Research and Treatment, Los Angeles, CA, (3)Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA, (4)Psychiatry and Biobehavioral Sciences, UCLA Center for Autism Research and Treatment, Los Angeles, CA*

Background: Baseline EEG has been increasingly studied as a biomarker of baseline brain activity in children with autism spectrum disorders (ASD). Characterization of baseline EEG in this population often requires the presentation of a visual stimulus to maintain a child's attention; stimuli range from live examiners interacting with the child to abstract videos (Machado 2015, Gabard-Durnam 2015). Stimulus type may impact a child's overall state and level of engagement with the testing environment, altering the child's EEG oscillations, leading to variability in signal that reflects "state" and not "trait' of a child.
Objectives: We asked if there were differences in baseline EEG power at specific frequency bands when children with ASD watched a video of abstract shapes compared to a segment of their favorite video. We hypothesized that neural correlates of attention and engagement, as quantified by higher theta power, would occur when children watched a more appealing stimulus like their favorite video.
Methods: We examined data from 27 children with ASD ages 2-6 years old (37% female; mean age = 55.6±13.2 months, IQ 49-114), recruited from the Early Childhood Partial Hospitalization Program. Baseline EEG was recorded using a high density system (EGI Inc. 128-channels). Children watched a video of an abstract screen saver

followed by their favorite cartoon video (varied based on each child's preference). Each video was presented for 2 minutes. EEG data were processed per prior protocols (McEvoy 2015). Relative spectral power for delta (1-3 Hz), theta (4-7 Hz), alpha (8-12 Hz), beta (13-30 Hz), and gamma (31- 48 Hz) frequency bands were calculated using Welch's method, in 9 regions of interest (ROIs) across the scalp. For statistical analysis, we used a general linear model with repeated measure design for 3 within-group comparisons (video, frequency, ROI); we further examined significant main effects using paired samples t-tests.
Results: There was a significant interaction of stimulus type with group ($F_{4, 23}$ = 4.878, P = 0.005). Post hoc analysis showed relative power in the delta frequency band was significantly higher (P_{delta} = 0.003) in the abstract video (mean = 0.495±0.087) compared with the favorite video (mean = 0.473±0.077). Relative power in the theta and beta frequency bands was significantly lower (P_{theta} = 0.019, P_{beta} = 0.043) in the abstract video ($mean_{theta}$= 0.252±0.067, $mean_{beta}$ = 0.107±0.028) than in the favorite video ($mean_{theta}$ = 0.271±0.078, $mean_{beta}$= 0.113±0.031). There were no significant differences in alpha or gamma power between stimulus types.
Conclusions: Baseline EEG power can change based on stimulus type, with greater theta and beta power that may reflect increased attention and engagement during a preferred video. Preferred video also has a social salience that may elicit greater attention. These findings support the importance of reporting stimulus type during baseline EEG recording and maintaining consistent testing parameters during recordings. In ongoing analyses, we will examine these findings in relation to the child's IQ, age, ASD severity, and rating of a child's behavior during the EEG session.

22 **107.022** Brain Dopamine D1 Receptor Binding in Young Adults with Autism Spectrum Disorder

K. Suzuki[1], *K. Nakamura*[2], *Y. Ouchi*[1], *K. Takebayashi*[1], *M. Yokokura*[1], *K. Nakaizumi*[1], *M. Tsujii*[3], *T. Sugiyama*[1] *and N. Mori*[1], *(1)Hamamatsu University School of Medicine, Hamamatsu, Japan, (2)Hirosaki University Graduate School of Medicine, Aomori, Japan, (3)Chukyo University, Toyota, Japan*

Background: Autism spectrum disorder (ASD) is characterized by repetitive and/or obsessive interests and behavior and by deficits in sociability and communication. Previous neuroimaging studies using positron emission tomography (PET) found the dopaminergic dysregulation in the orbitofrontal cortex and microglial activation in more diverse brain regions in adults with ASD, although the relationship between the two phenomena remains unclear.
Objectives: To determine a possible association between the dopamine D1 receptor availability and microglial activation in living subjects with ASD.
Methods: We measured the binding of dopamine D1-like receptors with the radio-ligand ^{11}C-SCH23390 in the brain of subjects with ASD (n=20) and age- and sex-matched control subjects (n=20). The binding of radio-ligand ^{11}C-PK11195 was also measured as a representative index of microglial activation. Whole-brain voxel-based analyses as well as regions of interest-based methods were used for between-subjects analysis and within-subjects correlation analysis with respect to clinical variables.
Results: We found significantly higher ^{11}C-SCH23390 binding potentials in the orbitofrontal cortex and midbrain of subjects with ASD compared to control (corrected P<.05). A previous finding of elevated ^{11}C-PK11195 binding in the brain of ASD was confirmed. The levels of ^{11}C-SCH23390 binding in the orbitofrontal cortex was positively correlated with ^{11}C-PK11195 binding in the midbrain, but not the orbitofrontal cortex per se. There was no significant correlation between PET data and clinical valuables evaluated.
Conclusions: The results suggest that the availability of D1 receptor at the resting state is elevated in the orbitofrontal cortex of subjects with ASD. The increased availability of D1 receptor may reflect a possible pathophysiological aspect intrinsic to the ASD brain with extensive microglial activation.

23 **107.023** Cerebellar Contributions to Whole-Brain Resting-State Networks: A Combined Tdcs-Fmri Study

A. M. D'Mello[1], *P. E. Turkeltaub*[2,3] *and C. J. Stoodley*[1], *(1)American University, Washington, DC, (2)Georgetown University Medical Center, Washington, DC, (3)Research Division, MedStar Rehabilitation Hospital, Washington, DC*

Background: Differences in cerebellar structure and function are amongst the most consistent neural findings in autism spectrum disorder (ASD). In particular, right lobule VII of the cerebellum (including Crus I/II) show grey matter reductions and differences in activation patterns in ASD individuals. This region is structurally and functionally connected to association regions of the cerebral cortex, participating in cerebro-cerebellar loops that form part of cognitive control and default mode networks. It has been proposed that the cerebellum is important in both the optimization of structure and function in the cerebral cortex during development, providing a framework for understanding a potential role for the cerebellum in ASD. However, the effects of cerebellar activity on these broader cerebro-cerebellar circuits is not yet clear, even in typically-developing (TD) adults.
Objectives: Here, we examined the effects of cerebellar transcranial direct current stimulation (tDCS) on resting-state functional connectivity patterns in TD young adults. We hypothesized that right cerebellar tDCS would modulate neural activation patterns throughout the brain, particularly in frontoparietal and default mode networks (DMN).
Methods: We combined 20min of 1.5 mA anodal or sham tDCS over the right posterolateral cerebellum with functional MRI in TD adults (n=27; μ=24.4 years old). Sixteen participants received active tDCS, and 11 participants received sham tDCS, where the current is ramped up over 15s and then ramped down before any clinically significant current is applied. The active (anodal) electrode was placed over the right posterolateral cerebellum (1cm down and 4cm over from inion; estimated to be over lobule VII) and the reference electrode was placed on the right pectoral muscle. Seven minutes of resting-state functional images were acquired both pre- and post-tDCS (47 interleaved slices, 168 volumes, TR 2500ms, TE 30ms, 3.2mm isotropic voxels, flip angle 90º, FOV 205mm).
Results: Relative to sham, anodal tDCS increased activation in right cerebellar Crus I/II. When functional connectivity was examined between right Crus I and the rest of the brain (seed-to-voxel analysis), we found that tDCS modulated cortical resting-state connectivity, shifting right Crus I connectivity patterns outside of canonically connected networks. Specifically, within frontoparietal networks, anodal tDCS increased functional connectivity between right Crus I of the cerebellum and the anterior cingulate cortex, regions that are typically anti-correlated in the frontoparietal network. Within the DMN, anodal tDCS increased functional connectivity between the right Crus I of the cerebellum and the bilateral precuneus (a DMN node) as well as occipital regions.
Conclusions: These preliminary results are consistent with the proposed role of the right posterolateral cerebellum in the modulation of broader cerebro-cerebellar networks. When anodal tDCS is applied over the right cerebellum in TD adults, the functional connectivity acquires an ASD-like pattern – increased out-of-network functional connectivity within frontoparietal cognitive control networks, and increased cerebro-cerebellar functional connectivity both within the DMN as well as outside of canonical DMN nodes. These findings are consistent with the deficits in resting-state network segregation found in ASD and provide testable hypotheses for future application of cerebellar tDCS in ASD populations.

24 **107.024** Cerebellar Metabolite Levels and Social-Communication Impairments in Twins with Autism Spectrum Disorder

J. P. Hegarty II[1], *M. Gu*[1], *D. Spielman*[1], *S. Cleveland*[1], *J. Hallmayer*[1], *L. Lazzeroni*[1], *M. Raman*[1], *T. W. Frazier*[2], *J. M. Phillips*[1], *A. L. Reiss*[1] *and A. Y. Hardan*[1], *(1)Stanford University, Stanford, CA, (2)Cleveland Clinic Center for Autism, Cleveland, OH*

Background:
Cerebellar circuits are important for providing regulatory feedback to other regions of the brain. Traditionally the cerebellum was thought to be exclusively involved with motor control, but imaging and lesion studies have implicated higher-order cognitive domains as well. The cerebellum is of particular interest in ASD because neuronal circuits in the cerebellar hemispheres have consistently been implicated in the disorder with multiple studies also reporting either hypo- or hyper- plasia in the vermis.
Objectives:
The goal of this study was to examine neurochemical profiles of the cerebellum to determine whether individuals with ASD exhibit differences in neuronal density, neurotransmitter signaling capability, or metabolic activity that are related to social-communication impairments.
Methods:
Data were acquired from a neuroimaging study of same-sex twin pairs that included monozygotic (MZ) and dizygotic (DZ) twin pairs with ASD and MZ and DZ control twin pairs. Cognitive/behavioral assessment included measures of intelligence (SB-5) and social-communication impairments (SRS). An oblique MR spectroscopy chemical shift imaging slab that covered portions of the cerebellar hemispheres and vermis was acquired. A subset of individuals with ASD and controls with valid spectra from the cerebellum was included in the present preliminary study and consisted of 25 individuals with ASD and 25 controls. Voxels (4.5 mL) included primarily grey matter (GM) or white matter (WM) in the right cerebellar hemisphere (R Cere Hemi) and a combination of GM and WM in the vermis. Metabolites were assessed in relation to internal creatine levels and adjusted for tissue composition. Compounds containing n-acetyl aspartate (NAA), glutamate (Gln), choline (Cho), and myo-inositol (mI) were examined.
Results:
Individuals with ASD exhibited the anticipated cognitive/behavioral profile including social-communication impairments (M_{ASD}=69.88,SD=19.73; M_{CTRL}=44.58,SD=10.89) and lower IQ (M_{ASD}=84.88,SD=31.13; M_{CTRL}=109.88,SD=16.49); but groups did not significantly differ in age (M_{ASD}=11.44,SD=2.76; M_{CTRL}=10.40,SD=2.38) or gender (M/F_{ASD}=19/6, M/F_{CTRL}=16/9), indicating sufficient control matching. Metabolites in the R Cere Hemi did not significantly differ between groups; however, there was a trend towards a difference in choline-containing compounds such that individuals with ASD exhibited higher concentrations in GM (M_{ASD}=0.29,SD=0.06; M_{CTRL}=0.26,SD=0.04), F(1,47)=3.509, p=0.067, η^2=0.069, and WM (M_{ASD}=0.31,SD=0.05; M_{CTRL}=0.28,SD=0.07), F(1,47)=3.197, p=0.080, η^2=0.064. R Cere Hemi GM and WM concentrations of NAA, Gln and mI did not differ between groups, and there were also no differences across metabolites in the vermis. Within individuals with ASD, there was a strong positive association between social-communication impairments and GM Cho (r=0.58) and a moderate association with WM Cho (r=0.39).
Conclusions:
Preliminary data from this investigation show that individuals with ASD may be more likely to present elevated choline-containing compounds in the right cerebellar hemisphere. Choline is a precursor of acetylcholine and marker of cellular membrane turnover. Elevated choline may indicate membrane degradation or increased cellular proliferation and is also present in less mature neuronal circuits. Therefore, our findings may suggest greater perturbation or less maturation of cerebellar circuits in some

individuals with ASD that are related to social-communication impairments. The examination of additional participants and the assessment of heritability will allow further elucidation of potential differences in cerebellar choline in individuals with ASD.

25 **107.025** Change of Neurophysiological Correlates of Biological Motion Processing By the Group Based SOSTA-FRA Intervention in High Functioning Children and Adolescents with ASD

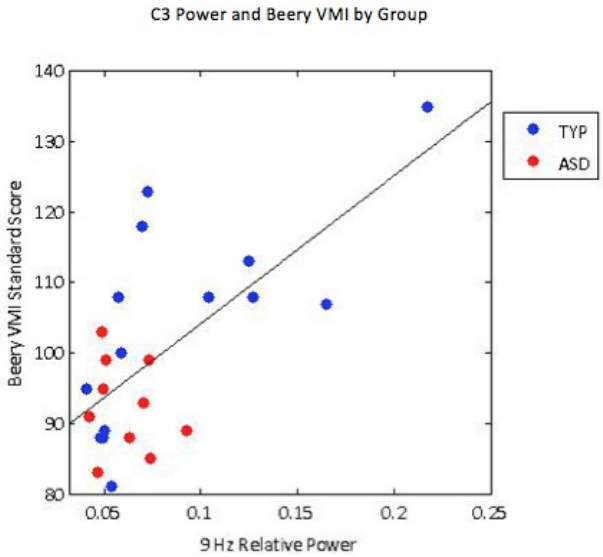
C. Luckhardt[1], *A. Kröger*[1], *S. Bender*[2] *and C. M. Freitag*[3], *(1)Autism Research and Intervention Center of Excellence Frankfurt, Goethe University Hospital, Frankfurt, Germany, (2)Department of Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy, University Hospital Cologne, Cologne, Germany, (3)Department of Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy, Johann Wolfgang Goethe-University Frankfurt/Main, Frankfurt, Germany*

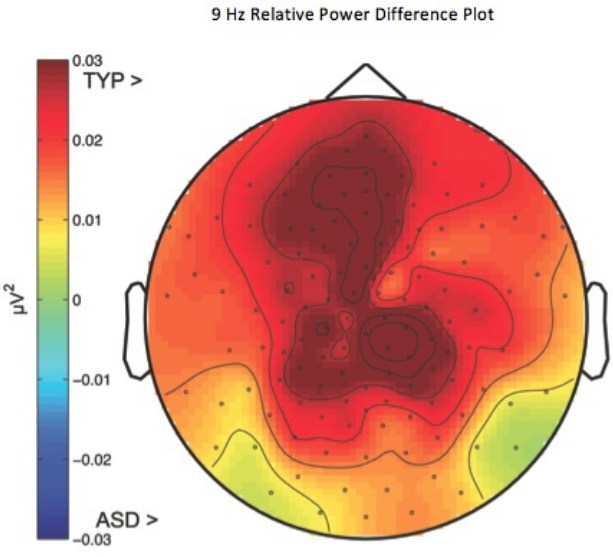
Background:
Group based psychotherapy focusing on improvement of social and self-regulation skills is the intervention of choice in high functioning children and adolescents with autism spectrum disorder (ASD). Systematic empirical evaluation of such interventions aims at elucidating mechanisms by which they improve social skills in ASD. Neurophysiological studies can contribute by assessing neural correlates of behavioral change. Biological motion processing is a fundamental skill required for almost all social interactions, as we need to interpret dynamic social signals such as gestures, body language or facial expressions. Biological motion processing therefore seems well suited for evaluating perceptual and cognitive changes following social skills trainings in ASD.
Objectives:
We hypothesized that the group based SOSTA-FRA intervention would change neural correlates of visual and cognitive biological motion processing in individuals with ASD.
Methods:
Data was collected within a randomized controlled trial. The intervention group received twelve sessions of the manualized SOSTA-FRA training, while the control group continued to receive treatment as usual (TAU). Both groups were assessed three times (t1=baseline, t2=post intervention, t3=3-months follow-up), completing both questionnaires and the neurophysiological assessment at all time points. In each group 17 matched children participated in the neurophysiological assessment at all three time-points and provided sufficient artifact free data for analysis. The task comprised two conditions in which pointlight-displays of biological (walking human figure) and non-biological motion (scrambled stimulus derived from the human stimulus) were shown and participants were instructed to discriminate between the two motion types. Taking into account hemisphere and condition we compared amplitudes and latencies of the P100, N200 and P400 event related potentials (ERPs) between the two groups across all three measurements.
Results:
Both groups showed a constant high performance on the motion discrimination task and no changes across time ($F_{2,60}$=.273;p=.762) or between groups (group*time: $F_{2,60}$=.791; p=.458) were evident. Still, ERP analysis revealed reduced N200 latencies at three months follow-up for the SOSTA-FRA but not the TAU group ($F_{2,64}$= 4.067; p=.022).
Conclusions:
While no improvement in task performance could be observed, likely due to ceiling effects, ERP results point towards change of neural function following the intervention. The intervention led to faster early neural processing of complex visual stimuli, which has been discussed as a deficit typical for ASD. While the exact mechanisms that lead to this change need to be investigated in further detail, results indicate improved visual processing strategies by SOSTA-FRA.

26 **107.026** Characterizing the Cortical Basis of Motor Impairments in ASD Using EEG

S. T. Major[1], *B. P. Rardin*[1], *R. Bernier*[2] *and M. Murias*[3], *(1)Duke Center for Autism and Brain Development, Duke University School of Medicine, Durham, NC, (2)University of Washington, Seattle, WA, (3)Duke University, Durham, NC*

Background:
Atypical visual motion perception is a feature of autism spectrum disorders (ASD) and may contribute to the abnormal development of motor milestones observed in this population. The EEG Rolandic mu rhythm, related to motor cortex function, has reduced suppression during action observation in ASD. Individuals with ASD also exhibit reduced global alpha (Berger) power; the alpha rhythm shares a frequency range, but not topography, with the mu rhythm. Exploring the relationship between mu and alpha rhythms and motor performance may help to better characterize the cortical basis of motor deficits seen in ASD.
Objectives:
The present study investigated relative power at each frequency in the mu and alpha band (8-12 Hz) in children with and without ASD during a visual motion task. Differences in motor performance between the two groups were assessed using the Movement Assessment Battery for Children (M-ABC) and the Beery-Buktenica Developmental Test of Visual-Motor Integration (Beery VMI). Power at each frequency was correlated with performance on these motor tests.
Methods:
Participants were 11 females and 18 males (n=29) between 7-8 years old, all but 2 were right handed. The ASD group's mean age was 95.2 months (+/- 6.3) and mean FSIQ was 100.1 (+/- 12.1). The control group's mean age was 95.1 months (+/- 7.6) and mean FSIQ was 107.6 (+/- 23.9). ASD diagnosis was based on ADOS and ADI-R. EEG was recorded as subjects watched sand fall through an hourglass. Time series data were transformed via FFT with 1 Hz resolution and standard electrodes were considered (C3, C4, P3, P4, F3, F4, O1, O2).
Results:
The ASD group had lower standard scores on Beery VMI (t=3.22, p<0.01) and M-ABC Total (t=3.88, p<0.001). At 9 Hz, the ASD group had lower relative power at C3 (t=1.82, p<0.05) and F3 (t=2.37, p<0.05). At 10 Hz, the ASD group had lower relative power at F3 (t=2.43, p<0.05) only. Combining ASD and TYP groups, the Beery VMI scores correlated with 9 Hz relative power at C3 (r=.67, p<0.001), F3 (r=.68, p<0.001), and F4 (r=.64, p<0.001). No correlations were observed at 8 Hz, 10 Hz, 11 Hz, or 12 Hz. Separately, the ASD group revealed no correlation between performance and 9 Hz power, while the TYP group showed strong positive correlations at C3 (r=.70, p<0.01), F3 (r=.67, p<0.01), and F4 (r=.65, p<0.05).
Conclusions:
Children with ASD scored lower on both motor tests, highlighting a motor execution deficit in the autism group. The ASD group exhibited lower 9 Hz power in left central (C3) and left frontal (F3) scalp regions and lower 10 Hz power in a left frontal (F3) region. No group differences were observed at 8 Hz, 11 Hz, or 12 Hz, at occipital or parietal electrodes (O1, O2, P3, P4), or in the right hemisphere (C4, F4). The group differences in 9 Hz power at C3 and F3 and the strong correlations with a visuo-motor integration assessment suggest that EEG power at this frequency may serve as an index of visual motor impairment in 7-8 year old children.





27 **107.027** Children with ASD Fail to Downregulate Visual Cortex during Auditory Processing

R. J. Jao Keehn[1], *S. Sanchez*[1], *C. R. Stewart*[1], *W. Zhao*[1], *E. Grenesko*[1], *B. Keehn*[2] *and R. A. Müller*[1], *(1)San Diego State University, San Diego, CA, (2)Speech, Language, and Hearing Sciences, Purdue University, West Lafeyette, IN*

Background: Autism Spectrum Disorders (ASD) are predominantly characterized by impairments in two core domains: social communication, and restricted and repetitive behaviors (RRB) that encompass atypical responses to sensory stimuli. Research has indicated a high prevalence of sensory issues in ASD; some children with ASD are easily overwhelmed while others seem unaware of their environment. Given the importance of sensory input during development, particularly from vision and audition (two of the main sensory modalities involved in social interactions and language), impairments in these systems may have cascading effects that contribute to disturbances in higher-order cognitive and sociocommunicative abilities.
Objectives: We assessed the neural mechanisms underlying basic sensory processing of visual and auditory information in ASD. Specifically, we examined the effects of auditory processing on visual cortical activity in nonlinguistic contexts.
Methods: Functional magnetic resonance imaging (fMRI) was used to test children and adolescents with ASD (n = 16) and typically developing (TD) participants (n = 16) matched for age, gender, nonverbal IQ, and handedness during a sensory discrimination task. Participants were presented with visual (dot located high or low in the display) and auditory stimuli (4000 or 1600Hz), and were instructed to indicate whether each stimulus was “high” or “low”. Measures of accuracy and reaction time were also recorded during the scan.
Results: Functional MRI findings indicated divergent patterns of activity in visual cortex during auditory processing. The TD group showed downregulation, whereas the ASD group showed upregulation in visual cortical areas, which was associated with symptomatology. Moreover, ASD children and adolescents had lower auditory discrimination accuracy than their TD counterparts.
Conclusions: Our findings (i) support the notions of basic auditory impairment, but visual sparing in ASD. They further indicate (ii) that individuals with ASD fail to downregulate visual cortex during simple auditory processing, and (iii) that this impaired crossmodal modulation is linked to sociocommunicative symptomatology. These results add to the existing evidence of atypically enhanced recruitment of visual cortices during a variety of cognitive and perceptual tasks (Samson et al., Hum Brain Mapp., 2012), suggesting that such atypical visual recruitment also occurs during sensory processing in non-visual modalities. They are also in line with the general hypothesis of atypical sensorimotor building blocks as developmental precursors of sociocommunicative impairments in ASD.

28 **107.028** Common CNTNAP2 Variant Relates to Altered Functional Connectivity of the Striatum

K. E. Lawrence[1], *L. M. Hernandez*[2], *D. H. Geschwind*[3], *S. Y. Bookheimer*[1] *and M. Dapretto*[1], *(1)University of California, Los Angeles, Los Angeles, CA, (2)University of California Los Angeles, Los Angeles, CA, (3)Department of Neurology, UCLA, Los Angeles, CA*

Background: Contactin associated protein-like 2 (*CNTNAP2*) plays an important role in the development of frontostriatal networks and has previously been associated with language endophenotypes in autism spectrum disorder (ASD) and specific language impairment (Penagarikano & Geschwind, 2012). *CNTNAP2* messenger RNA is expressed in frontostriatal networks of the human brain, and common variants in *CNTNAP2* have previously been related to brain connectivity (Dennis et al., 2011; Tan et al., 2010), as well as activity during language processing (Koeda et al., 2015; Whalley et al., 2011) and implicit learning (Scott-Van Zeeland et al., 2010a). However, no studies to date have investigated how *CNTNAP2* may relate to functional connectivity of brain structures that are involved in language learning. A prior study from our lab demonstrated that, unlike typically developing (TD) controls, individuals with ASD do not display increased striatal activity during an implicit language-learning task (Scott-Van Zeeland et al., 2010b). Therefore, in order to characterize how this neural circuitry may be influenced by genetic risk, we investigated the relationship between *CNTNAP2*rs2710102 (previously associated with age at first word in ASD) and striatal connectivity in youth with and without ASD.
Objectives: Examine how a common *CNTNAP2* variant (rs2710102) relates to functional connectivity of the striatum, an important structure for implicit language learning.
Methods: Thirty-seven children and adolescents with ASD and 30 matched TD controls completed a 6-minute resting-state functional MRI scan. Resting-state functional connectivity analyses were conducted using the left caudate and the left putamen as seeds. As prior imaging genetics studies have used either dominant or recessive modes of inheritance (Dennis et al., 2011; Scott-Van Zeeland et al., 2010a; Whalley et al., 2011), we analyzed the data separately using each model. Initial group comparisons were completed in FSL, prethresholded with a joint mask of the within group results and thresholded at Z>2.3 with a cluster threshold of p=.05.
Results: Under the dominant and recessive models, the risk and non-risk groups both displayed robust functional connectivity between the left caudate and frontal, temporal, and parietal regions. In the dominant model, the non-risk group displayed significantly greater connectivity than the risk group to the medial prefrontal cortex, a region in which *CNTNAP2*is known to be expressed (Abrahams et al., 2007). When using a recessive model, the risk group showed significantly greater connectivity to bilateral frontal pole regions than the non-risk group. With regards to left putamen connectivity, both groups displayed robust connectivity to frontal and temporal areas for the dominant and recessive models. There were no significant between-group differences in putamen functional connectivity regardless of model.
Conclusions: Connectivity of the striatum, an area previously associated with language learning differences between ASD and typical development, is significantly modulated by a common genetic variant that has been linked to language in ASD.

29 **107.029** DNA Methylation of the Oxytocin Receptor Gene Predicts Variability in Brain Response to Social Stimuli Among Children with Autism Spectrum Disorder

A. Jack[1], *T. S. Lillard*[2], *D. R. Oosting*[1,3], *J. P. Morris*[2], *K. Pelphrey*[1] *and J. J. Connelly*[2], *(1)Yale Child Study Center, Yale School of Medicine, New Haven, CT, (2)Department of Psychology, University of Virginia, Charlottesville, VA, (3)Psychology, University of Massachusetts, Boston, MA*

Background: The hormone oxytocin influences social perception, and variants of the oxytocin receptor gene (*OXTR*) have been associated with autism spectrum disorder (ASD)[1]. However, epigenetic modifications that impact gene transcription also impact phenotypic variability. One such modification is DNA methylation, which allows for transcriptional silencing as well as temporal control of gene expression. Previously, we (JJC) found elevated *OXTR* DNA methylation (*OXTR*m) in individuals with ASD[2] accompanied by decreased oxytocin receptor transcription in superior temporal sulcus (STS), a site associated with social perception. Subsequently, we (AJ, JPM, JJC) demonstrated that blood-derived *OXTR*m in healthy adults predicts variability in response to social stimuli in key brain sites, including STS[3,4]. These findings suggest that *OXTR*m is atypical in ASD, and variability in *OXTR*m within the typical range predicts social brain function. However, the relationship between *OXTR*m and functional brain outcomes within ASD is yet unexplored. Here we describe associations between *OXTR*m and brain response to human motion, among children with and without ASD.
Objectives: To characterize 1) how *OXTR*m interacts with ASD diagnosis to predict brain response to human motion, and 2) how sex differences in *OXTR*m interact with diagnostic status to predict brain response to human motion.
Methods: We enrolled 11 children with ASD (5 girls) and 14 typically developing (TD) children (6 girls). Blood was collected in mononuclear cell separating tubes and samples spun to separate the mononuclear cell fraction as per product protocol, and DNA was isolated. *OXTR*m was assessed at CpG sites -860, -924, and -934. Epigenotyping procedures are described in[3,4]. Scans included a T1-weighted anatomical image and a BOLD fMRI scan. The Biological Motion paradigm features interleaved blocks of coherent (BIO) and scrambled (SCRAM) point-light displays of human movement and recruits brain regions involved in social perception, including STS[5]. We assessed where BIO > SCRAM brain activity varied as a function of *OXTR*m, and where this relationship differed by diagnosis and sex ($z = 2.3$, $p = 0.05$, whole-brain cluster-corrected).
Results: Children with ASD with higher methylation at sites -934 and -924 had weaker response to human motion in social brain regions including bilateral STS, while TD children with higher methylation showed stronger response in these regions (Fig1). This finding suggests compensatory social brain activity in children with higher epigenetic risk but no expression of the disorder, and a lack of such compensation in ASD. Additionally, at sites -860, -924, and -934, higher methylation was associated with a weaker response in occipitotemporal regions including STS and fusiform gyrus, but only in girls with ASD.
Conclusions: These results suggest that variability in *OXTR*m holds promise for helping to explain processes of ASD risk and protection, including those that may differ by sex.

1. Yrigollen *et al. Biol. Psychiatry* **63:**911–6 (2008).
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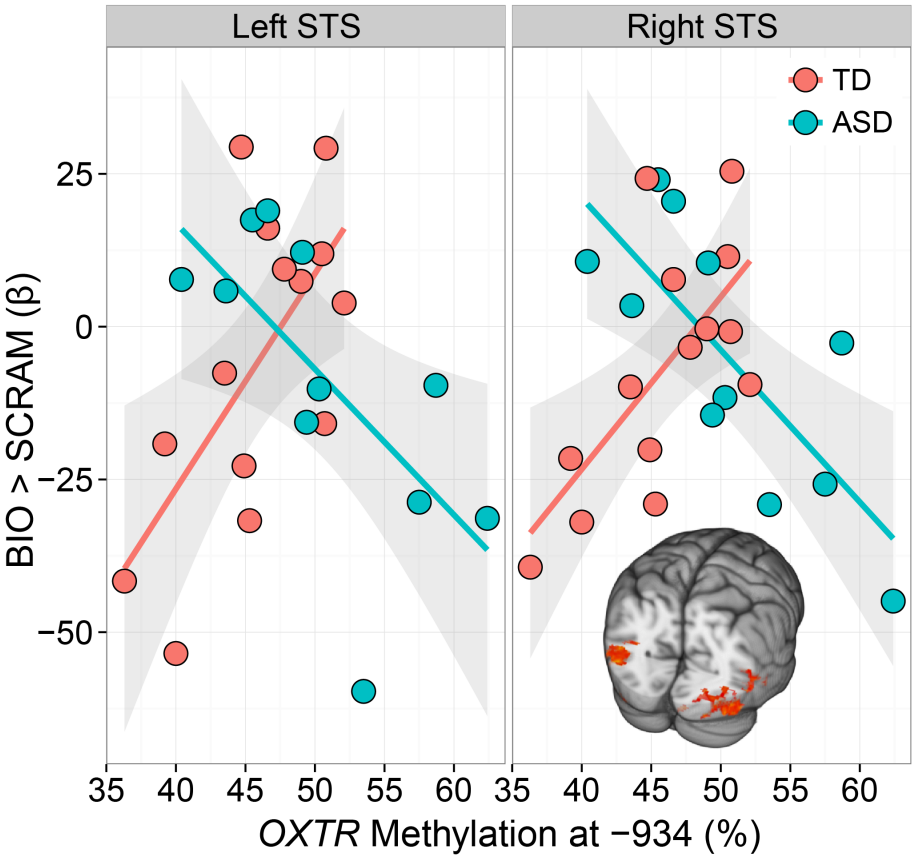
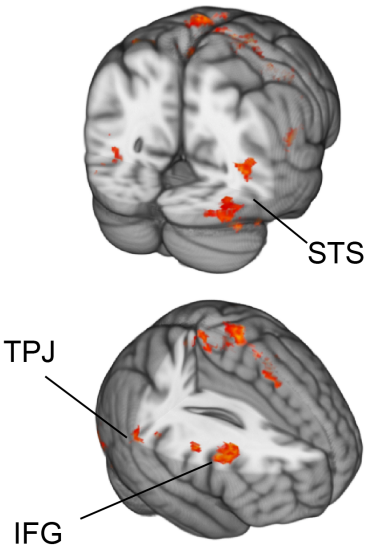
3. Jack, Connelly, & Morris. *Front. Hum. Neurosci.* **6:**280 (2012).
4. Puglia, Lillard, Morris, & Connelly. *Proc. Natl. Acad. Sci.* **112:**3308–3313 (2015).
5. Kaiser, M. D. *et al. Proc. Natl. Acad. Sci.* **107:**21223–8 (2010).

Fig. 1 | DNA methylation of the oxytocin receptor gene (*OXTR*) interacts with ASD diagnosis to predict brain response to displays of human motion.



While higher *OXTR* methylation at **CpG site -934** predicts stronger superior temporal sulcus (STS) response to biological motion in TD children, it predicts weaker STS response in children with ASD.



Right hemisphere view

A similar pattern is found at **CpG site -924** within right STS, right inferior frontal gyrus (IFG) and right temporo-parietal junction (TPJ).

30 **107.030** Default Mode Network - Insight into Disruptive Behaviour in Autism Spectrum Disorder

J. Lei[1,2], P. E. Ventola[1], E. Dayan[3], K. Pelphrey[1] and D. Yang[1], (1)Yale Child Study Center, Yale School of Medicine, New Haven, CT, (2)Psychology and Language Sciences, University College London, London, United Kingdom, (3)National Institute of Neurological Disorders and Stroke, National Institutes of Health, Human Cortical Physiology Section, Bethesda, MD

Background: One third of children with autism spectrum disorder (ASD) exhibit comorbid disruptive-behaviour, anxiety, and attentional-deficit problems. Disruptive-behaviour in ASD may be linked to poor self-regulation, and the neural correlates have not yet been established. Moreover, poor self-regulation may compromise social functioning. The Default Mode Network (DMN) is a set of brain regions typically deactivated during cognitive tasks and may be related to self-regulation. DMN may provide a neural window to study disruptive behaviour and social functioning in children with ASD, and may help clarify how disruptive behaviours are linked with comorbid anxiety or attentional-deficit-problems at the brain level.
Objectives: To examine how disruptive behaviour in children with ASD is related DMN deactivation, to determine how much this relationship is mediated by comorbid anxiety and/or attentional deficit problems, and to explore the link between DMN deactivation and social functioning.
Methods: Participants included 31 children (all male) with ASD between the ages of 4 and 18 years. Age appropriate versions of Child/Adolescent Symptom Inventory-4 (CSI-4/ASI-4) was used to assess comorbid symptoms of anxiety, attentional deficit, and disruptive behaviour (Cronbach's α= .75 to .91). Social Responsiveness Scale (SRS) was used to measure social functioning. All participants underwent functional magnetic resonance imaging (fMRI) whilst passively viewing alternating clips of biological (BIO) and scrambled point-light displays (12 blocks in total, 24 s each block) in a 3-Tesla scanner. The experiment began and ended with 20-s fixation interval, which were combined to create fixation (FIX) condition for all contrast analyses. A whole-brain group analysis was conducted using mixed-effects modelling (FSL's FLAME1+2), voxel-level thresholding $Z > 1.96$, and cluster-level thresholding $p < .05$, while controlling for age.
Results: At the group level and as expected, DMN deactivations in medial prefrontal cortex (MPFC), posterior cingulate cortex (PCC), and precuneus (PC) were observed in BIO<FIX contrast (Fig 1-top). DMN deactivation was negatively correlated with disruptive behaviour in MPFC and PCC/PC (Fig 1-bottom), suggesting that disruptive behaviours reduced the DMN deactivation in these regions. Furthermore, anxiety partially mediated the disruptive behaviours' effect of reduced DMN deactivation in a region within MPFC (Fig 2). There was no evidence supporting attention deficit problems mediated. DMN deactivation was also negatively correlated with SRS total raw score.
Conclusions: This study demonstrated that DMN deactivation provides a useful window to study the role of self-regulation in children with ASD. Reduced DMN deactivation in children with ASD who displayed disruptive behaviour suggests poorer self-regulation when engaged in a social perception task. The effect within MPFC is partially mediated by anxiety, suggesting interventions aimed to reduce disruptive behaviour via improving self-regulation may be more successful by simultaneously targeting comorbid anxiety in children with ASD. Reduced DMN deactivation is also linked to greater social impairment. To our knowledge, this study is the first to provide a neuromarker for disruptive behaviour in ASD, which describes a key brain-based dimension that may be used to facilitate the development of tailored treatment to reduce disruptive behaviour in ASD in the future.

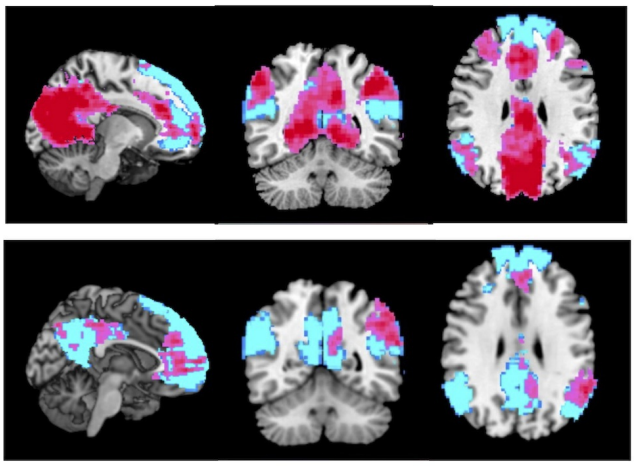


Fig 1. Activation overlaid on top of DMN template. **Top row:** BIO<FIX deactivation observed in posterior cingulate cortex, precuneus and medial prefrontal cortex (**pink**; voxel-level Z > 1.96, cluster-level p < .05 corrected). Slices taken at MNI 152 2mm coordinate: (-12, -54, 30). Cyan regions indicate the regions of DMN established in the previous literature (Yeo et al., 2011). **Bottom row:** BIO<FIX deactivation in DMN was weaker in children with greater disruptive behaviour (**pink**; mixed-effects, voxel-level Z > 1.96, cluster-level p < .05 corrected). Slices taken at MNI 152 2mm coordinate: (-12, -54, 30).

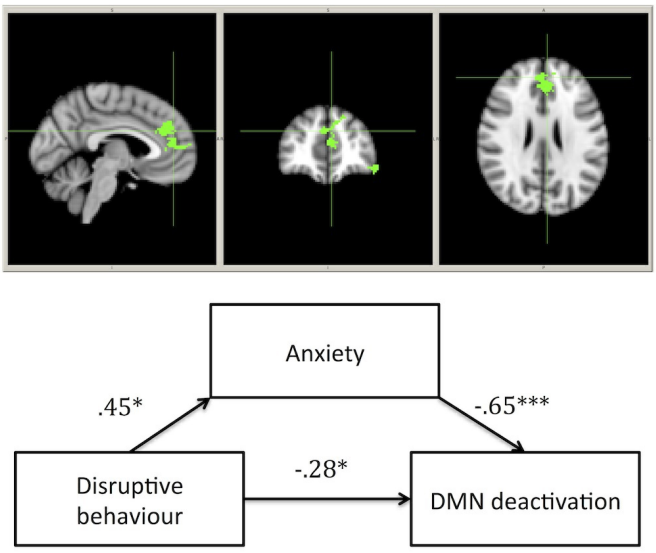


Fig 2. The effect of reduced BIO<FIX DMN deactivation with greater disruptive behaviour was partially mediated by anxiety in children with ASD in a DMN brain region within MPFC, shown in **green** (mixed-effects, voxel-level Z > 1.96, cluster-level p < .05 corrected), Sobel's Z = -2.39, p = .02. Slices taken at MNI 152 2mm coordinate: (-4, 46, 26). Coefficients were standardized estimates. *p < .05 **p < .01

31 **107.031** Developmental Changes in Learning to Predict Others' Preferences: Implications for Autism Spectrum Disorder

G. Rosenblau[1], *C. W. Korn*[2], *B. C. Vander Wyk*[1] *and K. Pelphrey*[1], *(1)Yale Child Study Center, Yale School of Medicine, New Haven, CT, (2)Department of Psychiatry, Psychotherapy, and Psychosomatics, University of Zurich, Zurich, Switzerland*

Background:
Many of our efforts in social interactions are dedicated to optimizing our predictions of others' preferences, mental states, and behaviors, an ability referred to as Theory of Mind (ToM). Research over the past two decades has established that children with autism spectrum disorder (ASD) show significant developmental delays in ToM. . In consequence, behavioral interventions for ASD focus mostly on improving ToM skills. However, a mechanistic understanding of how we improve our predictions of others' mental states over time, and an understanding of developmental changes in these learning processes are lacking.
Objectives:
We aim to gain a mechanistic understanding of how humans optimize predictions of others' preferences over the course of typical development. Optimizing predictions is defined as reducing the difference between expected and actual outcomes, i.e., prediction errors. In a next step, we will investigate developmental differences in encoding and updating social prediction errors between typically developed adolescents and adolescents with ASD.
Methods:
We utilize a novel preference task to investigate the behavioral and neural mechanisms involved in updating social predictions and learning from prediction errors. To ensure high ecological validity, the task involves real social feedback. Typically developed adults (N=21) and adolescents (N=23) are asked to predict the preferences of three different people for a number of items (food types, beauty products and leisure activities). They subsequently receive trial-by-trial feedback about others' actual preference ratings. After completing the task, participants rate their own preferences for the same items (see Figure 1 A). We use reinforcement learning (RL) models to describe participants' changes in ratings over time. On the neural level, we model participant's trial-by-trial prediction errors (the absolute difference between participant's rating of the other person's preference and the person's actual preference rating) and the perceived self-other difference (the absolute difference between participant's ratings of their own preference versus that of the other person). We also used estimated prediction errors and estimated ratings from the winning RL model to predict trial-by-trial changes in brain activity.
Results:
Estimating others' preferences relies on two components: reinforcement learning based on past feedback and participants' own preferences for an item. Learning processes differ across development. Adolescents are slower at updating their predictions based on past feedback (see Figure 1 B); older adolescents show more updating (i.e., smaller prediction errors). Paralleling the developmental differences on the behavioral level, brain regions typically assigned to the ToM network support distinct processes in adolescents and adults. For instance, medial prefrontal cortex (MPFC) and posterior cingulate cortex (PCC) activity are less related to estimated predictions and more strongly correlated with estimated prediction errors in adolescents compared to adults (see Figure 1 C).
Conclusions:
We show that adolescence is marked by substantial developmental changes in social learning. We are currently investigating differences between the developmental trajectories of TD and ASD adolescents. This could help identify behavioral and biological markers of treatment change, which could help predict behavioral treatment outcomes for adolescents with ASD.

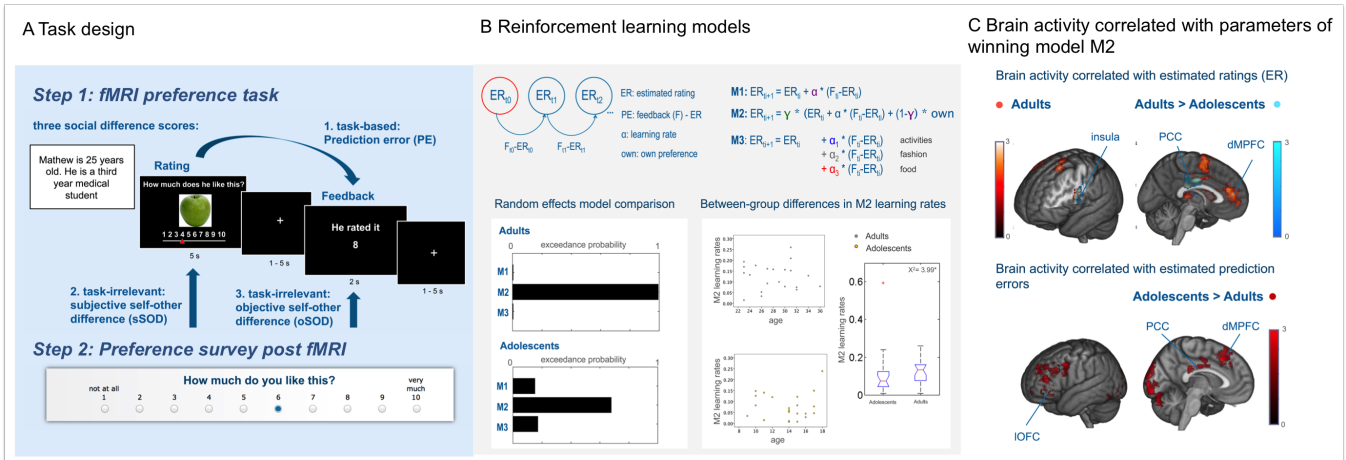


Figure 1 | **A)** Study design steps: Step 1 - participants predict the preferences of three different people in three consecutive fMRI task runs. Step 2 - participants rate how much they themselves like the items after the fMRI experiment. **B)** Reinforcement learning models tested in the adult and adolescent groups. Left panel: In the adult group the winning model (M2) is a combination of the classical reinforcement learning model based on past information and participants' own preferences for the items. In the adolescent group the difference between the tested models is less pronounced. Right panel: Adolescents show lower learning rates in M2 than adults. **C)** Upper panel: Brain regions that show significantly higher correlations with estimated ratings in adults versus adolescents. Lower panel: Brain regions that show significantly higher correlations with estimated prediction errors in adolescents versus adults. The results are whole brain cluster level FWE corrected at z = 1.7, p < 0.05.

32 **107.032** Differences in Auditory Evoked Potentials Between Children with Autism Spectrum Disorder with Versus without Language Impairment: A Methodological Comparison

E. Kwok, *E. Dovigi and J. Oram Cardy, Communication Sciences and Disorders, University of Western Ontario, London, ON, Canada*

Background: Atypical auditory processing is commonly reported in individuals with *autism spectrum disorder (ASD),* particularly in those with co-occurring *language impairment (LI).* One method commonly used to investigate these processes is recording of *auditory evoked potential (AEPs)*using electroencephalography. There is considerable interest in understanding whether atypical auditory cortical processing underlies LI in individuals with ASD, however, findings are inconsistent. Bomba and Pang (2004) identified two factors that explain some discrepancies in the literature: the heterogeneity of individuals diagnosed with ASD and the lack of an appropriate control group. A third possibility receiving little consideration in the literature to date is whether the choice of data analysis method contributes to discrepancies across studies.
Objectives: To compare differences in AEPs between children with ASD with normal language development (ALN) and those with language impairment (ALI) using three analysis methods: peak amplitude/latency, time-frequency, and global waveform resemblance.
Methods: Seventeen children aged 7-11 years (ALN: n=10, ALI: n=7) participated in a passive AEP paradigm where 225 trials of a 50ms, 490Hz tone were presented binaurally. A 128-channel EGI system recorded AEPs during stimulus presentation. Children with ALN had standard scores ≥ 85 on the *Clinical Evaluation of Language Fundamentals – 4*, while those with ALI scored < 85 (< 1 *SD*below the mean). The AEPs of children with ALN and ALI recorded at channel Fz were compared across three analysis methods. **1) Peak amplitude/latency analysis**: P1 and N2 AEP components were identified from the grand averaged waveform of all participants. The mean amplitude and peak latency within 60ms (±30ms) around the maximum of P1 and N2 were calculated and compared across groups. **2) Time-frequency analysis**: The AEPs of all participants underwent wavelet transformation from 5-100Hz in steps of 0.98 Hz using Morlet wavelets. The power and circular variance of AEPs at the gamma oscillation range (30-50Hz) were calculated and compared for both 200ms pre- and 200ms post-stimulus intervals. **3) Global waveform resemblance analysis**: An AEP segment from 0-400ms post-stimulus presentation was compared between children with ASD to our previously established normative AEPs of children with typical development aged 7-10 years. Using the intraclass correlation coefficient as an indicator of overall resemblance, the AEPs of children with ASD were assigned an age-equivalent based on the comparison that yielded the highest resemblance score.
Results: In amplitude/latency analysis, only the N2 mean amplitude was significantly different between ALI and ALN (p<0.005). Neither power nor circular variance of gamma-oscillation were significantly different between the two groups. Despite having the same mean chronological age, children with ALI had a younger AEP-age-equivalent than children with ALN (7.4 and 8.4 years respectively, p<0.01) on the global resemblance analysis.
Conclusions: Our results demonstrate that different AEP analyses can lead to different conclusions about putative auditory processing differences between children with ALI and ALN. Interpretation of the relation between AEPs and language functioning in ASD should take into consideration the choice of data analysis method and the neural processes thought to underlie different cortical responses.

33 **107.033** Differential Engagement of Prefrontal Cortex Underlies Local Bias in Children with Autism

A. J. Herringshaw, *S. L. Kumar and R. K. Kana, University of Alabama at Birmingham, Birmingham, AL*

Background: Visuospatial information processing in Autism Spectrum Disorders (ASD) is often described in terms of an inability to “see the forest for the trees.” The Weak Central Coherence (WCC) account of ASD (Frith, 1989) posits that a detail-oriented information processing bias exists in ASD, which can manifest as strength or as weakness depending on the task at hand. For example, in social cognition tasks where strong coherence is the norm, people with autism may falter, as opposed to visual search tasks where they perform well. Differences in brain responses in frontal versus posterior regions may underlie this cognitive and behavioral profile.
Objectives: To examine the neural correlates of WCC in children with ASD in the context of visual and social processing.
Methods: ASD (N=17) and Typically Developing (TD) (N=17) children and adolescents completed an emotion and shape judgement task in a Siemens 3.0 Tesla fMRI scanner. The task consisted of stick-figure human characters made up of geometrical shapes displaying different emotions. In the shape/local condition, participants indicated whether or not a given geometric shape (e.g., a rectangle) was present in the figure. In the emotion/global condition, participants recognized the emotion conveyed by the stick figure (e.g., sad). Whole-brain within-and-between-group activation and seed-to-voxel functional connectivity analyses were conducted in SPM12 and the CONN toolbox.
Results: 1) Significantly increased activity in ASD children, relative to TD, in posterior regions, including the middle occipital and middle temporal areas for both emotion and shape processing; 2) ASD children showed decreased activity (ASD<TD) in right superior and middle frontal regions (RSFG/MFG) while recognizing local shapes (p< 0.01; cluster =174 voxels); 3) Significantly weaker connectivity for emotion recognition in ASD participants (ASD<TD) between left extra-striate body area (EBA) to frontal pole (FP) and MFG (p< 0.05, cluster-level FDR corrected); and 4) The ASD group was significantly faster in the local/shape processing condition (ASD mean= 2871 milliseconds, TD mean= 3381 milliseconds; t(32)= 2.41; p< 0.05), while the TD group was significantly more accurate in the emotion condition (ASD mean= 88.2%, TD mean= 95.6%; t(32)= 2.63; p< 0.05).
Conclusions: Longer reaction times and greater recruitment of frontal regions in TD children during shape identification may suggest the need to override a global-processing bias that is not seen in ASD. Poorer accuracy of ASD children in recognizing emotions indicates that a default local bias may be a weakness in this context, and the decreased EBA-Frontal connectivity in ASD may underlie this weakness. While this local bias provided the ASD group with an advantage in faster processing of shapes, the TD group still performed the task with equal accuracy. Overall, our findings support weak central coherence in autism manifesting as a deficit and strength in social and visual tasks respectively, along with evidence for increased occipital recruitment and weaker connectivity. Clinical implications include targeting global visual processing in improving emotion recognition abilities.

34 **107.034** Dynamic Whole-Brain Functional Connectivity and Connectopathy in Autism: A Population-Based Neuroimaging Study of Brain Development

R. L. Muetzel[1], *L. M. Blanken*[1], *B. Rashid*[2], *R. Miller*[3], *F. Verhulst*[4], *H. Tiemeier*[4], *V. Calhoun*[3] *and T. J. White*[5], *(1)Child and Adolescent Psychiatry, Erasmus Medical Center - Sophia Children's Hospital, Rotterdam, Netherlands, (2)Electrical and Computer Engineering, University of New Mexico, Albuquerque, NM, (3)University of New Mexico, Albuquerque, NM, (4)Department of Child and Adolescent Psychiatry/Psychology, Erasmus MC-Sophia, Rotterdam, Netherlands, (5)Erasmus University Medical Centre, Rotterdam, Netherlands*

Background: Deficits in brain connectivity have been proposed to underlie symptomatology in autism spectrum disorders (ASD). Functional brain connectivity has been extensively studied in children and adults with ASD since the introduction of resting-state functional MRI (RS-FMRI). Despite the presence of an extensive and expanding

literature, both in terms of brain function and structure, the neurobiological etiology of ASD remains elusive. Traditional connectivity studies operate under the assumption that the characteristics of connectivity remain stationary throughout the measurement period. Dynamic functional connectivity (DFC), a new technique that relaxes this stationarity assumption and allows states to change over time, may show promise in the study of connectopathy in children with ASD.
Objectives: ASD has traditionally been conceptualized categorically, but is increasingly recognized as the end of a continuum of traits that extends into the general population(1). While these two constructs of the disorder clearly compliment one another in the search for the underlying neurobiology, there is an overrepresentation of case-control studies in the literature. The current study aims to expand the current functional connectivity literature in ASD in two ways: First by using a dimensional measure of autistic traits and second by using a novel metric of functional connectivity, namely DFC, in both globally 'disconnected' and default-mode states.
Methods: The present work utilizes a large, population-based cohort of children ages 6-to-10 years (mean age = 7.9 years). 774 children (52% boys / 48% girls) participated in the study. Mean non-verbal IQ was 102±14. Autistic traits were measured using the short form (18 item) Social Responsiveness Scale. Children underwent a 5½-minute RS-FMRI scan with a 3 Tesla GE MRI system. MRI data were pre-processed using the Statistical and Parametric Mapping Software, and group independent component analysis was performed using the GIFT-toolbox. Special care was taken to account for movement artifact(2). Traditional static connectivity was first estimated, followed by DFC using a sliding-window approach and k-means clustering(3). Summary metrics, including mean dwell time were computed for each participant and dynamic state. Multiple linear regression analyses were conducted to assess the association between DFC and autistic traits.
Results: Figure 1A illustrates the average, static connectivity state, and the 4 dynamic connectivity states observed in the current sample. Linear regression analyses, accounting for age, sex, and non-verbal IQ, show that autistic traits are positively associated with average time spent in a globally disconnected state (state 2, Figure 1B). Conversely, low levels of autistic traits were associated with a greater average time spent in a default-mode state.
Conclusions: For the first time, we demonstrate associations between autistic traits on a continuum and aspects of DFC in a large, population-based study of children. Specifically, we show evidence of children with high levels of autistic traits spending more time in a globally 'disconnected' functional state, relative to children with lower levels of autistic traits.
References:
1. Constantino, J.N., Todd, R.D., 2003. Arch Gen Psychiatry 60: 524-30.
2. Power, J.D., et al. 2012. Neuroimage 59: 2142-54.
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Figure 1A Static (mean) functional state (left) and the 4 dynamic states. State 2 is the globally disconnected state, and state 3 is the modularized default-mode state.

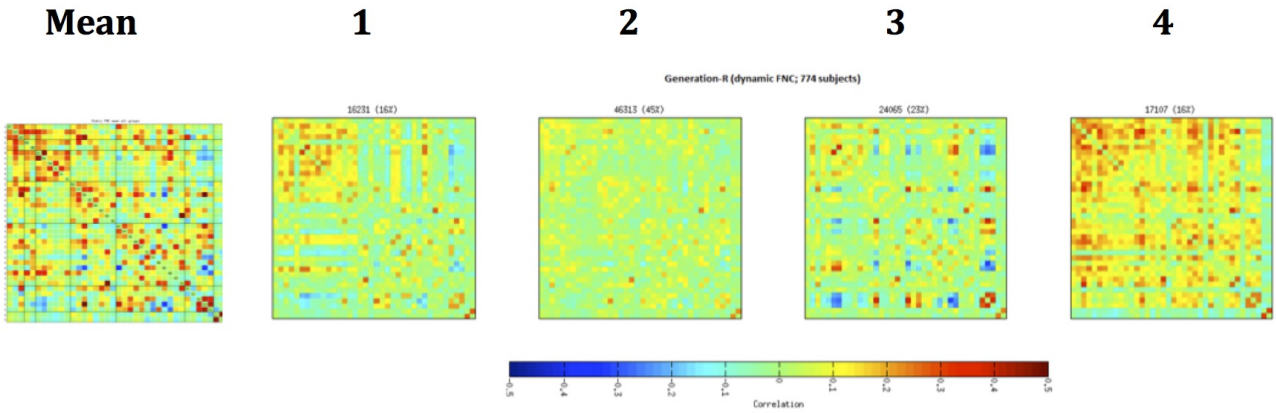
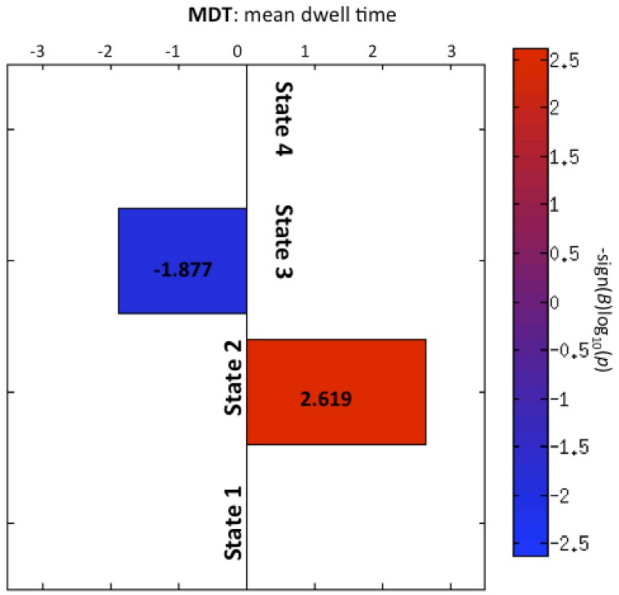


Figure 1B Mean dwell time (time spent in each state) associated with autistic traits. X-axis represents the –log(10) of the p-value for the regression coefficient.



35 **107.035** EEG Findings Processed By Next Generation Artificial Adaptive Systems Can Perfectly Distinguish ASD Children from Typically Developing Children: A Proof of Concept Pilot Study

E. Grossi[1], *M. P. Buscema*[2] *and C. Olivieri*[1], *(1)Autism Unit, Villa Santa Maria Institute Neuropsychiatric Rehabilitation Center, Tavernerio, Italy, (2)Semeion Research Centre*

of Sciences of Communication, Roma, Italy

Background:
To our knowledge, this is the first study that applies an artificial adaptive system to extract interesting features in computerized EEG that distinguishes ASD children from typically developing ones. The new system, named MS-ROM/I-FAST, belongs to the family of systems developed by The Semeion Research Institute in Rome. MS-ROM/I-FAST is a new, complex algorithm used for blind classification of the original EEG tracing of each subject. This is accomplished by recording and analyzing a few minutes of their EEG without any preliminary pre-processing. A proof of concept study published in *The Artificial Intelligence Journal* in 2015 showed accuracy values ranging from 94%-98% in discerning subjects with Mild Cognitive Impairment and/or Alzheimer's Disease from healthy elderly people.
Even if the neuropathology related to autism is markedly different from that of Alzheimer disease, simple reasoning would support the idea that the atypical organization of the cerebral cortex present in autism should result in an EEG signature open to detection through potent analytical systems like ANNs.
Objectives:
The aim of the study is to assess how effective this methodology distinguishes ADS subjects from typically developing ones.
Methods:
Fifteen definite ASD subjects (age range 8 -22) and ten typically developing subjects (age range 7-12) were included in the study. Patients received independent Autism diagnoses according to DSM-V criteria, then subsequently confirmed by a qualified psychiatrist at Villa Santa Maria, where the patients reside, using the ADOS scale (overall severity score had a range from a minimum of 4 to a maximum of 10 points, average = 7.9). No autistic child was affected by genetic conditions and/or cerebral malformations documented by neuroimaging and epilepsy.
A continuous segment of artefact-free EEG data lasting 60 s in ASCCI format was used to compute multi-scale entropy values and for subsequent analyses.
A Multi-scale ranked organizing map (MS-ROM), based on the self-organizing map (SOM) neural network, coupled with the TWIST system (an evolutionary system able to select predictive features) created an invariant features vector input of EEG on which supervised machine learning systems acted as blind classifiers.
Results:
After MS-ROM/I-FAST preprocessing, the overall predictive capability of different machine learning systems in deciphering autistic cases from normal ones consistently amounted to 100% (Table 1). These results were obtained at different times in separate experiments performed on the same training and testing subsets. The similarities among the ANN weight matrixes measured with apposite algorithms were not affected by the age of the subjects. This suggests that the ANNs do not read age-related EEG patterns, but rather invariant features related to the brain's underlying disconnection signature.
Conclusions:
This pilot study seems to open up new avenues for the development of non-invasive diagnostic testing for the early detection of ASD.

Machine Learning system	Num Input	ASD	Control	Overall accuracy	Error
K-CM	21	100%	100%	100%	0
kNN	21	100%	100%	100%	0
FF_Bp	28	87%	90%	88%	1.5
FF_Sn	28	80%	90%	85%	2
NaiveBayes	28	94%	70%	82%	2
RandomForest	28	67%	80%	73%	3.5
SMO	28	53%	90%	71%	4
Logistic	28	46%	90%	68%	4.5

36 **107.036** ERP Correlates of Inhibitory Control and Theory of Mind Are Associated with Each Other and with ASD Symptoms

***A. D. Nijhof**, M. Brass and J. R. Wiersema, Ghent University, Ghent, Belgium*

Background:
Both Theory of Mind (ToM) and Executive Functioning (EF) impairments have been argued to play a causal role in ASD. Interestingly, over the years, there has been growing support for a link between EF and ToM, and EF has been mentioned as an 'enabling factor' in the development of ToM. It is suggested that specifically inhibitory control is needed for successful ToM, as mentalizing almost always requires overriding a prepotent response (e.g., overriding own belief in false-belief tasks). Indeed, some studies have shown correlations between ToM and inhibitory ability, and fMRI studies have shown overlapping brain activation during ToM and inhibition tasks. Still, studies attempting to directly test the link between inhibitory control and ToM are scarce, especially at the neural level, but may be of much importance to better understand ToM deficits in ASD.
Objectives:
The aim of the current study was to investigate the relationship between neural correlates of inhibitory control and ToM, using EEG. In addition, correlational analyses were conducted to relate the ERP findings to ASD symptoms in a neurotypical population.
Methods:
22 neurotypical participants carried out a ToM task and a Go/No-Go task while their EEG activity was being recorded. The Go/No-Go task required participants to respond to a certain letter (80%, Go), and to inhibit responding to another letter (20%, No-Go). The ToM task consisted of watching short videos, in which both the participant and another agent formed a belief about the location of a ball. During the outcome phase, participants had to respond in accordance with what the agent had believed, enabling false- versus true-belief analyses. ERP components were calculated for No-Go versus Go trials, and for false- versus true-belief trials. These were subsequently related to ASD symptomatology assessed by means of the Autism Spectrum Quotient (AQ).
Results:
For the Go/No-Go task, the typical pattern of N2 and P3 components was found, with expected differences between Go- and No-Go-trials. In the outcome phase of the ToM task, a P3-like component could be observed at the midline, for the false-belief versus true-belief trials. A strong positive and specific correlation was found between the false-belief (versus true-belief) related P3 component and the No-Go (versus Go) P3 component ($r = 0.50$); no link was found with the N2. In addition, both the false-belief P3 and No-Go P3 were moderately and negatively correlated with ASD symptoms ($r = -0.35$ and $r = -0.32$ respectively).
Conclusions:
The finding that ERP indices of inhibitory control and mentalizing are positively correlated suggests that general inhibitory control plays a significant role in Theory of Mind tasks. Both ERP indices were found to be associated with ASD symptoms, with smaller amplitudes for adults with more ASD symptoms. Although we used a dimensional approach in a neurotypical population and replication of the findings is warranted in individuals with a formal diagnosis of ASD, these findings may help to better understand ToM deficits in ASD.

37 **107.037** Effects of Age and Social Function on Voice-Processing Systems in Autism

***A. E. Baker**[1], A. Padmanabhan[1], P. Odriozola[2], D. A. Abrams[2] and V. Menon[3], (1)Stanford University School of Medicine, Palo Alto, CA, (2)Stanford University, Palo Alto, CA, (3)Stanford University School of Medicine, Stanford, CA*

Background:
Children with autism spectrum disorders (ASD) often show a lack of engagement with social communication cues, including speech, perhaps due to diminished attribution of reward to social stimuli, which may impact the development of social skills. In adolescence, increased importance is placed on social interactions as individuals begin to make a world for themselves outside of the home. Social communication impairments thus may leave individuals with ASD uniquely vulnerable during the transition from childhood to adulthood. Neuroimaging research suggests that children with ASD show weaker connectivity between voice-selective superior temporal sulcus and reward and affective brain regions compared to typically developing (TD) children, and that the strength of connectivity is associated with individual differences in social communication abilities. However, little is known about the development of speech processing in the social brain during adolescence, or its relationship to social communication deficits in ASD.
Objectives:
We examined the neural basis of 1) processing unfamiliar voices compared to non-vocal sounds and 2) processing unfamiliar voices compared to mother's voice, a familiar vocal source associated with the home environment, in children and adolescents with ASD compared to their TD peers. Specifically, we explored age- and social function-related effects to better understand how voice processing in ASD deviates from typical development and correlates with social communication abilities.
Methods:
We used fMRI to measure brain activity in 31 individuals with high-functioning ASD (8-18 y/o) and 39 age- and IQ-matched TD controls (7-17 y/o) in response to nonsense words produced by both unfamiliar female speakers and their own mothers, as well as energy- and duration-matched non-vocal environmental sounds. We also administered the social responsiveness scale (SRS) to measure social function.

Results:
The ASD group showed less activity in reward and social brain regions compared to the TD group in response to vocal stimuli. Moreover, unfamiliar voices, compared to both environmental sounds and mother's voice, elicited increased activity in the brain's reward circuit as a function of age in the TD group, suggesting increased reward attribution to novel vocal sources in adolescence. This relationship was absent in the ASD group, who showed no age-related change but did show variability in brain activity in voice-selective and affective regions as a function of SRS score, with increased activity correlating with more severe social impairments.
Conclusions:
Our results support previous findings by showing that both familiar and unfamiliar vocal sources elicit reduced brain activity in reward and affective circuits in individuals with ASD compared to their TD peers. Moreover, the absence of age-related changes in response to unfamiliar voices in the ASD group suggests a deviation from typical development. Such impairments may play a role in the ability of adolescents with ASD to experience novel vocal sources as salient and pleasurable stimuli, thereby impacting social skill development in this population. Our results also suggest a neural basis for individual differences in social function in ASD, with immature brain responses correlating with behavioral impairments.

38 **107.038** Electrophysiological Signatures of Visual Statistical Learning in Three-Month Old Infants at Risk for Autism Spectrum Disorder

A. Marin[1], *T. Hutman*[2], *M. Dapretto*[3], *C. Ponting*[1], *S. P. Johnson*[4] *and S. S. Jeste*[1], *(1)Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA, (2)University of California Los Angeles, Los Angeles, CA, (3)University of California, Los Angeles, Los Angeles, CA, (4)UCLA, Los Angeles, CA*

Background: Visual statistical learning (VSL) refers to implicitly extracting commonalities and transitional probabilities within the visual environment (Bulf et al., 2011), and may be a precursor to later cognition and social communication (Romberg & Saffran, 2010). We previously demonstrated impairments in VSL in preschool-age children with ASD using a novel electrophysiological (EEG) paradigm (Jeste et al., 2015). No studies have examined VSL in infants at risk for ASD.
Objectives: We asked whether EEG signatures of VSL could be quantified at 3-months of age, and whether VSL distinguished high- and low-risk infants (HR infants have an older sibling with ASD), and whether there was an association between VSL at 3-months and later cognitive function.
Methods: Three-month-old infants (n=22, high-risk (HR): n=11, low-risk (LR): n=11) were exposed to a continuous stream of shapes based on a modified version of the Kirkham et al. (2002) VSL task. High density EEG was recorded (128 electrode, EGI inc) and the event-related potential (ERP) of interest was the frontal Positive Slow Wave (PSW). A general linear model evaluated within-subject effects of region and condition and between-subject effects of group with respect to PSW mean amplitude. Learning was operationalized as differentiation between conditions (expected vs. probabilistic). Whole group correlations between ERP markers of learning and cognitive skills at 6-months (Mullen Scales of Early Learning, 1995) were also performed.
Results: There was a significant group by condition interaction ($F(1, 20) = 7.393$, $p = .013$, partial $h^2 = .270$) and a significant main effect of region ($F(2, 19) = 5.302$, $p = .015$, partial $h^2 = .358$). Post-hoc tests revealed greater mean amplitude within the middle region as ($M = 2.560$, $SD = 4.162$) compared to the right ($M = 2.039$, $SD = 3.155$) and left ($M = .687$, $SD = 3.841$). Post-hoc tests revealed that HR infants significantly differentiated conditions ($t(10) = 2.967$, $p = .014$), while LR infants did not ($t(10) = -.793$, $p = .446$). An independent samples t-test returned significant differences between HR ($M = 3.282$, $SD = 3.669$) and LR ($M = -.809$, $SD = 3.384$) groups in PSW difference amplitudes ($t(20) = 2.719$, $p = .013$). The absolute value PSW difference amplitudes correlated with six-month visual receptive skills ($r(21) = .49$, $p = .02$) and mental age ($r(21) = .48$, $p = .03$), but groups did not differ on mental age at 6 months.
Conclusions: EEG correlates of VSL seem to differentiate HR from LR infants as early as 3-months of age, with HR infants displaying evidence of VSL. EEG signatures of learning predict both visual receptive skills and mental age at six months. The relationship between VSL and cognitive function suggest a role of pattern learning in later cognitive development. Group differences in VSL suggest that infants at risk for ASD demonstrate strengths in processing visual patterns—a strength that may occur at the expense of later social attention or learning. As we confirm diagnostic outcomes, we will better understand the predictive nature of this cognitive domain in infants at risk for ASD.

39 **107.039** Engagement of Language and Theory-of-Mind Networks during Self-Other Processing in Autism Spectrum Disorders

E. Sartin[1], *C. E. Stevens*[2], *C. L. Klein*[3], *M. R. Klinger*[4], *L. G. Klinger*[5] *and R. K. Kana*[6], *(1)UAB, Trussville, AL, (2)Psychology, University of Alabama at Birmingham, Birmingham, AL, (3)Psychology, Marietta College, Marietta, OH, (4)University of North Carolina at Chapel Hill, Chapel Hill, NC, (5)Psychiatry, University of North Carolina TEACCH Autism Program, Chapel Hill, NC, (6)University of Alabama at Birmingham, Birmingham, AL*

Background: Autism Spectrum Disorder (ASD) is characterized by difficulties in social interaction and social communication (American Psychiatric Association, 2013). Self-referential processing, critical in interpersonal interactions, entails the ability to process information by incorporating self-awareness, self-judgment, and self-memory. Self-referential processing has been linked to several brain areas, including the medial prefrontal cortex (MPFC), inferior parietal lobule (IPL), anterior cingulate cortex (ACC), and left inferior frontal gyrus (LIFG). Individuals with ASD have been found to show atypical brain responses in some of these areas when engaged in self-other representation tasks (Craik et al., 1999; Chiu et al., 2008; Lombardo et al., 2010).
Objectives: The primary objective of this fMRI study is to examine the role of language and theory-of-mind (ToM) brain networks in self-other processing across ASD and typically developing (TD) individuals.
Methods: 15 high-functioning adults with ASD and 15 age-and-IQ-matched TD control participants (mean age= 21.7; mean IQ: ASD=105, TD=111, p=.124) took part in this study. All participants were right-handed males. Participants made "yes" or "no" judgments of whether an adjective, presented visually, described them (*self*) or their favorite teacher (*other*). There was also a case judgment control condition where the participants determined whether the adjective contains the letter "e". The data were collected using a Siemens 3T Allegra scanner and analyzed using the SPM 12 software. Participants also completed the Reading Mind in the Eyes (RMIE) task outside of the scanner to asses ToM.
Results: The main results of this study are: 1) Both ASD and TD participants showed significant activity in left superior temporal gyrus (LSTG), LIFG, MPFC, and LIPL during *self* as well as *other* processing (p= .001, voxels=78); 2) Between-group analyses showed significantly decreased activity in RSTG in ASD for both *self* as well as *other* processing (p= .05, voxels= 579); 3) Other related processing also elicited significantly reduced activation in the precuneus in ASD participants(p=.001, voxels=78); 4) When *self* and *other* processing were directly contrasted, ASD participants showed reduced activation in the ACC, putamen, caudate, and cerebellum (p=.001, voxels 78); and 5) A regression analysis with MIE scores as covariate significantly predicted RIFG activation for self-processing in ASD participants (p=.01, voxels=253).
Conclusions: Increased activity in LIFG and LSTG for self and other processing, but not for case judgment, suggests greater levels of semantic processing; this is consistent with the findings of previous imaging studies (Kelley et al., 2002). Reduced RSTG and precuneus activation during *other* processing in ASD participants reflects poor engagement of regions that are part of the ToM network. Recent meta-analysis data underscore the role of these regions in other-related processing (Murray et al., 2015). Comprehending *self*-related words also seems to recruit temporal and IFG areas differently in ASD participants, as seen in previous studies (Lombardo et al., 2010, D'Argembeau et al., 2007). Overall, the findings of this study emphasize the role of social and semantic processing brain networks and their alterations in the neurobiology of autism.

40 **107.040** Evaluation of Mismatch Negativity As Biomarker for Language Impairment in Autism Spectrum Disorder

H. L. Green[1], *L. C. Goodwin*[2] *and K. Froud*[3], *(1)Columbia University, New York, NY, (2)Columbia University, Staten Island, NY, (3)Biobehavioral Sciences, Columbia University Teaches College, New York, NY*

Background: Currently, autism spectrum disorder (ASD) is diagnosed using the Diagnostic Statistical Manual of Mental Disorders-Fifth Edition (DSM-V) and children often go undiagnosed until around the age of three. Moreover, current language assessments are designed to behaviorally measure language skills, therefore requiring that a child have language or be "of language age" in order to participate. As a result of these diagnostic limitations, speech and language interventions for children with ASD plus language impairment (ASD+LI) are often not initiated until a child is of preschool age. Finding an early and objective way to identify language impairment (LI) in ASD has the potential to lead to earlier speech and language intervention for individuals "at risk" for the disorder. Magnetoencephalography (MEG) studies use the Mismatch Field component (MMF) to investigate how the brain processes speech sounds. Previous MEG studies by Roberts et al. (2011) utilizing the MMF component have shown that increased MMF latency (i.e., longer processing time) is a predictor of LI in children with ASD (sensitivity 82.4%; specificity 71.2%).
Objectives: Since MEG is expensive and not widely used with infants or young children, we attempted to replicate these results using the mismatch negativity (MMN), the electroencephalography (EEG) equivalent of MMF. EEG is inexpensive and can be used with children of all ages making it an appropriate method to identify LI in children on the autism spectrum. We explored increased MMN latency as a potential biomarker for LI in autism.
Methods: EEG was recorded in children ages 5-10 with ASD+LI, ASD-LI and typically developing controls (TD) during a passive auditory oddball experiment presenting speech sounds. During the recording children were instructed to watch a movie and ignore the sounds.
Results: Contrary to previous MMF findings, individuals with ASD+LI demonstrated decreased MMN latency in the left hemisphere in response to vowel sounds compared to those with ASD-LI and TD controls. A positive correlation between left hemisphere MMN latency and language scores on the Clinical Evaluation of Language Fundamentals-Fifth edition was found when combining both ASD groups. No correlation between MMN latency and language score was found in the control group. Parent report revealed that all individuals with ASD who participated in this study were hyper-sensitive to sounds.
Conclusions: Our results show that children with ASD+LI and hyper-sensitivity to auditory stimuli detect change in the auditory stream faster than children with ASD-LI and TD controls. Our results support the theory that children with ASD+LI have increased connectivity in primary sensory cortices at the expense of computational connectivity between association areas of the brain (Belmonte et al., 2004). This may account for faster auditory processing time despite low language scores in these children. Further

research needs to be done in order to determine if grouping children by hyper- versus hypo-sensitivity to auditory stimuli could explain conflicting results between studies and elucidate a neurophysiological biomarker of language impairment in subgroups of children with ASD.

41 **107.041** Evaluation of the Pupillary Light Reflex As a Potential Biomarker in Children with Autism Spectrum Disorder

V. Y. Kang[1,2], *M. Pereverzeva*[1], *S. T. Geller*[1,2], *S. Lo*[1], *L. V. Ibanez*[1,2], *W. L. Stone*[1,2] *and S. O. Murray*[1], *(1)Department of Psychology, University of Washington, Seattle, WA, (2)UW READi Lab, Seattle, WA*

Background:
Previous studies have found differences in autonomic nervous system (ANS) functioning between children with ASD and typically developing (TD) children. The pupillary light reflex (PLR) is one measure of autonomic functioning that has revealed a longer latency, faster constriction velocity, and lower constriction amplitude for individuals with ASD compared to those with TD between 7 and 20 years of age (Daluwatte et al., 2012; Fan et al., 2009). Evaluation of the PLR in a younger age group could provide insight into the early development of the ANS in ASD and be useful in discovering potential early biomarkers of ASD.
Objectives:
This study investigated PLR parameters in younger ASD and TD children than have been studied previously, using a simplified paradigm. The goal of the study was to examine differences in the PLR between groups of ASD and TD children between the ages of 3 and 10 years, and to develop a simple testing procedure that could be used for young, pre-verbal children.
Methods:
Children with ASD (n= 34, male=28; $M_{age=}$ 5.79 years) and TD children (n= 33, male=21; $M_{age=}$ 6.06 years) participated in two testing sessions. Each session lasted under 5 minutes and included four to six 21-second-long trials. The visual stimuli were large black and white circles, presented on a uniform gray background, and alternating every second. A standard LCD monitor (Vizio SV420M), calibrated with a spectroradiometer (PR 650), was used to present the stimuli. Pupil size was measured by an infrared-based eye tracker (Tobii X120). The PLR parameters, measured from the white circle onset, included the means of baseline pupil size (pupil size prior to the presentation of the stimulus, in millimeters), PLR latency (time point when the change in the pupil size over the change in time is maximum, in milliseconds), and dilation time (time point at the maximum pupil size, in milliseconds).
Results:
Children with ASD (M=3.83, SD=.38) had significantly larger average baseline pupil size than controls (M=3.59, SD=.31), $F(1)$=8.22, $p < .01$, and had significantly longer mean PLR latency (M=402.88, SD=37.64) than controls (M=382.48, SD=27.10), $F(1)$=6.10, p=.016. In addition, children with ASD (M=260.44, SD=20.58) had marginally significantly longer mean dilation time than controls (M=250.76, SD=18.16), $F(1)$=3.91, p=.052.
A similar pattern was present in the youngest, previously untested age group (ages 3 to 6). The ASD group (n= 23, M=262.96, SD=21.64) had significantly longer mean dilation time than controls (n= 18, M=251.28, SD=11.73), $F(1)$=4.25, p=.046 and had significantly longer mean PLR latency (M=410.00, SD=40.40) than controls (M=385.00, SD=23.81), $F(1)$=5.40, p=.025.
Conclusions:
There were significant differences in PLR parameters between children with ASD and TD in an age group that was younger than previously studied. The results are consistent with previous findings in older children, which suggest that PLR measures could be extended to younger ages and potentially serve as an early biomarker for ASD.

42 **107.042** Evidence for Early Divergence of Thalamocortical Networks in High-Risk Siblings of Individuals with Autism Spectrum Disorder (ASD)

A. Nair[1], *T. Tsang*[2], *C. Ponting*[3], *J. Liu*[2], *S. Y. Bookheimer*[2] *and M. Dapretto*[2], *(1)Psychiatry, University of California Los Angeles, Los Angeles, CA, (2)University of California, Los Angeles, Los Angeles, CA, (3)Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA*

Background: The thalamus is an important subcortical relay structure, through which most sensory information is routed. It plays a crucial role in modulation of visual, auditory, and somatosensory functions, as well as attention and motor control. Various lines of evidence have suggested thalamic abnormalities in ASD (e.g., Chugani et al. 1997, Friedman et al. 2003). Highly specific patterns of thalamocortical connectivity have been demonstrated in typically developing (TD) individuals using functional connectivity MRI (fcMRI; Zhang et al. 2008, 2010; Fair et al. 2010). In prior studies (Nair et al., 2013; Nair et al., 2015), we demonstrated that children and adolescents with ASD showed mostly reduced connectivity especially for prefrontal-thalamic networks, accompanied by overconnectivity within temporal-thalamic networks.
Objectives: Given the importance of early identification of biomarkers and endophenotypes of ASD, it is crucial to understand how early in the developmental process these differences in thalamocortical networks emerge.
Methods: Resting-state fcMRI (rs-fcMRI) data were acquired during natural sleep for 8 minutes on a 3T Siemens scanner for 19 infant siblings (6 weeks post-birth) of children with ASD (i.e., high-risk group; HR) and 21 infants at low risk (LR) for ASD. Data were preprocessed using AFNI and FSL, and included motion correction, spatial smoothing, isolation of low frequency fluctuations (.008<f<.08), and normalization to the UNC Infant 0-1-2 neonate atlas (Shi, 2011). The same atlas was used to obtain masks for prefrontal cortex, motor cortex, somatosensory cortex, parietal lobe, occipital lobe, temporal lobe and thalamus (see Nair et al., 2013). Time-series were extracted from each of these cortical regions, and submitted to partial correlation analyses with field of view restricted to thalamus. Results were normalized using Fisher R-to-Z transformation and submitted to paired t-test analysis for comparison between groups. Additional rs-fcMRI data were obtained for 10 HR and 11 LR participants at 9-months post-birth. Similar preprocessing and statistical analyses were used on these data, except that these data were normalized to the UNC Infant 0-1-2 1-year atlas.
Results: Rs-fcMRI results showed aberrant patterns of thalamocortical connectivity in the HR group compared to LR groups at 6-weeks post-birth. These patterns mostly indicated underconnectivity effects for all regions in the HR group, except for the parietal lobe, which showed bilateral overconnectivity effects with the thalamus. At 9 months post-birth, the HR group showed thalamocortical patterns similar to older ASD children and adolescents in our prior studies (Nair et al., 2013; Nair et al., 2015). More specifically, as compared to the LR group, the HR group demonstrated marked bilateral underconnectivity within prefrontal-thalamic networks, and bilateral overconnectivity within temporal-thalamic networks.
Conclusions: Our findings suggest that aberrant subcortical-cortical connectivity may be disrupted as early as the first weeks of life in infants at higher risk of developing ASD. Further longitudinal assessment is required to determine if these thalamocortical connectivity differences can predict which individuals within the HR group will later meet criteria for diagnosis of ASD.

43 **107.043** Examination of the Role of Social and Sensory Factors in Atypical Speech Processing in Autism Spectrum Disorder

L. Latterner, *J. Pandey, J. E. Maldarelli, R. T. Schultz and J. McCleery, The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA*

Background: Language and social development are intimately linked. Individuals with Autism Spectrum Disorder (ASD) display differences in language processing, including atypicalities in speech sound discrimination and lateralization of speech processing. It is unclear, however, whether these differences are related to the inherent social nature of speech or its unique sensory features. In light of evidence for both broad sensory and specific auditory processing abnormalities in ASD, further research is necessary to determine how atypicalities in language processing are related to social and sensory aspects of speech.
Objectives: To investigate brain responses to speech and non-speech stimuli in children with ASD using event-related potentials, in order to elucidate how abnormalities in speech processing relate to social and sensory factors associated with speech.
Methods: Participants are children with ASD aged 3-5 years and chronological age-matched typically developing (TD) controls (see Table 1 for sample characteristics). ASD participants were diagnosed by research-reliable doctoral level clinicians using best clinical judgment based on a variety of measures (ADOS-2, Mullen Scales of Early Learning, Vineland Adaptive Behavior Scales). Speech stimuli in this on-going study consist of short nonsense phrases spoken with angry or neutral prosody, selected based upon affect ratings (interrater reliability ≥.875). Non-social sensory-matched controls for the speech sounds were created by synthesizing a complex tone with the same pitch, amplitude, and overtones as the original speech. Speech and non-speech stimuli are presented in separate blocks, each contrasting prosody (angry, neutral). This experimental design allows for analysis of broad (speech vs. non-speech) and specific (angry vs. neutral) social factors while controlling for sensory features. Analyses focus on the P2 component and a late positive component (P450) over frontal cortex, in order to examine both perception and cognitive evaluation of the stimuli. ANOVAs with Stimulus Type (Human, Non-Human), Emotion (Angry, Neutral), and Hemisphere (Left, Right) as within-subjects factors and Group (ASD, TD) as a between-subjects factor were conducted on the amplitudes of these components.
Results: Perceptual P2 component amplitudes exhibited a significant Group by Hemisphere interaction whereby P2 amplitudes were larger in the left hemisphere for ASD participants but larger in the right hemisphere for TD participants ($F(1, 13) = 6.265$, p<.05, η_p^2=.325). Amplitudes of a frontal P450 cognitive component also displayed an interaction effect between Stimulus Type and Group in which TD participants exhibited larger discrimination of speech and non-speech stimuli, ($F(1, 13) = 6.838$, p<.05, η_p^2=.345).
Conclusions: Preliminary analyses found that ASD participants exhibit atypical left-lateralization of auditory perceptual processing regardless of the stimulus, suggesting the possibility that abnormal hemispheric specialization is independent of both social and prosodic factors. However, these preliminary results suggest that ASD participants also exhibited reduced discrimination of speech and non-speech sounds relative to control participants at a later cognitive stage of processing. Because the speech and non-speech stimuli were carefully matched on physical properties, this finding suggests that impairments in later cognitive processing of speech versus non-speech in ASD may be driven by social factors. Data collection is on-going and full sample ASD and TD data will be reported.

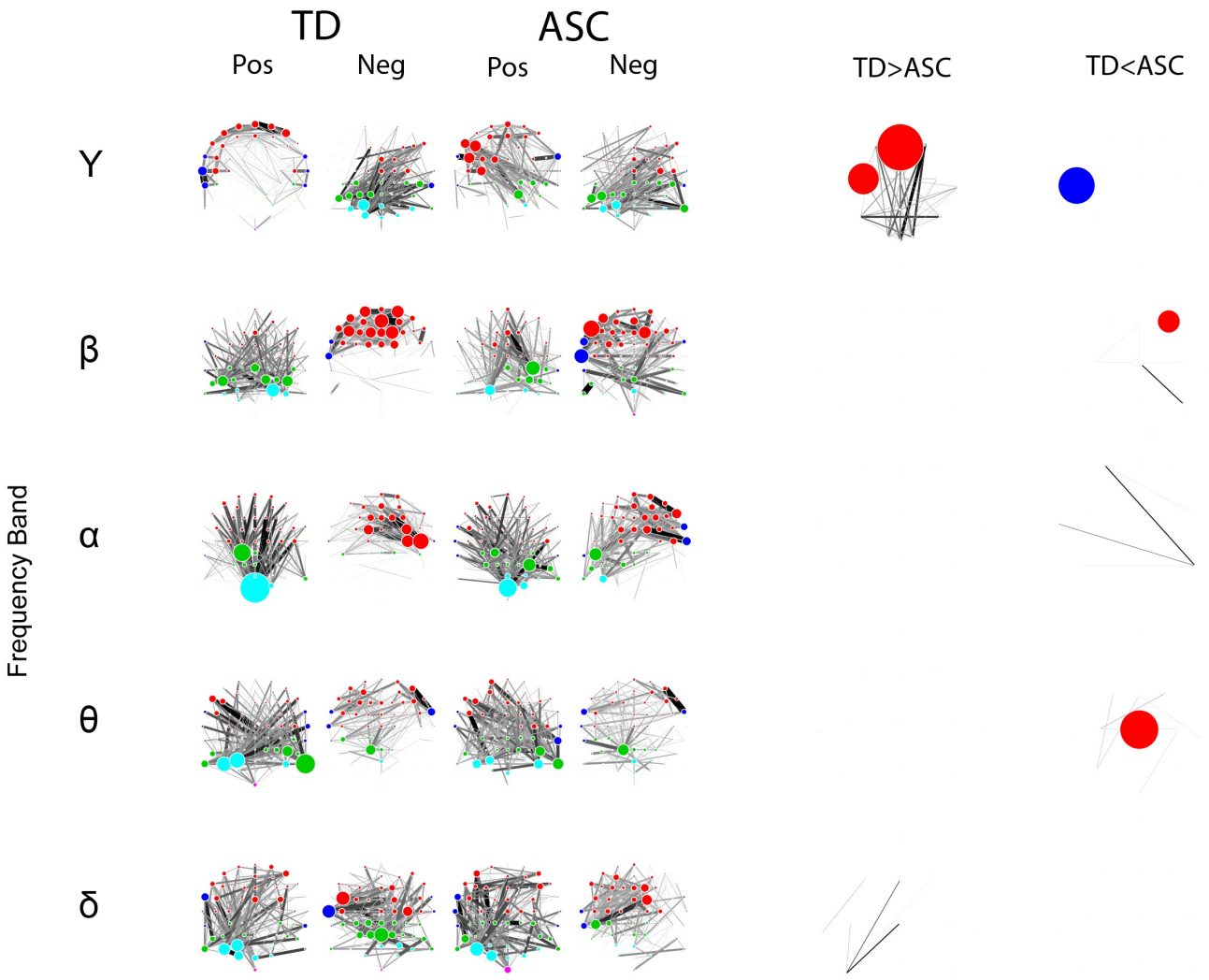
Table 1: Participant characteristics.

	ASD	TDC
N	11	4
Age (months) *mean (SD)*	57.5 (9.4)	59.25 (14.3)
% female	18.2%	50.0%
Early Learning Composite (Mullen Scales of Early Learning) *mean (SD)*	75.3 (13.4)	92.8 (12.8)
Race (% Caucasian)	54.5%	50.0%

44 **107.044** Exploring Atypical Connectivity in Autism Using Graph Theory and Electroencephalography

R. A. Bethlehem[1], *M. G. Kitzbichler*[2], *J. Freyberg*[1], *E. Ruzich*[1], *S. K. Crockford*[1] *and S. Baron-Cohen*[1], *(1)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (2)Department of Psychiatry, Brain Mapping Unit, University of Cambridge, Cambridge, United Kingdom*

Background:
Atypical neural connectivity has been proposed to be a potential hallmark of autism, with hypotheses including decreased fronto-posterior and enhanced parietal-occipital connectivity, reduced long-range and increased short-range connectivity, and temporal binding deficits. However, empirical findings vary substantially depending on the aspects of connectivity examined, the developmental stage of the individual, the spatial and temporal scales, task versus no-task conditions, how motion artefacts are handled, and the specific neural systems under consideration.
Objectives:
To explore the atypical connectivity hypothesis of autism with functional connectivity (FC) analysis of resting-state electroencephalography (EEG) data, using graph theoretical analysis, a non-biased, model-free, data-driven approach.
Methods:
Resting-state EEG data (4-minute with 1-minute alternating eyes-closed, eyes-open) were recorded from 14 adults with autism and 34 neurotypical controls matched for age and IQ. We used data-driven graph theory methods to study FC during the eyes-closed condition of these data. Functional connectivity was estimated using envelope correlations that are more robust against the problem of volume conduction in EEG. In contrast to fMRI, EEG data arguably suffer less from head-motion artefacts and provide a much higher temporal resolution to study network dynamics.
Results:
There were weak whole-brain effects combined with heterogeneous local effects. Consistent with prior literature, differences were found in the alpha and beta frequency range. Specifically, in the alpha frequency range there was a trend towards increased clustering of positive correlations in occipital regions in the neurotypical group, relative to the autism group. Conversely, in the beta frequency range there was increased clustering of negative correlations in central and frontal regions in the neurotypical group relative to the autism group. Most prominently we found higher absolute coupling between frontal and occipital regions in the gamma frequency range in the control group. As the sign of this coupling in the gamma frequency is negative, it means there was less decreased coupling and this is thus interpreted as relative increased functional connectivity between occipital and frontal regions in ASC, that was most prominent in frontal regions.
Conclusions:
The results reveal no clear whole-brain connectivity pattern associated with autism. There are numerous local differences between the neurotypical and autism groups. Most prominently there was a slight but robust increase in functional connectivity between occipital and frontal regions in ASC in the gamma frequency range. Gamma osciliations have previously been associated with a possible excitation-inhibition balance in visual cortex and it is possible the present hyperconnectivity during resting state conditions is the result of a similar excitation-inhibition imbalance.



45 **107.045** Functional Connectivity in the Salience Network Differs Between Infants at High- and Low-Risk for ASD

T. Tsang[1], *C. Ponting*[2], *R. McCarron*[1], *K. E. Lawrence*[1], *S. Y. Bookheimer*[1] *and M. Dapretto*[1], *(1)University of California, Los Angeles, Los Angeles, CA, (2)Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA*

Background: Autism spectrum disorders (ASD) are characterized by deficits in social communication and sensory processing. Disruptions in brain connectivity have been implicated in ASD (Geschwind & Levitt, 2007), which may result from altered prenatal neural development (Stoner et al., 2014). In particular, hyperconnectivity of the salience network (SN) has been associated with symptom severity in children with ASD (Uddin et al., 2013). The SN is involved in modulating attention to salient aspects in the internal and external environment. Social stimuli represent salient features of an infant's environment (Johnson & Morton, 1991) and atypical attention allocation to social stimuli has been observed among infants who develop ASD (e.g., Shic, Macari, & Chawarska, 2104). This feature of ASD may stem from altered functional connectivity within the SN during infancy.
Objectives: Here we examine functional connectivity in the SN in 6-week-old infants at high- (HR) and low-risk (LR) for ASD in order to identify how early patterns of connectivity may relate to social cognitive development.
Methods: An 8-minute rs-fcMRI scan was acquired during natural sleep in 6-week HR and LR infants on a 3T Trio Scanner. Risk status was determined by virtue of having one or more older siblings with a confirmed ASD diagnosis. The rs-fcMRI data were motion scrubbed and preprocessed using FSL. The SN was identified using the right insula region-of-interest from an infant atlas (Shi et al., 2011) as the seed. The Autism Observation Scale for Infants was administered 12 months.
Results: HR and LR infants were matched on age ($t(32) = .44$, $p = .65$) and head motion ($t(32) = .37$, $p = .71$).Whole-brain correlation maps generated from the insula seed demonstrated that the SN was detectable in all infants ($p < .05$, cluster corrected). In comparison to LR infants, HR infants exhibited hyperconnectivity between the right insula and somatosensory areas; in comparison to HR infants, LR infants showed stronger connectivity between the right insula and frontal regions of the SN ($p < 0.05$, cluster corrected). Hyperconnectivity between the right insula and sensory cortices among HR infants was associated with the severity of early ASD symptomatology ($r = -.83$, $p < 0.001$).
Conclusions: These preliminary findings indicate that risk status is associated with significant differences in SN connectivity as early as 6 weeks of age. The right insula has been identified as the hub of the SN, which is involved in modulating attention to interoceptive and exteroceptive stimuli (e.g., Uddin & Menon, 2009). Hyperconnectivity between the right insula and somatosensory cortices in the HR group may cascade to altered developmental trajectories characterized by diminished attention to external social stimuli and increased attention to internal sensory perception (e.g., sensory over-responsivity—Green et al., 2013). Although diagnoses cannot be confirmed until 36 months, these findings suggest that disruptions in SN connectivity may provide early reliable biomarkers of ASD before observable social and cognitive symptoms are present.

46 **107.046** Functional Near-Infrared Spectroscopy of Neural Responses to Speech at Three Months

N. M. McDonald[1], *J. A. Eilbott*[2], *H. M. Fichtenholtz*[3], *M. L. Braconnier*[4], *C. A. Wall*[5], *C. A. Paisley*[4] *and K. Pelphrey*[4], *(1)Yale Child Study Center, New Haven, CT, (2)Yale University, New Haven, CT, (3)Yale University School of Medicine, West Haven, CT, (4)Yale Child Study Center, Yale School of Medicine, New Haven, CT, (5)Yale Child Study Center, Yale University School of Medicine, New Haven, CT*

Background: Infants show a behavioral preference for speech vs. other human and environmental sounds within the first months of life. This preference for speech sounds is an important factor in social development, with a lack of preference potentially indicating risk for social deficits, such as in autism spectrum disorder (ASD). While several studies have identified specialized neural circuitry for processing speech vs. non-speech sounds in adults, it is less clear whether this specialization is evident in the first months of life. A previous study from our group using functional magnetic resonance imaging (fMRI) found increased activation to speech vs. non-speech sounds in the left temporal cortex in one- to four-month-old infants during natural sleep. We sought to replicate these findings using functional near-infrared spectroscopy (fNIRS) in awake infants at three months of age.
Objectives: In preparation for developing less-invasive risk biomarkers for ASD, we examined whether 3-month-old infants showed increased neural activation in response to

infant-directed speech vs. other human sounds using fNIRS.
Methods: Infants were seated in their parent's lap across from a screen and wearing the infant fNIRS headgear (optodes covering right and left temporal cortices; see Figure 1). Auditory stimuli were adapted from Shultz et al. (2014). Infants heard five 10-s blocks (pseudorandom order) for each of the three conditions: infant-directed speech (IDS), human communicative non-speech vocalizations (HCM), and human non-communicative vocalizations (HNC). Speech sounds were comprised of a set of phrases in Japanese to allow for a focus on the social, rather than language-related, aspects of speech. While the sounds played, an infant-friendly video depicting non-social stimuli played to maintain infant attention. Changes in oxygenated hemoglobin (Oxy-Hb) within the speech condition were contrasted with the non-speech conditions.
Results: Data from 14 infants were included in analyses. As depicted in Figure 2, grand average waveforms within each hemisphere indicated increased activation in the right temporal cortex in response to infant-directed speech. A *t*-test contrasting the speech vs. non-speech conditions revealed a significant difference in mean Oxy-Hb concentration at 4.5 to 7.5 s post stimulus, $p = .02$.
Conclusions: Infants exhibited increased activation to speech sounds within the first three months of life. We found increased activation to infant-directed speech within the right temporal cortex, an area often found to be sensitive to social stimuli. These findings offer important implications for understanding ASD. Specifically, it may be that a lack of neural specialization for social stimuli, including speech, within the first months of life places infants at risk for the disruptions in social development apparent in ASD. As a next step, we plan to examine whether individual differences in neural sensitivity to speech are associated with concurrent parent reports of early sociability. Future directions include longitudinally examining whether infants who are more sensitive to speech at three and six months of age are more social at 12 months and whether these early neural responses are associated with risk for ASD.

Figure 1. Optode configuration by hemisphere

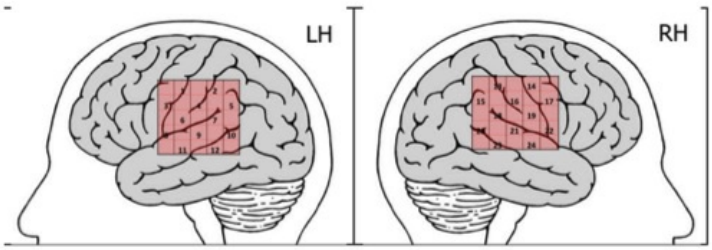
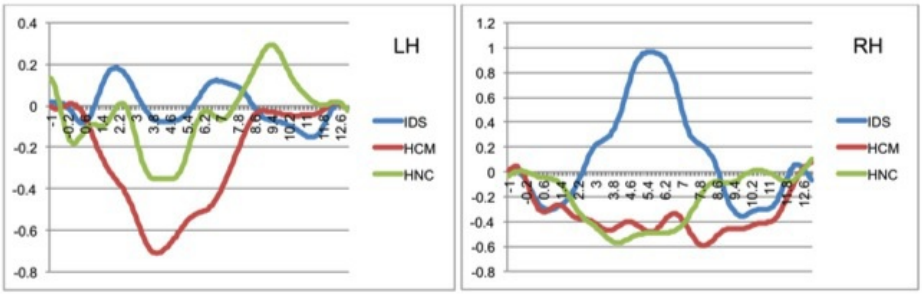


Figure 2. Comparison of post-stimulus Oxy-Hb concentrations by hemisphere and condition

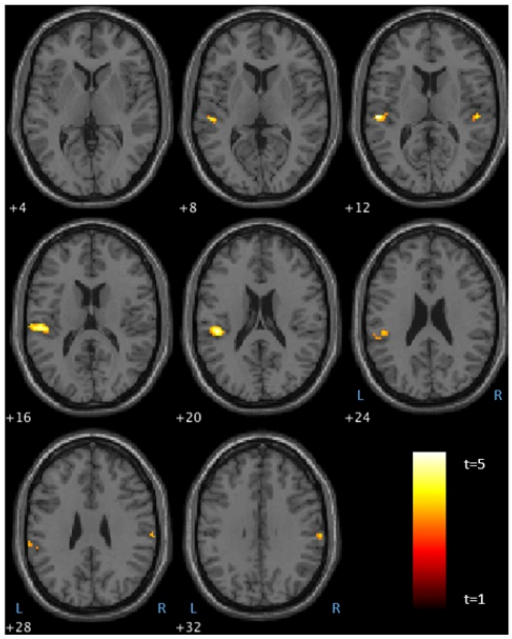


Note. IDS = Infant-directed speech, HCM = Human communicative non-speech vocalizations, HNC = Human non-communicative vocalizations

47 **107.047** Hemispheric Differences in Auditory Complexity Processing in ASD

L. A. Sand[1], *E. Redcay*[2], *T. Zeffiro*[3], *F. Samson*[4] *and D. J. Bolger*[1], *(1)Human Development & Quantitative Methodology, University of Maryland, College Park, MD, (2)Department of Psychology, University of Maryland, College Park, MD, (3)Neurometrika, Potomac, MD, (4)Department of Psychology, University of Western Ontario, London, ON, Canada*

Background: Autism Spectrum Disorder (ASD) can be accompanied by delays in speech acquisition and a puzzling combination of auditory abilities, with enhanced pitch processing abilities often coexisting with atypical spoken language processing, particularly involving prosody. Speech has complex auditory characteristics and there is evidence for hemispheric specialization of auditory processing, with temporal processing more lateralized to the left hemisphere and spectral processing to the right. It is possible that some aspects of autistic individuals' atypical auditory behavior results from lateralized differences in complex sound processing in both primary and non-primary auditory cortex.
Objectives: N/A
Methods: We employed fMRI to explore the neural basis of complex sound processing in 12 ASD and 15 typical participants, ages 16-30. Participants performed a simple visual discrimination task while hearing 7 sec trials of parametrically varying complex auditory stimuli with a random spectrogram that had 5 levels each of spectral and temporal complexity. These stimuli are noise-like and do not resemble speech sounds. We used an accelerated multiband (MB) echo planar imaging (EPI) pulse protocol providing both high temporal and spatial resolution, thus enabling more accurate measurement of functional responses. Single subject fixed effect regression models were used to compute parameter estimates for each of the 25 spectral/temporal sound complexity combinations. Head motion covariates and motion outlier exclusion were used to minimize the effects of participant head motion. Group mixed effects models were used to identify group and groupXtask interaction effects.
Results: Both groups showed strong bilateral activity modulations with increasing spectral complexity in the planum temporale (PT; secondary auditory cortex), and transverse temporal gyri (TTG; primary auditory cortex). Increasing temporal complexity had a weaker modulatory effect and was only seen in the left PT. Averaging across all levels of spectral and temporal complexity, ASD participants exhibited higher activity in the PT and TTG, with the effect larger on the left than the right.
Conclusions: While we observed similar spatial patterns of hierarchical functional organization for auditory processing in both groups, the ASD participants exhibited higher task-related activity in left primary and non-primary auditory cortex when listening to complex sounds. This lateralized difference was largest in auditory cortex lateral to TTG. Greater auditory stimulus complexity effects in regions sensitive to acoustic temporal features could represent atypical left hemisphere processing of complex auditory stimuli in ASD, possible related to atypicalities in spoken language processing.



T-values for regions showing significantly greater BOLD signal in ASD > TYP contrast for average of all levels of spectral and temporal complexity displayed on a template brain. Relative to typical controls, ASD participants exhibited higher activity in planum temporale (PT) and transverse temporal gyri (TTG), with the effect larger on the left than the right. Axial slices are displayed.

48 **107.048** Increased Gamma Oscillatory Activity within the Salience Network: Relationship to Social and Attention Functioning in ASD

T. Andersen[1], *A. M. Flores*[1], *C. Swick*[1], *J. Brennan*[2], *I. Kovelman*[2], *S. Bowyer*[3] *and R. Lajiness-O'Neill*[1], *(1)Eastern Michigan University, Ypsilanti, MI, (2)University of Michigan, Ann Arbor, MI, (3)Henry Ford Hospital, Detroit, MI*

Background: Autism spectrum disorders (ASD) are characterized by deficits in social and attention functioning. Research to date has failed to clarify the pathogenesis, and there is an urgent need to identify biomarkers to aid earlier diagnosis given its escalating prevalence. Deficits in the salience network (SN) have been shown to distinguish between children with autism and neurotypical children; however, links to clinical symptoms have not been established. The insula is a key node of the SN, responsible for "selecting" stimuli for additional processing. Disruptions in connectivity are believed to lead to aberrant salience processing, which may contribute to core symptoms of ASD (i.e. lack of attention to social stimuli).
Objectives: This study investigated relationships between neural synchrony within the SN and social/attention functioning.
Methods: Twelve children with ASD (Age: M = 9.2; SD = 1.0) and 13 neurotypical (NT) controls (Age: M = 9.3; SD = 1.3) underwent magnetoencephalography at rest. Synchronization of activity was quantified by calculating coherence (0 to 1) between the insula and other cortical regions of the SN. Group differences were computed using t-tests for each region pair. Kendall Tau correlations were computed to examine relationships between coherence and social/attention functioning, as measured by NEPSY-II Auditory Attention (AA)/Response Set (RS) and Social Responsiveness Scale-2 (SRS-2), respectively.
Results: Within gamma, higher coherence was noted in NT between L Insula (LI) to: R Angular Gyrus (p = .02), R Middle Occipital Gyrus (p=.05), and R Superior Occipital Gyrus (p = .04). In ASD, significant positive relationships were noted between SRS-2 Cognitive subscale and coherence from LI to: L Cingulate (p=.003), L Inferior Frontal Gyrus (IFG) (p=.04), L Superior Frontal Gyrus (SFG) (p=.03), R Cingulate (p=.007), R Insula (RI) (p=.04), and R SFG (p=.03). Significant relationships between SRS-2 Restricted and Repetitive Behavior (RRB) subscale and coherence from RI to L Cingulate (p=.05) and LI to: L Cingulate (p=.003), L SFG (p=.03), R Cingulate (p=.02), RI (p=.05), and R SFG (p=.03), were noted. Within NT, significant negative relationships between NEPSY RS and coherence from LI to L IFG (p=.04) and LI to L MFG (p=.05) was noted. SRS-2 Communication and Motivation were positively related between coherence and LI to L Cingulate (both p=.04).
Conclusions: In NT, higher gamma band synchrony is noted in cross-hemispheric connections between LI and R parieto-occipital regions. In ASD, greater deficits in social cognition/RRB are related to higher gamma band synchrony, specifically within the left hemisphere and between insula and cingulate/frontal gyri. A similar relationship is reflected in heightened coherence between bilateral insula, cingulate and SFG. Better complex attention is related to lower gamma coherence between left insular and frontal regions in NT, while no relationship was found in ASD, suggesting alternate "selection" pathways. Overall, findings suggest enhanced frontal gamma oscillatory activity between the insula, a vital component of the SN, and other frontal regions may contribute to core symptoms of ASD.

49 **107.049** Increased Trial-By-Trial Neural Variability Associated with Increased Autistic Traits in Healthy Adults

M. H. Puglia*, J. J. Connelly and J. P. Morris, Department of Psychology, University of Virginia, Charlottesville, VA*

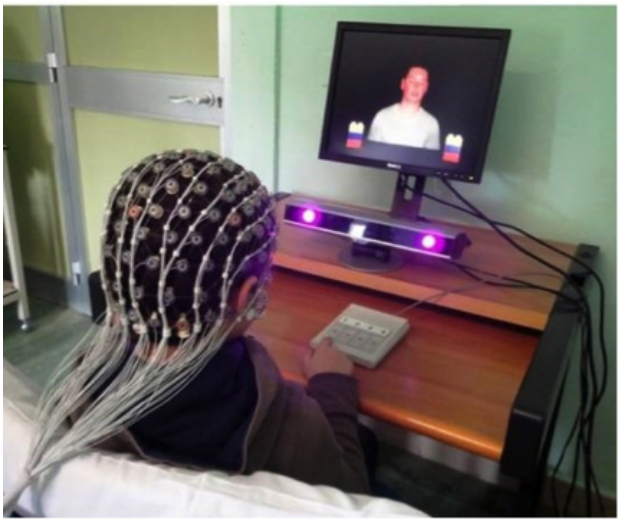
Background: The Noisy Brain Theory suggests that the unique constellation of symptoms present in autism spectrum disorder (ASD) might be the result of a single widespread abnormality in neural functioning. Specifically, the evoked response to stimuli across multiple sensory modalities is less reliable and shows greater variability among individuals with ASD when compared to neurotypical controls (Dinstein et al., 2012; Milne, 2011).
Objectives: As it is increasingly understood that autistic traits are expressed on a continuum in the general population, the current study expands upon these results to examine whether trial-by-trial variability in neural response is also associated with the occurrence of autistic traits in healthy adults. We utilize a biological motion perception paradigm to explore how response variability is associated with autistic traits under both social and nonsocial contexts.
Methods: Eighty-six healthy adults (49 males) aged 18 to 25 years passively viewed alternating 24-s blocks of point-light-walker displays of biological motion or random motion while undergoing fMRI. Autistic traits were assessed with the Autism Spectrum Quotient Questionnaire (AQ) (Baron-Cohen et al., 2001). An independent components analysis (ICA) was first performed to identify regions of interest (ROIs) with a model-free, data-driven approach. To assess the evoked response to each stimulus type (biological, random), the peristimulus timecourse from each ROI was extracted separately for each trail (5 per stimulus type), with onset aligned to the onset of the stimulus, and a duration of 44 seconds capturing the entire hemodynamic response to the stimulus including recovery. Neural variability was calculated as the standard deviation of each time point within each individual's timecourse for each ROI and stimulus type.
Results: AQ scores showed a normal distribution and ranged from 4 to 32 in the current sample. The first component of the ICA accounted for 46.57% of variance in data and consisted of 12 spatial clusters encompassing bilateral fusiform gyrus, posterior superior temporal sulcus, precuneous, rostromedial prefrontal cortex, superior frontal gyrus, left orbitofrontal cortex and rostrolateral prefrontal cortex, and right inferior frontal gyrus. Across both conditions and all ROIs, AQ score and neural variability showed a significant positive association (all p's < 0.0001). For the biological condition, variability of neural response across ROIs accounted for 5 to 28% of variance in autistic traits. Similarly, for the random condition, variability of neural response across ROIs accounted for 7 to 59% of variance in autistic traits.
Conclusions: Previous research has indicated that poor response reliability may be a fundamental neural characteristic of autism. The current study expands upon this hypothesis by demonstrating that healthy adults with a high occurrence of autistic traits show a similar "noisy" neural response across repeated trials of stimulus presentation as indicated by increased standard deviations within the timecourse. Within healthy populations, neural noise has been associated with developmental processes (Misiæ, et al., 2010), and may therefore prove to be a particularly useful metric for informing differential developmental trajectories among individuals with ASD.

50 **107.050** Integrated Study of Joint Attention in Autism Spectrum Disorders By High-Density EEG and Eye-Tracking

L. Billeci[1,2], *A. Narzisi*[2], *A. Tonacci*[3], *S. Calderoni*[4], *G. Pioggia*[5] *and F. Muratori*[2], *(1)Department of Clinical and Experimental Medicine, University of Pisa, Pisa, Italy, (2)IRCCS Stella Maris Institute, Pisa, Italy, (3)Clinical Physiology Institute - National Research Council, Pisa, PI, Italy, (4)Magnetic Resonance Laboratory, Division of Child Neurology and Psychiatry University of Pisa; Stella Maris Scientific Institute, Pisa, Italy, (5)National Research Council of Italy (CNR), Pisa, PI, Italy*

Background: Autism Spectrum Disorders (ASD) are characterized by a strong impairment in joint attention (JA) development. This deficit is associated with difficulties in social

learning and has consequences on the subsequent behavioral and neural development of children with ASD. For this reason the implementation of protocols for the study of brain-behavior correlation of JA are crucial in understanding and treating ASD. Electrophysiology (EEG) can provide cues about the behavioral correlates of JA with an excellent temporal resolution. To our knowledge no study in literature have explored yet the neurophysiological correlates of JA in ASD using EEG. Moreover eye-tracking can provide additional information about the direction of the gaze during the task.
Objectives: The aim of this study was to describe the neurophysiological and gaze correlates of JA in children with ASD during responding and initiating joint attention tasks. A further aim was to use this quantitative assessment to evaluate the eventual modifications in EEG and eye-tracking measures due to the treatment.
Methods: Data were acquired in 10 children with ASD at T0 and after six months of treatment (T1). Stimuli consisted in video sequences, with an actor between two identical toys placed on the floor in front. The experiment involved two conditions: the responding to joint attention (RJA) and the initiating joint attention (IJA). A control condition without objects was also added. EEG data were acquired using a high-density 128-channels system (HCGSN 128; Electrical Geodesics Inc) while children' gaze was recorded with SMI Eye Tracking device by SensoMotoric Instruments (Germany). A switch connected to the stimulus PC allowed sending the events simultaneously to the two systems. EEG data epochs, in which the child attended the screen, were pre-processed to remove artifacts and analyzed using quantitative methods (QEEG) to obtain power, asymmetry and coherence. For eye-tracking data analysis three regions of interests (ROIs) were selected: model's face, target object and non-target object. Gaze duration within each ROI and transitions between different ROIs were computed.
Results: In the IJA condition treatment induced an increased in frontal gamma activity and a decrease in alpha and delta activity in frontal, temporal and occipital areas. Coherence in gamma band increased in frontal and occipital areas while delta and alpha coherence decreased in occipital areas. In the RJA condition power decreased in frontal regions in theta and alpha bands, in right temporal area in alpha and in left occipital area in delta. Coherence increased in delta band between occipital and temporal areas and in parietal area in theta and alpha bands. Eye-tracking analysis revealed an increased attention at face and a decreased attention at objects at T1. In addition in the IJA task transitions from both target and non-target object to face increased compared with T0. Significant correlations were observed among QEEG measures and eye-tracking parameters.
Conclusions: The integrated protocol realized allowed to explore neurophysiological and gaze correlates of the different components of JA. The results of this study suggest that IJA and RJA subtend two different neural circuitries, which can be modified by treatment.



51 **107.051** Interactive Social Neuroscience to Assess Reward Processing in the Broad Autism Phenotype: An Event-Related Potential Study

M. Rolison[1], *A. Naples*[1], *J. Herrington*[2] *and J. McPartland*[1], *(1)Child Study Center, Yale School of Medicine, New Haven, CT, (2)The Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA*

Background: Autism Spectrum Disorder (ASD) is hallmarked by interpersonal difficulties, yet scant published neuroscience research investigates actual social interactions. Atypical reward processing is implicated in ASD, but ecologically valid studies dissociating social versus non-social reward in ASD are lacking. This study utilized interactive social neuroscience methods to examine reward processing in a social context and its association with autistic traits in typically developing (TD) adults. Using simultaneous recording of electroencephalogram (EEG) and electrocardiogram (ECG) in pairs of people competing in a computer game, we examined reward processing (indexed by event-related potentials [ERP]), heart rate variability, and their association with autistic symptomatology.
Objectives: Characterize neural and cardiac markers of reward and feedback processing and their association with autistic traits during face-to-face social interactions.
Methods: 16 TD adults, grouped in same-sex dyads, (a) sat quietly apart versus together while making eye contact, and (b) played a competitive treasure hunt game against a computer and against each other. EEG and ECG were recorded from each member of the dyad using wireless recording devices. ERP components marking early visual processing (P1, N2) and reward processing (FRN, P3) were contrasted based on competitor (computer/human), outcome (win/loss), and player (self/opponent). To quantify social function and dysfunction, the Autism Quotient (AQ) and Broad Autism Phenotype Questionnaire (BAPQ) were administered.
Results: Preliminary analyses of heart rate variability and resting data revealed differences associated with the presence of another person. Autistic traits were associated with attenuated FRN and P3 indices of reward processing. Sensitivity to feedback, indexed by the FRN, during live, not computer, competitors was correlated with autistic traits. There was a significant correlation between the differences in FRN amplitude between self-win and opponent-win when playing against another person and AQ (r=-0.505, p=0.046) and BAPQ (r=-0.558, p=0.025) scores. Additionally, BAPQ score was correlated with differences in FRN amplitude between self-win and opponent-miss when playing against another human (r=-0.544, p=0.030), as well as with the difference in FRN amplitude for opponent-win and self-miss (r=0.526, p=0.036). Sensitivity to reward during live interaction, indexed by the P3, was correlated with autistic traits. For the P3, BAPQ scores were correlated with the difference in amplitude between self-win and opponent-win conditions when playing against another person (r=-0.516, p=0.041), as well as between opponent-win and self-miss conditions when playing against another person (r=0.524, p=0.037). There were no significant effects of outcome, player, competitor, or interactions for low-level sensory components (P1 and N2; all ps>0.10).
Conclusions: This study applied interactive social neuroscience to investigate reward processing during live interaction in TD adults. This was the first study to examine electrophysiological indices of reward-feedback monitoring during live dyadic interaction. Results reveal task-specific modulation of brain activity during live interaction that is absent during computer interaction. Individuals with lower levels of autistic traits exhibited greater sensitivity to outcome during live interaction versus playing alone. Our findings provide new insight into differences in reward processing mechanisms associated with autistic traits and further emphasize the import of utilizing more ecologically valid approaches in neuroscientific studies of social brain function.

52 **107.052** Investigation of Face Processing in Autistic Spectrum Disorder (ASD) for the Development of Clinically Useful Biomarkers: An Electroencephalographic Approach

N. Mc Devitt[1], *L. Gallagher*[2] *and R. B. Reilly*[3], *(1)Trinity College Dublin, Dublin, Ireland, (2)Psychiatry, Trinity College Dublin, Dublin, Ireland, (3)Department of Engineering, Trinity College Dublin, Dublin, Ireland*

Background: Autistic Spectrum disorders (ASDs), are characterized by social deficits and restricted/repetitive behaviours. Underlying mechanisms are unclear, though they are thought to be caused by an interaction between genetic and environmental factors. Using imaging methods such as electroencephalography (EEG) to understand more about the neural mechanisms of ASDs may aid in the development of clinically useful biomarkers for earlier diagnosis as well as for drug treatment endpoints.
Objectives: To conduct behavioural and electrophysiological endophenotyping to probe core social deficits of ASD to facilitate improved knowledge regarding underlying neural mechanisms of ASD.
Methods: 5 participants with ASD and 10 typically developing (TD) participants have completed this research currently, data collection is ongoing. ASD participants have an unambiguous clinical diagnosis of ASD. EEG was recorded continuously using a high density 64 electrode array. Analysis was carried out offline. The paradigm consisted of schematic faces representing different emotions. There were three stimulus categories: Standard, Target and Deviant. The deviant varied between conditions A (Angry) and B (Happy). This paradigm was adapted from a study by Kreegipuu et al (2013). For this research particular focus was paid to the parietal region as this area is consistently associated with P300 generation.
Results: A within group analysis comparing the difference between stimuli in the ASD group was carried out. All mean amplitudes between the time period of interest (250-550ms) were found to be significantly different from each other ($p<0.001$), a between group analysis compared mean P3 amplitudes, between the two groups, each stimulus

response was compared. All three were found to be statistically significant from each other ($p<0.001$). A within group analysis of amplitude differences for each stimulus between the two conditions, exhibited that there was no significant differences found in mean P3 amplitudes in the ASD group ($p<0.05$). The control group conversely exhibited a significant difference in mean amplitudes in response to the deviant between conditions.
Conclusions: The aim here was to probe the core social deficits in ASD utilising EEG in TD individuals in comparison to individuals with ASDs. The significant differences in P3 amplitudes exhibited between the two groups suggest mechanistic differences in emotional processing between the two groups. Additionally, within group analysis of Condition A and B revealed a significant difference in amplitudes between the deviant stimuli in TD adults ($p<0.001$). There was no difference observed in the ASD group between the two conditions ($p>0.05$). Angry faces have been shown previously to elicit higher amplitudes than happy faces (Martens, Leuthold, & Schweinberger, 2010). There are several reasons this may have occurred, the ASD group have been more focused on details of the faces rather than the global representation, this more detail oriented observation has been exhibited in ASD previously. Secondly, ASD group may not be able to differentiate between the emotions on the schematic faces as easily as the TD group. Overall, significant differences in emotional face processing between the two groups were exhibited, further investigation into these differences could lead to the development of clinically useful biomarkers for earlier diagnosis.

53 **107.053** Mental Imitation and Mirroring in Children with Autism

*J. O. Maximo, **R. J. Donnelly**, H. M. Wadsworth and R. K. Kana, University of Alabama at Birmingham, Birmingham, AL*

Background: Although a deficit in imitation has been reported in autism spectrum disorders (ASD) (Williams et al., 2001; Rogers et al., 2003; 2008), recent studies have reported intact imitation skills in this disorder (Bird et al., 2007; Dinstein et al., 2010; Hamilton et al., 2007). Mental imitation, perhaps a precursor to motor imitation, involves visual perspective-taking and motor imagery (Jeannerod, 1994; Goldman, 2005). Research on mental imitation in autism has been rather limited compared to that on motor imitation. Considering the proposed role of impairments in the mirror mechanism and mentalizing ability in autism, we hypothesize that children with autism will have altered patterns of brain responses coupled with poorer task performance in mental imitation of actions.
Objectives: The main objective of this study is to determine the differences in brain responses underlying mirroring and mentalizing networks during mental imitation in children and adolescents with ASD
Methods: Thirteen high-functioning children and adolescents with ASD and 16 age-and- IQ-matched typically developing (TD) control participants took part in this fMRI study. In the MRI scanner, participants were shown cartoon pictures of people performing everyday actions (*Transitive actions*: e.g., ironing clothes but with the hand missing; and *Intransitive actions*: e.g., clapping hands with the palms missing) and were asked to identify which hand or palm orientation (of three answer choices) would best fit the gap (Mozaz et al., 2002). Neuroimaging data was analyzed using AFNI and SPM12 to examine brain activation and functional connectivity.
Results: The main findings of this study are as follows: 1) Processing both transitive and intransitive actions yielded activation in the bilateral inferior frontal gyrus (IFG) and inferior parietal lobule (IPL) in both ASD and TD groups; 2) Between-group analysis yielded hypoactivation in the ASD children, relative to TD, in the right angular gyrus and cerebellum for both conditions; 3) Hyperactivation in ASD, relative to the TD group, in the left middle occipital gyrus, left IFG, and IPL for both transitive and intransitive actions; and 4) whole-brain functional connectivity analysis revealed underconnectivity (ASD < TD) between the RIFG seed with left cerebellum, right insula, and the right fusiform gyrus and between the right IPL seed and right precentral gyrus (All analyses are reported at a statistical threshold of $p < 0.05$, cluster size $k = 100$; FWE corrected).
Conclusions: Increased activation in IFG and IPL in both groups suggests possible role of mirroring mechanism in mental imitation of actions. Hypoactivation in RIPL and its hypoconnectivity with motor areas in ASD suggest limited and/or altered engagement of the mirroring/motor network. This pattern of activation difference may have implications for understanding social movement and in social development through modeling in ASD. Hypoconnectivity of IFG with several regions also underscores the limited engagement of social brain areas in autism. Overall, our findings suggest that mirroring and mentalizing brain networks respond differently in children with ASD during tasks of mental imitation.

54 **107.054** Neural Adaptation during Learning in ERPs to Visual Target Detection in Children with ASD

S. E. Schipul[1]*, G. T. Baranek*[2]*, A. M. Campbell*[1] *and A. Belger*[1]*, (1)University of North Carolina, Chapel Hill, NC, (2)UNC Chapel Hill, Chapel Hill, NC*

Background: Previous fMRI studies have demonstrated reduced neural adaptation in adults with autism spectrum disorder (ASD) during short term learning tasks (Schipul et al., 2012; Schipul & Just, 2015). Reduced neural adaptation may impair learning abilities in ASD and possibly play a role in the emergence of behavioral characteristics of ASD. However, it is critical to examine the neural processing underlying learning throughout development in ASD. Therefore, in the present study we use electroencephalography (EEG) to examine neural adaptations during learning in children with ASD during performance of a visual target detection task.
Objectives: The current study examines changes in event-related potentials (ERPs) over time during a visual target detection task in children with ASD and typically developing (TD) children, in order to gain insight into neural adaptability in children with ASD.
Methods: Participants include children with ASD and TD children, ages 8 to 12 years old and with IQs in the normal range. EEG data was collected while participants performed a visual target detection task for 30 minutes. Data was collected from 128 electrode sites and was analyzed using EEGLab. EEG waveforms were compared for both non-targets (red circle, 85% of trials) and targets (blue square, 15% of trials) between Early and Late blocks of the experiment. Data collection is ongoing and currently includes 10 ASD and 12 TD participants.
Results: Preliminary results suggest that the ASD group (n=4) and TD group (n=4) show similar EEG waveforms to Non-Targets in Early blocks, but that the ASD group shows a similar pattern in Late blocks, while the TD group shows significant attenuation in Late blocks in both the P1 and N2 (Fig. 1). In response to Targets, the ASD group shows an attenuated P3 response relative to the TD group in Early blocks (Fig. 2). Group adaptations in the response to Targets is currently unclear. Behavioral accuracy and reaction time was similar across groups and well above chance.
Conclusions: These preliminary findings suggest reduced adaptation over time in ERP responses to visual non-target stimuli in children with ASD. This may reflect reduced neural adaptability in ASD that may affect the learning process throughout development. Furthermore, we found blunted ERPs to targets in ASD (despite intact behavioral performance). Future analyses will include the full final participant groups and will relate neural measures to clinical measures of ASD symptom severity and sensory features. Reduced neural adaptability in ASD may affect the learning of a variety of behaviors throughout development and may play a role in the emergence of ASD symptoms.

Fig 1.

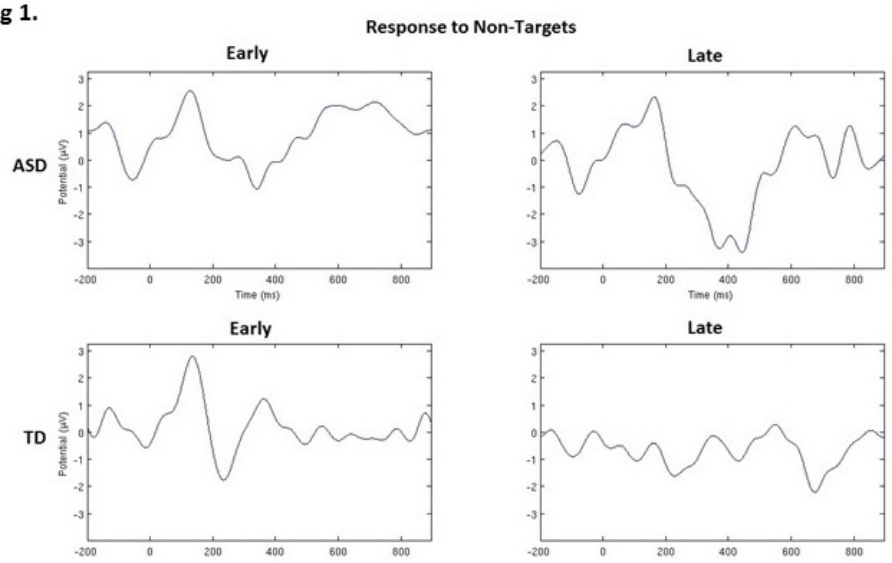
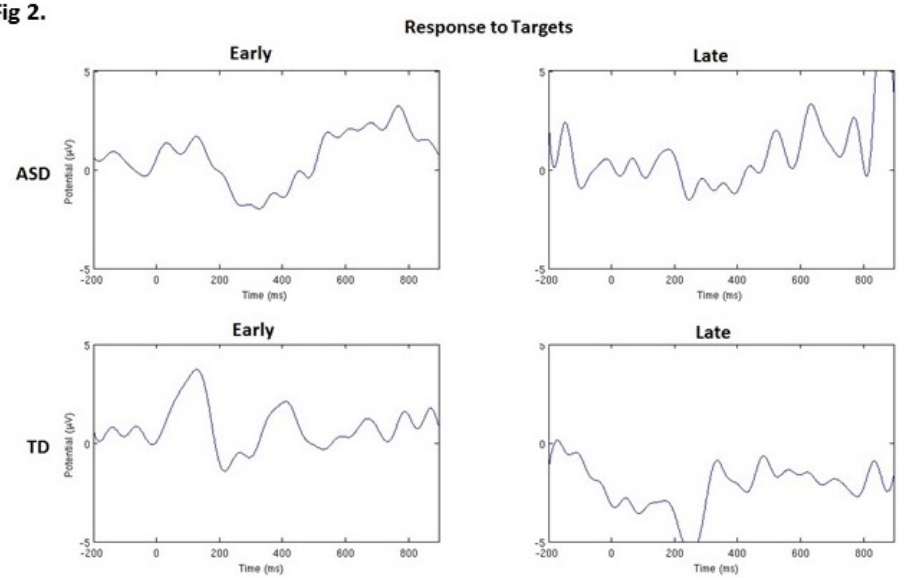


Fig 2.



55 **107.055** Neural Bases of Hierarchical Shape Processing in Autism Spectrum Disorder

T. DeRamus[1], *K. N. Rody*[2], *S. L. Kumar*[3] *and R. K. Kana*[3], *(1)Psychology, University of Alabama at Birmingham, Birmingham, AL, (2)Psychology, University of Alabama Birmingham, Birmingham, AL, (3)University of Alabama at Birmingham, Birmingham, AL*

Background: Enhanced visuospatial processing (Mottron et al., 2006) and Weak central coherence (WCC) (Frith & Happe, 2006) accounts argue that individuals with autism spectrum disorders (ASD) may focus on featural aspects of information more than the configural aspects. Nevertheless, there is increasing evidence that the "local bias" in ASD is not always present when other developmental factors (such as age and metrics of IQ) are taken into account (Pellicano et al., 2006). Furthermore, a number of experiments have found enhanced recruitment of frontal, parietal, and occipital brain regions in ASD, but studies reporting how these regions are interconnected during such visuospatial processing tasks in ASD is limited.
Objectives: To obtain a greater understanding of brain circuitry involved in visuospatial functions in individuals with ASD.
Methods: Fifteen children and adolescents with ASD and sixteen typically developing (TD) control participants (age 8-17 years) performed a hierarchical shape stimuli task (Navon, 1977) in the fMRI scanner. The task utilized a blocked design with trials that require the participant to name the larger shape composed of the smaller shapes (Global), and to name the smaller shapes that compose the large shape (Local). Data collected from a Siemens 3T Allegra scanner were analyzed using SPM12; functional connectivity analyses were performed using the CONN Toolbox, with 28 seed regions of interest (ROIs) selected from previous literature and from meta-analysis data. Connections were grouped and familywise error corrected using Network Based Statistics (NBS) in CONN. ANCOVAs were used to assess group differences in mean reaction time (RT) with age and full scale IQ (FSIQ) as covariates.
Results: While processing global shapes, ASD children displayed greater activity in the middle and superior temporal (MTG/STG), middle occipital, and lingual, superior and middle frontal gyri (SFG/MFG), and inferior parietal lobule (IPL), along with putamen and thalamus. A similar effect was found while identifying local shapes, with greater lingual, posterior cingulate, MTG, and SFG activation, along with putamen thalamus in ASD. ASD participants showed hyperconnectivity during local processing between the STG seed with the fusiform, inferior occipital, lingual, postcentral gyri and the thalamus. The thalamic seed revealed increased connections in ASD between the insula, inferior frontal, and postcentral gyrus. Faster RTs were found in the Local compared to the Global condition. Task accuracy did not differ by trial type or between ASD and TD individuals, but there was a significant main effect of FSIQ on task performance.
Conclusions: Our functional results are consistent with some previous findings of increased activation among visual-spatial regions of the brain in ASD (Gadgil et al., 2013; Kana et al., 2013). Increased connectivity between these regions and the thalamus in ASD may suggest an altered pattern of perceiving and integrating visual stimuli in ASD. The behavioral results from this study do not support the hypothesis of enhanced perceptual processing for local stimuli in ASD, and suggest that performance for such tasks may be more influenced by other factors such as IQ. Future experiments with additional measurements are needed to explore this hypothesis further.

56 **107.056** Neural Correlates of Sociocognitive Processing in Infants with Congenital Visual Impairment

N. J. Dale[1], *M. O'Reilly*[2], *E. Sakkalou*[2], *A. Salt*[2] *and M. De Haan*[3], *(1)Clinical Neurosciences, UCL Institute of Child Health/ Great Ormond Street Children's Hospital, London, United Kingdom, (2)Clinical Neurosciences, UCL Institute of Child Health, London, United Kingdom, (3)Developmental Cognitive Neuroscience, UCL Institute of Child Health, London, United Kingdom*

Background:
Young children with congenital profound or severe visual impairment (VI) have a high risk of developing difficulties in social communication and interaction. However the electrophysiological mechanisms underlying socio-cognitive processes in infants with VI remains unknown. The Subject's Own Name (SON) is a powerful and unique auditory social stimulus; behavioural, imaging and ERP studies in healthy infants have shown that the SON response can be detected as early as 4-5 months (Mandel, 1995, Grossmann *et al*., 2010; Blasi *et al*., 2011, Lloyd-Fox *et al*., 2012). The SON is considered a reliable measure of socio-cognitive processing (Carmody *et al*., 2006) and has the potential to demonstrate abnormalities in atypical populations.

Objectives:
We set out to examine ERP responses to the SON in infants with VI at 1 year of age compared to age-matched typically sighted controls. Based on previous SON ERP findings, we predicted that the SON would elicit greater amplitudes compared to the other name in typically sighted infants. We predicted atypical ERP responses in infants with VI compared to sighted controls based on the evidence that children with VI have socio-cognitive difficulties (Dale & Salt, 2008).
Methods:
23 infants with severe and profound VI (mean 12.7 ± 2.5 months) with 'simple' peripheral disorders of the congenital visual system and 14 age-matched typically sighted infants (mean age mean 12.5 ± 2.4 months) underwent ERP recording using a 128-channel EGI Sensor Net. SONs and 'other' names spoken by the mother's voice were presented in an equiprobable design at 70 dB intensity. Two ERP components were identified by selecting peak amplitudes (± 30 ms) of grand averages per group: *P300* (213-273 ms) component and *N500* (484-544 ms) component.
Results:
Repeated-measures ANOVAs revealed no effect of the SON on P300 responses in the infants with VI or in the typically sighted control group (all *p*'s >.05). A significantly larger N500 amplitude (greater response) for the SON compared to Other name at frontal and central sites was observed (Name x Location: $F(3,39.1) = 2.5$, $p<0.05$) in the typically sighted control group. However in the infants with VI, no significant name effect on the N500 component was found, with similar magnitude of response to both SON and other name observed ($p>.05$).
Conclusions:
This finding for the N500 component in typically sighted group was consistent with Parise *et al.* (2010), who also found significantly larger negative-going amplitudes (N200-600) at frontal and central sites in response to the SON in 5-month-old typically sighted infants. However, infants with VI showed an atypical response to the SON, showing a reduced SON effect and not localized in the same sites, compared to the typically sighted control group. Therefore, as early as 1 year of age, infants with congenital VI appear to be processing socially salient information differently to age-matched sighted infants and we can detect this at neural level. Further investigation will identify if the ERP SON response acts as an early biomarker for later socio-communicative difficulties in children with VI who are most at risk of emerging autism.

57 **107.057** Neural Mechanisms of Emotion Regulation with Circumscribed Interests in Adults with ASD

***L. Antezana**, M. Coffman and J. A. Richey, Virginia Tech, Blacksburg, VA*

Background: Restrictive and repetitive behaviors (RRB) are a core feature of autism spectrum disorder (ASD), and circumscribed interests (CI) are one of the core characteristics of RRB. Individuals with ASD also evidence increased affective responses (i.e. hyperarousal and positive valence) toward CI (Sasson, Dichter, & Bodfish, 2012). Intensity of CI are known to impact difficulties in executive function and social responsiveness (Anthony et al., 2013). The ability to modulate one's affective responses is known as emotion regulation (ER) and deficits in ER around CI may therefore be related to impairment with these day-to-day difficulties arising from CI. Although there are noted atypical neural mechanisms of ER with social information in ASD (Richey et al., 2015), mechanisms of ER have not been studied in the context of CI. We hypothesize that the lateral prefrontal cortex (PFC), a core area in modulating behavior, may underlie altered ER for CI in ASD.
Objectives: To examine activation of the PFC in the context of CI under varying states of ER in ASD and control groups.
Methods: A total of 27 adults (ASD=13; Control=14) participated in this study. Groups were matched on age (ASD M=26.1; Control M=27.4) and IQ (ASD M=113.3; Control M=116.3). ASD diagnosis was confirmed with the Autism Diagnostic Observation Schedule. Functional magnetic resonance imaging (fMRI) data were collected during a cognitive appraisal task on a 3T General Electric Signa Excite HD scanner. Each individual was asked to bring in ten photographs of their CI, which were used as stimuli for the task. After receiving standardized training in cognitive emotion regulation techniques, participants viewed each image for 4 seconds (free viewing period) and were then asked to "Think Positive," or "Think Negative" about CI images while undergoing fMRI. Whole group activation for the pre-instruction [<] post-instruction periods contrast showed activation of the medial PFC (mPFC). A region of interest (ROI) was identified using a 40-voxel sphere in the mPFC from which parameter estimates were extracted.
Results: Contrary to predictions, significant clusters of activation were observed in the medial, rather than lateral prefrontal cortex. ROI analyses of mPFC clusters revealed no group differences between ASD and control subjects during the baseline (pre-instruction) or think-negative conditions ($p>0.25$). However, for the think-positive condition, the control group showed significantly increased activation in the mPFC, compared to the ASD group, $t(17.78)=2.12$, $p<0.05$, $d=0.85$.
Conclusions: Individuals with ASD showed diminished function in mPFC during think-positive instructions for CI. These findings may indicate impairment in constraining positive affect toward CI, and thus provide evidence for targeting emotion regulation in the context of treatment.

58 **107.058** Neural Mechanisms of Uncertainty Processing in Children with Autism Spectrum Disorder

***C. R. Damiano**[1,2], E. Hanna[3], D. Cockrell[4], K. L. Dunlap[5], S. Miller[1], M. L. Kovac[1], L. Turner-Brown[6], J. Kinard[1] and G. S. Dichter[1], (1)Carolina Institute for Developmental Disabilities, University of North Carolina School of Medicine, Chapel Hill, NC, (2)Department of Psychiatry and Behavioral Sciences, Duke University School of Medicine, Durham, NC, (3)Department of Psychology and Neuroscience, Duke University, Durham, NC, (4)Virginia Tech Carilion School of Medicine and Research Institute, Roanoke, VA, (5)Vanderbilt Kennedy Center, Nashville, TN, (6)UNC TEACCH Autism Program, University of North Carolina at Chapel Hill, Carrboro, NC*

Background: Autism spectrum disorder (ASD) is often characterized by a preference for predictability and difficulty coping with unpredictable or unexpected circumstances referred to as insistence on sameness. This behavioral tendency may also have an impact on other core symptoms of ASD as a preference for sameness and aversion towards uncertainty may bias individuals with ASD to prefer predictable circumscribed interests versus inherently unpredictable social interactions. Yet, despite the prevalence of such symptoms and their potential role in core ASD symptomatology, uncertainty processing and its neurobiological mechanisms have yet to be studied empirically in children with ASD
Objectives: The present study had the following aims: (1) to better understand the neural circuitry involved in processing uncertainty using functional magnetic resonance imaging (fMRI) in both a social and non-social context and (2) to investigate how neural activation during uncertainty processing might be related to caregiver-reported aversion to uncertainty (i.e., intolerance of uncertainty) and insistence on sameness symptoms.
Methods: This study included 25 children with ASD and 21 typically developing (TD) children who were matched on age, IQ, and gender. An fMRI task previously used to measure neural responses to uncertainty (Grupe & Nitschke, 2011; Sarinopoulos et al., 2010) was adapted to include positively valenced social stimuli (i.e., faces with positive affect) and positive non-social stimuli (i.e., monetary compensation). All fMRI analyses were corrected for multiple comparisons to obtain a cluster-corrected threshold of $p< .05$ using a frontolimbic small volume correction. Structurally defined frontolimbic regions of interest were also correlated with caregiver-reported measures of intolerance of uncertainty and insistence on sameness.
Results: During the processing of uncertainty in a non-social context, the ASD group demonstrated attenuated activation of the bilateral putamen, nucleus accumbens, insula, and anterior cingulate cortex relative to the TD group. During uncertainty in social context, the ASD group demonstrated enhanced activation of the bilateral anterior cingulate cortex and frontal medial cortex. Frontolimbic activation during uncertainty processing was also found to be positively correlated with caregiver-reported levels of intolerance of uncertainty and insistence on sameness in children with ASD.
Conclusions: These results suggest that differential neural mechanisms are involved in the processing of uncertainty in children with ASD versus TD children and that these mechanisms may be influenced by a social versus nonsocial context. In addition, atypical processing of uncertainty may be related to elevated intolerance of uncertainty and insistence on sameness symptoms. An improved understanding of the mechanisms underlying atypical processing of uncertainty in ASD may ultimately provide insight into core ASD symptomatology, help differentiate these symptoms in ASD versus other clinical populations, and work towards developing interventions to address this symptom domain in ASD.

59 **107.059** Neurodevelopmental Indices of Theory of Mind and Their Relations to Everyday Social Functioning

***C. E. Mukerji**[1,2], S. H. Lincoln[1,2], A. V. Torricelli[3], N. Kleeman[1], S. Hasselmo[1], C. I. Hooker[4] and C. A. Nelson[1,2], (1)Harvard University, Cambridge, MA, (2)Boston Children's Hospital/Harvard Medical School, Boston, MA, (3)Rutgers University, New Brunswick, NJ, (4)Rush University Medical Center, Chicago, IL*

Background: Theory of mind, the capacity to reason about others' mental states, is a fundamental social cognitive ability affected in children with autism spectrum disorder (ASD). Prior research indicates that the functional specialization of neural mechanisms supporting ToM is related to social cognitive task performance in typically developing (TD) children. Preliminary evidence from a study of adolescents and adults with ASD suggests that activation in the right temporoparietal junction (rTPJ), a key node of the ToM network, may be related to symptom severity in ASD. Although influential theories of child development posit that ToM is central to social functioning, the relation between neural ToM mechanisms and the broad spectrum of daily social functioning observed across typical (TD) and atypical child development remains unclear.
Objectives: This study aimed to (a) isolate neural activation specifically elicited by ToM reasoning and (b) investigate, for the first time, the relations between these neural ToM mechanisms and individual variation in children's daily social functioning. We predicted that school-age TD children would demonstrate enhanced activation in the neural ToM network during mental state reasoning. Moreover, we predicted that activation at key nodes of this ToM network (e.g., rTPJ and precuneus) would be associated with individual variation in children's social functioning in daily life.
Methods: Participants were 31 TD children between 9 and 13 years old. Functional neuroimaging (BOLD) data were collected on a 3T Siemens Tim Trio scanner while participants completed a false belief task developed for school-age children. In the experimental (ToM) condition, children listened to vignettes describing social scenarios and then evaluated characters' beliefs. In the control condition, they listened to non-social scenarios and then made inferences about physical causality. In addition, parents completed a multidimensional interview measure assessing their children's daily social functioning (Vineland Adaptive Behavior Scales, 2ndedition).
Results: Whole-brain analyses indicated enhanced activation to ToM reasoning relative to the control task at key nodes of the ToM network: the right temporoparietal junction (rTPJ), precuneus, and right anterior superior temporal sulcus ($p<.05$, FWE-corrected). Controlling for the effects of general cognitive ability (IQ), activity in the precuneus

(r=0.51, p=0.035) and rTPJ (r=0.46, p=0.05) correlated with children's daily social play and leisure functioning.
Conclusions: Results revealed that, during mental state reasoning, school-age children engage key nodes of a distributed ToM network previously identified in adults. Moreover, our results elucidated key relations between social brain and behavior: activity in the precuneus and rTPJ was associated with daily social functioning in play and leisure activities, such that greater activation was linked to better functioning. These findings indicate that neural ToM mechanisms index variation in children's everyday social functioning, demonstrating value as a biological metric of functional heterogeneity in child development. Neural activation in the ToM network may also serve as a useful biomarker of social intervention change that may be detectable before meaningful behavioral differences emerge. Ongoing work investigates relations among neural activity in the ToM network, social cognitive ability, and daily social functioning in children with ASD.

60 **107.060** Neuromodulation Therapy Integrating Prefrontal rTMS and Neurofeedback for the Treatment of Autism

E. M. Sokhadze[1], *A. S. El-Baz*[2], *A. Tasman*[2], *Y. WANG*[3] *and M. F. Casanova*[4], *(1)Biomedical Sciences, University of South Carolina School of Medicine, Greenville, SC, (2)University of Louisville, Louisville, KY, (3)State Key Laboratory of Cognitive Neuroscience and Learning,BeiJing Normal University, Beijng, China, (4)Pediatrics and Biomedical Sciences, University of South Carolina School of Medicine, Greenville, SC*

Background: The study is based on an underlying neuropathological model of autism (Casanova et al. 2006) which emphasizes "minicolumnar" pathology and cortical lateral inhibition deficits resulting in behavioral abnormalities and executive dysfunctions. We propose that neuromodulation based on repetitive Transcranila Magnetic Stimulation (rTMS) over prefrontal area will enhance lateral inhibition through activation of inhibitory double bouquet interneurons and will be accompanied by positive EEG alteration that can be operantly conditioned using neurofeedback (NFB) training immediately after each rTMS session. In our studies using rTMS we demonstrated improvements in executive functions, as well as positive effects of prefrontal neurofeedback training in autism (Sokhadze et al., 2014; Wang et al., 2014). In the current study each rTMS session was followed by NFB, and this was predicted to result in synergetic response.
Objectives: The overall aim of the study was to investigate behavioral responses, ERP indices of information processing, and coherence of induced gamma oscillations in children with autism enrolled either in 18 weekly sessions of combined rTMS -NFB training group or in the wait-list group. The goal of our study was to investigate whether behavioral, EER and EEG indices, and behavioral evaluation outcomes will show positive changes in the treatment group (N=20) as compared to wait-list group (N=22).
Methods: We used 18 weekly sessions of 0.5 Hz rTMS bilaterally over dorsolateral prefrontal cortex followed by prefrontal neurofeedback in 20 children with autism (14.9 yrs). Another group of children with autism (N=22, 15.6 yrs) was tested twice within 4 months. Baseline and post-treatment assessments used selective attention tests with EEG/ERP recording and behavioral evaluations (Aberrant Behavior Checklist [ABC] and Repetitive Behavior Checklist [RBS-R]).
Results: Post-TMS-NFB evaluations showed decreased irritability and hyperactivity on ABC, and decreased stereotypic and total repetitive behaviors scores on RBS. The TMS-NFB group showed decrease of error rate (F=5.62, p=0.02). Magnitude of the frontal N100 decreased, while amplitude of the P200 to target stimuli increased post-TMS-NFB. Similar effects were expressed as well in the parietal P3b. The treatment group showed increase coherence of induced gamma to targets between frontal and temporal sites (e.g., F3-T7, F=6.67, p=0.014). NFB sessions resulted in linear regression of the theta-to-beta ratio and increase of gamma power over 18 sessions of integrated treatment.
Conclusions: Improved clinical behavioral evaluation outcomes along with functional EEG/ERP measures post-TMS-NFB are indicative of more efficient information processing post-treatment. The study represents a pilot translational clinical research exploration where rTMS and neurofeedback were combined, and treatment effects were compared with a wait-list group using clinical, behavioral and cognitive outcome measures. Preliminary results are very encouraging and warrant further more rigorous randomized controlled clinical trials.
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61 **107.061** Object Selectivity or Motivational Relevance: Fusiform Activation to Faces and Food

K. M. Adamson[1], *C. Hyde*[1,2] *and V. Troiani*[1], *(1)Geisinger Autism & Developmental Medicine Institute, Lewisburg, PA, (2)Bucknell University, Lewisburg, PA*

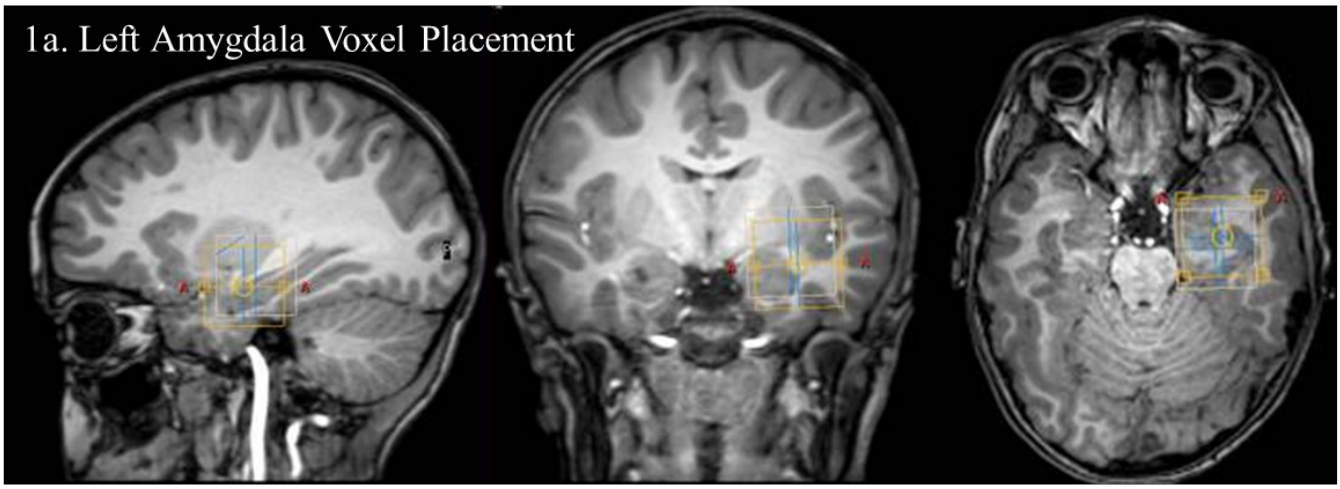
Background: While activation of the fusiform gyrus is most commonly linked to face processing, this region is also activated when viewing pictures of food and increases its responsivity following a period of fasting. Because objects must compete for our visual attention, an intriguing hypothesis is one in which parts of the ventral visual stream respond to salient objects, determined by individual preferences or item value. To our knowledge, no study has been conducted viewing activation to the ventral visual stream to both faces and food. Here, we examine whether altered motivation in one domain, such as food, will have an impact on another domain, such as faces.
Objectives: To characterize category-selectivity and brain-behavioral correlates in the ventral visual stream in response to various categories of objects in a cohort of 48 healthy college age adults using fMRI (24 female; mean age=22.33).
Methods: In an fMRI study acquiring BOLD images, we used a block design in which 4 categories of objects were presented, including faces, scenes, clocks, and highly palatable food. *Prior to the imaging session, participants also completed the Broader Autism Phenotype Questionnaire (BAP-Q). Body mass index (*BMI) was calculated based on self-reported measurements of height and weight and used as a measure of food motivation. We implemented a region of interest (ROI) analysis using parcellation maps generated by a watershed algorithm with an independent data set (Julian et al., 2012). We calculated face-selectivity in bilateral FFA by contrasting face and food blocks and correlated this with phenotyping metrics.
Results: We find a positive correlation between BMI and the BAP-Q Aloof subscore ($r(46)=0.494$, $p<0.001$), indicating that as body mass increases, social motivation decreases. We also show a significant impact of food motivation on face-selectivity in the right fusiform ($r(46)=-0.288$, $p<0.024$). That is, with increasing BMI, the right fusiform shows less of a differential response to faces relative to food. To further explore this effect, we ran analyses separately for each gender. When genders were split, we find the BMI:BAP-Q Aloof relationship was only present in females ($r(22)=0.648$, $p<0.001$) and the relationship between food motivation and face-selectivity in the right fusiform was only present in males ($r(22)=-0.550$; $p=0.003$).
Conclusions: These findings suggest that the fusiform may not be specific to only perceptual aspects of face processing, but may also respond to other items of motivational relevance. One possibility is that the fusiform is part of a relevance detection system that typically serves the role of face processing, but can be hijacked in cases of chronically altered motivation (i.e. towards food as chronic food motivation increases). Our findings also indicate some degree of differentiation between how atypical motivational and social relevance systems interact with gender, a finding that warrants future exploration in autism and other developmental disabilities.
References**:** Julian, J. B., Fedorenko, E., Webster, J., & Kanwisher, N. (2012). An algorithmic method for functionally defining regions of interest in the ventral visual pathway. *Neuroimage*, *60*(4), 2357-2364.

62 **107.062** GABA and Glutamate Concentrations in the Amygdala Modulate BOLD Response to Rapidly Presented Fearful-faces and Houses

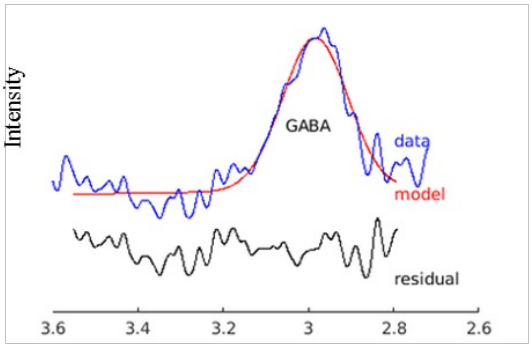
M. A. Reiter[1], *K. Kolodziej*[2], *T. L. Richards*[2], *N. M. Corrigan*[2], *K. Sambrook*[1], *T. St. John*[3], *M. Reilly*[1], *E. Shankland*[1], *R. A. Edden*[4], *S. Dager*[5] *and N. M. Kleinhans*[2], *(1)Radiology, University of Washington, Seattle, WA, (2)University of Washington, Seattle, WA, (3)University of Washington Autism Center, Seattle, WA, (4)Johns Hopkins University School of Medicine, Baltimore, MD, (5)University of Washington School of Medicine, Seattle, WA*

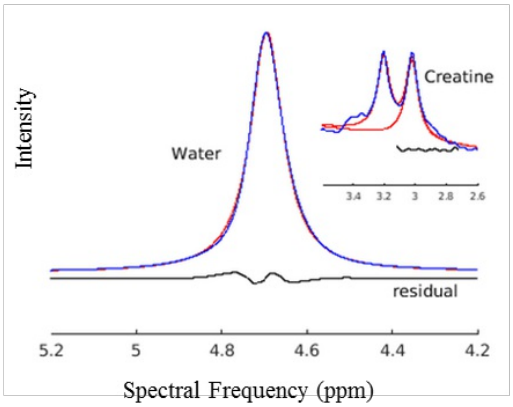
Background:
Abnormal face-processing is a pervasive deficit in individuals with ASD, which may be driven by amygdala dysfunction. Although the relationship between atypical functional and structural characteristics of the amygdala and abnormal face processing has been widely reported in ASD, the role of biochemical characteristics is largely unknown. Both glutamatergic and GABAergic mechanisms are thought to underlie experience-dependent plasticity of neural circuits, including those involved in emotional face processing. However little is known about the role of GABA and Glutamate (Glu) in modulating the BOLD response to fearful-faces and objects in humans.
Objectives:
Investigate the relationship between GABA and Glu concentrations in the amygdala and BOLD response to fearful-faces and houses in a sample of children with ASD and other sensory difficulties.
Methods:
T1-weighted 3DMPRAGE, fMRI, and magnetic resonance spectroscopic (MRS) data were acquired on a 3T Philips Achieva. Data were collected for 17 individuals and after quality control 14 were included in the analysis (mean age:10.4(1.64), IQ: 123.5(19.9)).
Data acquisition, fMRI: 54 volumes of high resolution data ($2.3mm^3$) were collected. Participants were shown blocks of rapidly-presented fearful-faces, houses and scrambled images. MRS: Single-voxel MRS data were acquired from the left amygdala-hippocampal region at two echo times (TE=30 and 80ms) using a MEGA-PRESS pulse sequence (TR 2000, 2048 complex time points, spectral width 2000 Hz, 32 averages, voxel size 30x30x30mm). A similar sequence, with a modification for GABA-editing, was acquired from the same voxel location (TR/TE 2000/68ms).
Data processing: fMRI data were processed using FSL. MRS: The LCModel software package (Provencher, 1993), with water-signal referencing, was used to derive concentration estimates for Creatine and Glu. The GABA-edited data were processed using the "Gannet" software toolkit.
Analysis: FMRI analyses were conducted using FLAME. Concentrations of GABA and Glu were entered as covariates in the GLM to test the correlation between chemical concentration and activation to fearful-faces and houses. Data were corrected for multiple comparisons using cluster-thresholding set at $z>2.3$ (voxel height) and $p<.05$ (cluster extent), whole brain corrected.

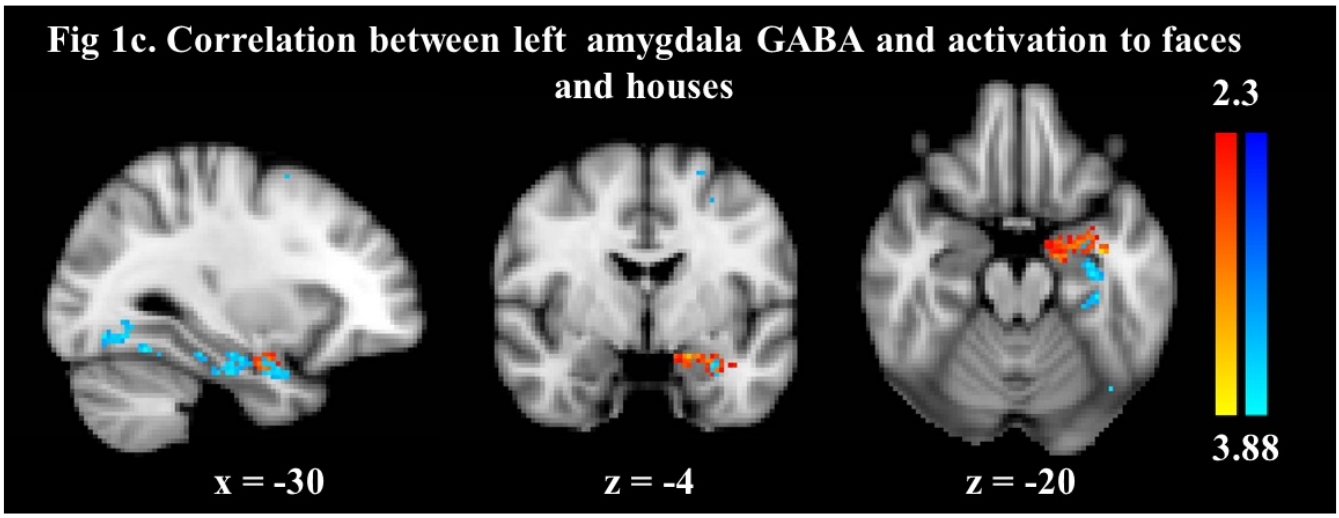
Results:
Fearful-faces: Higher concentrations of amygdala GABA were associated with decreased activation to fearful-faces in the amygdala. Amygdala Glu concentration was positively correlated to activation in the prefrontal cortex, superior parietal lobule, lateral occipital cortex, and cerebellar vermis and negatively correlated to activation in the striatum and subcallosal cortex.
Houses: Higher concentrations of amygdala GABA were associated with increased activation to houses in the prefrontal cortex, and with decreased activation in the hippocampus and fusiform gyrus. Higher concentrations of Glu were associated with increased activation to houses in the frontal-pole and frontal eye fields.
Conclusions:
Higher levels of Glu were associated with widespread increases in cortical activation to both fearful-faces and houses. Higher amygdala GABA levels were specifically associated with decreased activation to fearful-faces in emotional face-processing areas, and with decreased activation to houses in areas involved in object-processing and memory. This suggests that interactions between GABA and Glutamatergic mechanisms within the amygdala may underlie some of the emotional face-processing deficits experienced by individuals with ASD.

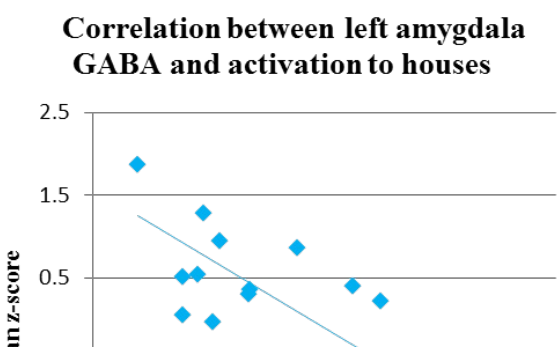


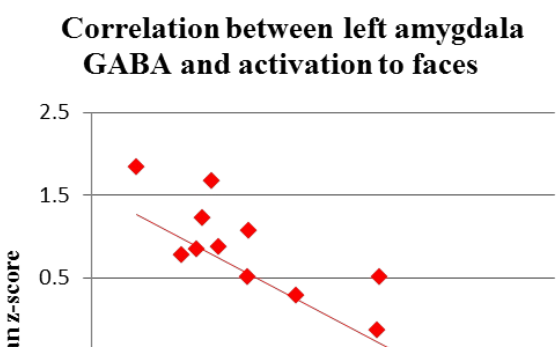
1b. Example of GABA, Water, and Cre Spectra for an 8 Year old Child











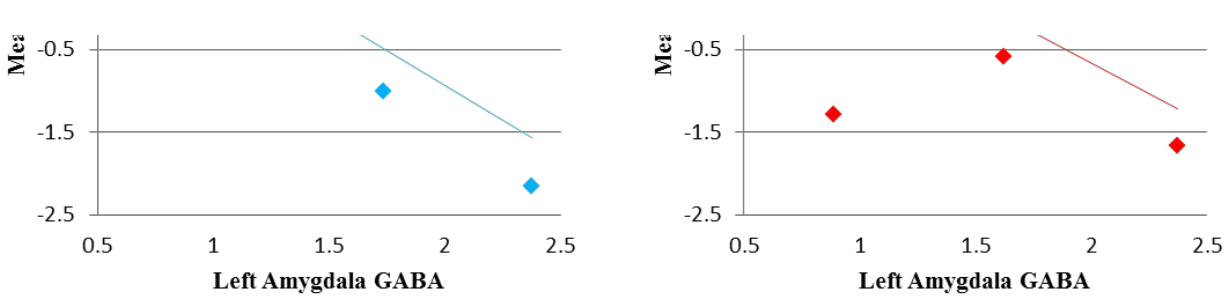


Figure 1.a. Example of left amygdala voxel placement acquired during data acquisition. The orange borders represent the area covered by the 30x30x30mm voxel. **1.b** shows the representative MEGA-PRESS spectra of GABA, Cre, and water in the left amygdala processed using the "Gannet" toolkit (Edden et al. 2013). The red curve in the panels shows the GannetFit curve-fitting results. The blue curve shows the postphase and frequency aligned GABA, Cre and water data. The black curve below the red and blue curves depicts the residual difference between the experimental data and the curve fit. **1.c** The correlation between left amygdala GABA and activation to faces and houses. Higher levels of GABA in the left amygdala were associated with decreased activation to faces in the left amygdala (red) and with decreased activation to houses in the left hippocampus (blue). Images are presented in radiological convention (R=L). Scatter plots in the lower panel are presented for illustrative purposes.

63 **107.063** Phase-Locked Frequency Contributions to Executive Functioning in Children with and without ASD

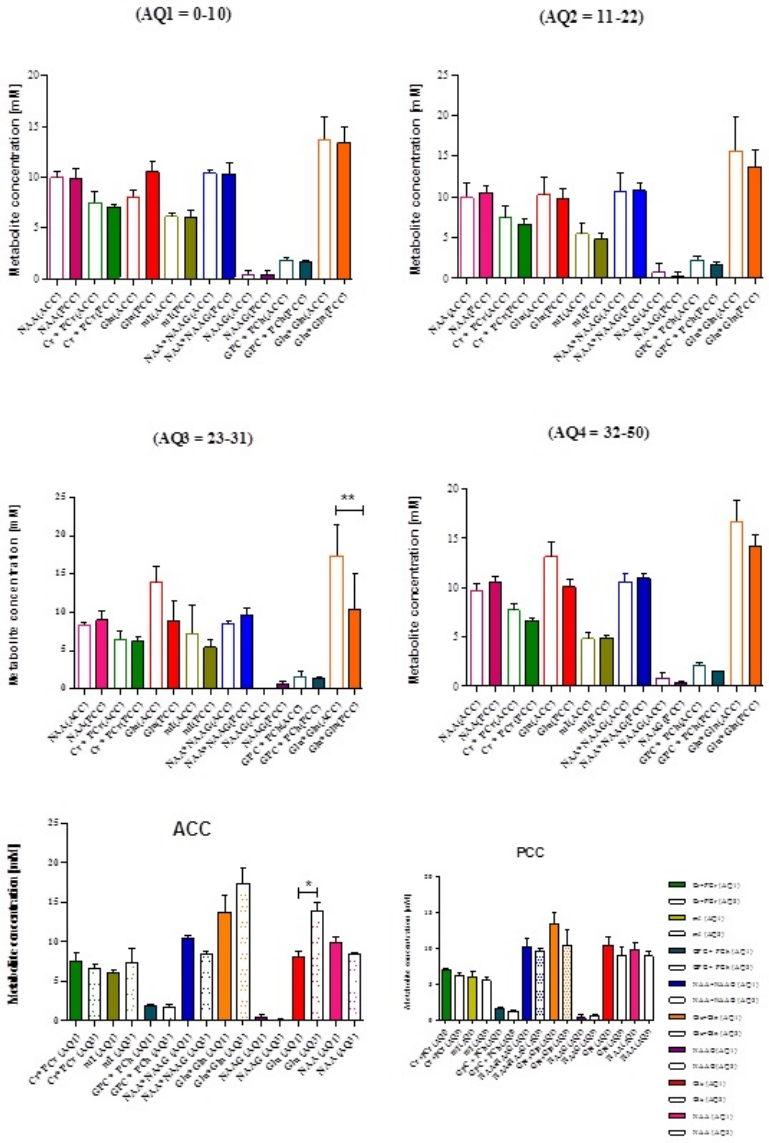
T. Clarkson[1], *A. R. Bhandarkar*[2] *and S. Faja*[3], *(1)Boston Children's Hospital: Harvard Med School, Boston, MA, (2)Laboratories of Cognitive Neuroscience, Boston Children's Hospital: Harvard Med School, Boston, MA, (3)Boston Children's Hospital/Harvard Medical School, Boston, MA*

Background:
Executive Functioning (EF) is the ability to manage complex or conflicting information in the service of a goal. Children with autism spectrum disorders (ASD) show deficits in EF but little is known about what neural networks contribute to this phenotype. One region implicated in conflict monitoring and working memory is the Anterior Cingulate Cortex (ACC), which is a known theta oscillatory generator (Tsujimoto, et al. 2006). Event-related time-frequency analysis can be used to help determine phase-locked frequency contributions to the neural signal, which help elucidate regional activation based on known oscillatory generators (Roach, & Mathalon, 2008). A developmentally appropriate flanker task was used for measuring phase-locked frequency responses in the N2 component in typically developing (TYP) children compared to children with ASD.
Objectives: To determine whether phase-locked frequency band activities during the N2 ERP component predict EF performance in children with and without ASD.
Methods: 19 children with ASD and 29 TYP children between the ages of 7-11 years participated. Additional children with ASD are being recruited. All had an IQ > 85 and there were no group differences on IQ, age or gender. The EF Battery included the Stroop task to measure inhibition of interfering information, the Change task to examine monitoring, the Backwards Digit Span to measure working memory, and the Flanker task as another measure of inhibition. Time-frequency analysis using the Fourier Transform on averaged ERP waveforms was used to examine phase-locked spectral data within the N2 component in the incongruent condition.
Results: In the TYP group, higher theta and beta power predicted of worse monitoring, ($F(2, 28) = 11.67$, $p < 0.001$) with an $R^2 = .46$. Additionally, higher theta and alpha power predicted worse inhibition ($F(2, 21) = 3.54$, $p < 0.049$) with an $R^2 = .27$ on the Stroop task, and higher theta and beta power predicted worse inhibition on the Flanker task ($F(2, 29) = 3.61$, $p=0.04$). Theta power alone predicted worse working memory ($F(1,29) = 4.09$, $p=0.05$). In the ASD group, theta and beta power trended towards predicting poor working memory performance ($F(2, 18) = 3.23$, $p = 0.06$), $R^2 = .29$.
Conclusions: Overall within the TYP group, increased theta power within the N2 predicted worse EF performance on our tasks that measured monitoring, inhibition, and working memory. This is consistent with previous literature that demonstrated increased ACC activation, which is a theta oscillatory generator, is associated with increased conflict monitoring activity on more difficult tasks. More involvement of the ACC indexed by theta suggests more effortful neural response, thus worse overall performance. Within the TYP group these findings suggest that phase-locked time-frequency analysis could be a powerful tool for examining specific neural activity and brain networks that are important for EF performance. Specifically, an increase in phase-locked theta power during the N2 is a good indicator of poor EF abilities. Within the ASD group, our initial examination did not show this pattern, only a trend in theta and beta power related to working memory. However data collection is ongoing for children with ASD to increase statistical power.

64 **107.064** Phenotypic Plasticity in the Cingulate Cortex in Autism Spectrum Disorders: Target on Etiology?

C. D. Jimenez de Espinoza[1], *F. Marcano*[2] *and J. L. González-Mora*[3], *(1)San Cristobal de La Laguna, Universidad de La Laguna, Lab. Neuroquímica y Neuroimagen., Santa Cruz de Tenerife, Spain, (2)Research units ULL, Magnetic Resonance Center IMETISA, La Laguna, Spain, (3)Neurochemistry and neuroimage laboratorie, University of La Laguna, La Laguna, Spain*

Background: Phenotypic plasticity is the ability of the human brain to change its morphological patterns, interactions in its sensory modalities and patterns of release of neurotransmitters. In previous studies, we observed changes in the levels of the neurotransmitters in the cingulate cortex in adult autism spectrum disorders (ASD) using ^{1}H-MRS techniques and this led us to further investigate these changes.
Objectives: The purpose of this study was the detection of a possible secretion pattern of specific neurotransmitters in the cingulate cortex in adults with Autism Spectrum Disorder.
Methods: In this case-control study, *in vivo* single-voxel proton magnetic resonance spectroscopy signals (^{1}H-MRS) were recorded in 12 right-handed young adults with ASD (median age, 22 years ± 2.2), and 19 typically developing (TD) controls (mean age, 22.80 ± 3.25) who were well matched for age, IQ and different AQ score groups: (AQ1=0-10; AQ2=11-22; AQ3=23-31) and AQ4=32-50. The diagnosis of autism was established by a neurologist, psychiatrist and psychologist in every case. The Autism Spectrum Quotient (AQ) designed by Baron-Cohen et al., 2001 to assess Autistic Spectrum traits in intellectually competent adults in both the general population and the Autism Spectrum community. Imaging was performed on a 3.0-T scanner using a single-voxel point-resolved spectroscopy technique. The volume of interest (VOI) was located in the anterior and posterior bilateral cingulate cortex. The absolute concentrations of creatine + phosphocreatine (Cr+Pcr), N-acetyl-aspartate (NAA), N-acetyl-aspartate+N-acetyl-aspartyl-glutamate (NAA+ NAAG), N-acetyl-aspartyl-glutamate (NAAG), glycerophosphocholine + phosphatidylcholine (GCP+PCh), myo-inositol (mI), glutamate (Glu) and glutamate+glutamine (Glu+Gln) were processed by the LC Model 6.2-3A.
Results: A significant increase glutamate + glutamine (Glu+Gln) was observed, $F=20.77$; $t= 4.73$, in the subject group with AQ3 = 23-31 between the bilateral anterior cingulate cortex (ACC) and the posterior bilateral cingulate cortex (PCC). While, this group (AQ3 = 23-31) showed a significant increase in the level of glutamate (Glu) in the anterior cingulate cortex (ACC), $F=23.43$; $t=4.06$, compared with the control group (AQ1=0-10). One-way ANOVA and Bonferroni's Multiple Comparison Test. $P < 0.05$ were applied to perform the statistical analysis.
Conclusions: The presence of an imbalance in the glutamate (Glu) system between the anterior and posterior cingulate cortex was apparent in the ASD group with AQ3 = 23-31. The elucidation of the etiology of this difference in this brain region studied in autism spectrum disorders is and will be a research goal for our team.



65 **107.065** Pivotal Response Treatment Increases Neural Processing Efficiency of Faces in Children with Autism Spectrum Disorder

Z. J. Williams[1], *M. Rolison*[2], *K. K. Stavropoulos*[2], *J. H. Foss-Feig*[2], *S. M. Malak*[1], *A. Naples*[2], *K. Pelphrey*[1], *P. E. Ventola*[1] *and J. McPartland*[2], *(1)Yale Child Study Center, Yale School of Medicine, New Haven, CT, (2)Child Study Center, Yale School of Medicine, New Haven, CT*

Background:
Pivotal Response Treatment (PRT) is an empirically validated, naturalistic behavioral intervention that uses the principles of Applied Behavior Analysis (ABA) to address core deficits in social communication in individuals with Autism Spectrum Disorder (ASD). Originally developed to promote language acquisition in nonverbal children with ASD (Koegel et al., 1987), PRT has been expanded to target other developmental areas. Recent work has demonstrated improvements in pragmatic language, social engagement, and adaptive functioning skills (Ventola et al., 2014), as well as normalization of neural activation (Ventola et al., 2015) following a 16-week course of PRT. Effects of PRT on the temporal dynamics of neural activation have yet to be studied. By utilizing the precise temporal resolution of electroencephalography (EEG), this study aims to assess changes in the efficiency of neural processing of social information following a 16-week course of PRT.
Objectives:
To identify changes in temporal dynamics of the neural processing of social information following a 16-week course of PRT.
Methods:
Seven children with ASD between the ages of 4 and 6 years received PRT (6 hours with the child and 2 hours with the parent per week) for 16 consecutive weeks. Participants completed an EEG session, recorded with a 128-channel Hydrocel Geodesic sensor net, before and after treatment and at 16-week follow-up. A subset of participants (n = 3) completed an additional EEG 16 weeks prior to the start of treatment as a waitlist control group. During EEG recording, participants were presented with 73 computer-generated faces that displayed either neutral or fearful expressions. Event-related potentials (ERPs) were measured over the right occipitotemporal region. The latency and amplitude of ERP components that reflect early visual processing and face processing (P100 and N170, respectively) were examined at each time point.
Results:
An overall main effect of treatment on N170 latency was observed [$F(1,6) = 11.34$, $p = .015$], signifying a change in the efficiency of face processing. Post-hoc paired samples t-tests revealed that a significant reduction in N170 latency occurred to both neutral ($p = .027$) and fearful ($p = .029$) face stimuli following treatment. There were no significant changes in N170 amplitude or in either P100 latency or amplitude ($ps > .05$). Additionally, no significant change in N170 latency was observed over the 16-week period prior to treatment in the waitlist control group [$F(1,2) = 2.45$, $p = .26$]. Preliminary analyses of follow-up data suggest stability in increased efficiency of N170 latency.
Conclusions:
These preliminary findings suggest that a 16-week course of PRT is associated with increased processing efficiency of socially salient stimuli. The improvements were seen only in brain responses associated with social perception (N170), as opposed to lower-level visual processes (P100), suggesting focal treatment effects on social processing. Waitlist control data indicate that this is unlikely to related to practice effects, and follow-up data suggest that these effects endure beyond treatment. Results suggest specific and persistent action of PRT on neural systems subserving social perception.

66 **107.066** Processing of Facial Expressions and Their Mental Imagery in ASD: An EEG Study with Feasibility Analysis for a Neurofeedback Approach

M. Simoes[1], *J. Andrade*[1], *R. Monteiro*[1], *S. Mouga*[1], *P. Carvalho*[1], *G. G. Oliveira*[2] *and M. Castelo-Branco*[1], *(1)University of Coimbra, Coimbra, Portugal, (2)Hospital Pediátrico de Coimbra, Coimbra, Portugal*

Background:
Facial expression (FE) processing deficits have been identified in ASD. Studies on this topic usually use static photographic stimuli of facial expressions. Here we explored induced brain dynamics of facial expression morphing. These stimuli may be potentially relevant in helping attributing mental states to others in ASD, by facilitating the capability of imagining another person performing an action such as a facial expression.

Objectives:
In this study we investigated brain responses to dynamic FE stimuli. Additionally, we searched the neural correlates of imagery of a third person performing FEs, and assessed the viability of a neurofeedback approach based on such correlates.
Methods:
EEG data on 58 scalp locations were so far collected from eleven male teenagers with high-functioning ASD (16.91 ± 2.51 years old) and seven neurotypical male teenagers (15.57 ± 3.31 years old), performing a task divided in two parts: visual stimulation and mental imagery. On the visual stimulation part, a virtual male teenager (always present on the screen) performed dynamic happy and sad facial expressions, starting and returning to the neutral expression (morphing duration: 250ms and FE duration: 1500ms). On the mental imagery task, the participant was asked to imagine the virtual person performing the FE (happy or sad), after a visual instruction and an auditory trigger. EEG data were preprocessed and cleaned from noise and artifacts. Event-related potentials (ERP) for each FE stimulus were computed, and their peak and respective latencies were extracted. For the imagery part, event related spectral perturbation (ERSP) was computed for each FE. Finally, a linear Support Vector Machine (SVM) was used to discriminate EEG segments as FE imagery or no imagery, using power variations from a neutral baseline as feature after the application of a Common Spatial Patterns algorithm on the train data. Cross-validation was used to assess the accuracy of the classifier in the cleaned and original data, as simulation for an online application.
Results:
ERP responses to sad expressions were more sustained than for happy stimuli. Peak responses for sad stimuli were found delayed for the ASD group in frontal and left central cortex ($p<0.05$). ERSP analysis showed power decreases in theta rhythms during the imagery process, mainly in fronto-temporal and parieto-occipital areas. ASD group theta power deactivations were statistically significantly smaller than controls ($p<0.05$), but yet significantly different than baseline in the occipital region. Regarding the classifier, an accuracy of 74(±2)% was achieved in single-trial level for both groups. Those results were statistically different from the chance level for every participant ($p<0.01$).
Conclusions:
Results from the ERP analysis suggest abnormal responses to sad facial expressions in the ASD group. Theta event-related desynchronization in frontal and parieto-occipital areas was present during the FE imagery task on both groups, although with significantly lower intensity in the ASD group. That group difference opens the possibility of using theta band as target for neurofeedback approach using FE imagery, as validated by the SVM classifier which identified imagery segments with an accuracy of 74% in single-trial level.

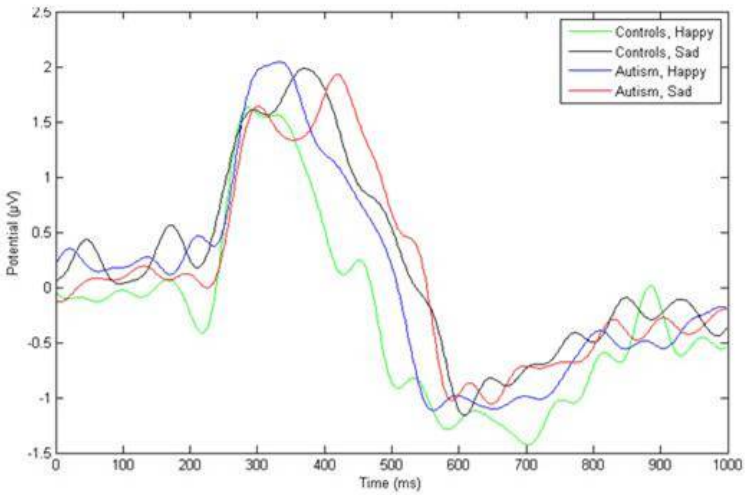


Figure 1 – ERP example for the frontal midline cluster, showing responses to Happy and Sad stimuli for both ASD and Control groups.

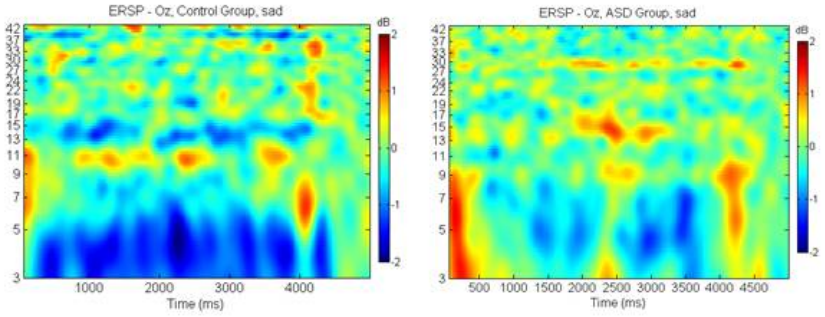


Figure 2 – Group ERSP of sad facial expression imagery in Controls and ASD, captured from the Oz channel, showing different theta power deactivations.

A. M. Viruly[1,2], *E. Daly*[1], *M. Gudbrandsen*[1], *M. C. Lai*[3], *C. M. Murphy*[1], *M. V. Lombardo*[3], *A. N. Ruigrok*[3], *R. H. Wichers*[1], *V. P. Giampietro*[1], *M. Craig*[1], *M. J. Brammer*[4], *S. Baron-Cohen*[3], *A. Popma*[2], *D. G. Murphy*[1] *and C. Ecker*[1], *(1)Sackler Institute for Translational Neurodevelopment, Department of Forensic and Neurodevelopmental Sciences,, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (2)Department of Child and Adolescent Psychiatry, VU University Medical Center, Amsterdam, Netherlands, (3)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (4)Department of Neuroimaging, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom*

Background: Although the cerebellum is widely recognised to be primarily involved in motor function, accumulating evidence indicates that it also plays a crucial role in mediating wider cognitive functioning. Differences in cerebellar neuroanatomy have been well documented in males with Autism Spectrum Disorder (ASD), but have not yet been examined in females. The neuroanatomy of ASD in females therefore remains insufficiently understood.
Objectives: (1) To examine differences in cerebellar neuroanatomy in females with ASD compared to female neurotypical controls, and (2) to establish the relationship between cerebellar neuroanatomy and the severity of autistic symptoms within the ASD group.
Methods: Structural Magnetic Resonance Imaging (sMRI) data were acquired in 49 females with an Autism Diagnostic Interview Revised (ADI-R)-confirmed diagnosis of ASD, and 47 neurotypical female controls who did not differ significantly in age (28±7 and 27±7 years, respectively) and full-scale IQ (118±11 and 115±7, respectively). These participants were recruited as part of the MRC UK Autism Imaging Multicentre Study (MRC AIMS), and scanned at the Institute of Psychiatry, Psychology and Neuroscience in London, and the Autism Research Centre, University of Cambridge, UK. To examine between-group differences in regional cerebellar neuroanatomy, we utilized the SUIT-toolbox (http://www.diedrichsenlab.org/imaging/suit.htm), which provides a high-resolution template of the human cerebellum and a parcellation for different functionally defined cerebellar subregions. Following cerebellar isolation and normalisation, data were analysed using a voxel-based approach to examine between-group differences at each cerebellar voxel. A cluster-threshold was used to assess cluster-level significance at a P-value that provided the expected number of false positive clusters by chance to be smaller than one (i.e. p=.003). We also examined Pearson correlation coefficients between the individual's cluster volumes and the different subdomains of the ADI-R, and the Autism Diagnostic Observation Schedule (ADOS).
Results: Individuals with ASD showed significant reductions in regional cerebellar volume in (1) the left lobules Crus II, IX, VIIB, VIIIb, (2) the right lobules IX and VIIIb, and (3) parts of the vermis (VIIb, VIIIa, VIIIb). These clusters functionally sub-serve the default-mode network and the frontoparietal network. Significant negative correlations were found between the cluster volume (1) in the left hemisphere and the ADI-R social (r=-0.313, p=0.44) and communication domain scores (r=-0.396, p=0.009); and (2) between the volume of the right-hemisphere cluster and the ADI-R social domain (r=-0.39, P=0.011), and ADOS social (r=-0,396, P=0.006) and communication scores (r=-0,3, P=0.041). Both clusters also correlated with the total ADI scores (i.e. lower regional volumes were associated with more severe autistic symptoms).
Conclusions: This is the first large-scale multicentre MRI study to investigate differences in cerebellar neuroanatomy between females with ASD and female controls, and to relate neuroanatomical findings to clinical outcomes. We found that females with ASD – like their male counterparts – have regional differences in cerebellar neuroanatomy, and that these are associated with clinical symptom severity. Future research is, however, warranted to compare males and females with ASD directly in order to determine whether these neuroanatomical differences are shared or distinct across sex.

68 **107.068** Regulation of Brain Excitatory/Inhibitory Balance through the Mu-Opioid System Depends on the Extent of Autistic Symptoms

J. L. Findon[1], *R. H. Wichers*[2], *J. Horder*[3], *E. Daly*[2], *R. A. Edden*[4], *D. G. Murphy*[2] *and G. M. McAlonan*[5], *(1)Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, England, United Kingdom, (2)Sackler Institute for Translational Neurodevelopment, Department of Forensic and Neurodevelopmental Sciences,, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (3)Institute of Psychiatry, King's College London, London, England, United Kingdom of Great Britain and Northern Ireland, (4)Johns Hopkins University School of Medicine, Baltimore, MD, (5)Department of Forensic and Neurodevelopmental Science, IoPPN, KCL, London, United Kingdom*

Background: There is accumulating evidence that ASD involves an imbalance between excitatory (E) glutamate and inhibitory (I) GABA transmission. E/I balance can be modulated through multiple signalling pathways, including the opioid system. For example, genetic abnormalities in the mu-opioid receptor gene are linked to ASD; and the social behaviour abnormalities of the mu-opioid receptor 'null' mouse can be rescued by a glutamate acting drug (mGluR4 positive allosteric modulator; Becker et al, 2014). However, whether E/I balance can be regulated through the mu-opioid system in adults with and without ASD has not been directly examined.
Objectives: To provide Proof of Concept evidence for a difference in E/I response to mu-opioid activation in adults with and without symptoms of ASD.
Methods: We used MEGAPRESS proton magnetic resonance spectroscopy ($[^1H]$-MRS) to measure levels of Glx (glutamate + glutamine) and GABA from the dorsomedial pre-frontal cortex of 19 unmedicated adult men with (n=8) and without (n=11) ASD. Individuals were scanned twice, once after oral administration of 12.5mg of tianeptine (a mu-opioid receptor agonist; Gassaway et al, 2014) and once following matched placebo in a randomised double blind procedure. Scans were at least 8 days apart to ensure full washout of the drug. An 'Inhibitory Index' was defined as GABA/(GABA + GLx), and the percentage (tianeptine-induced) change in Inhibitory Index from baseline (placebo) was calculated. ASD symptoms were rated in the entire cohort using the Autism Quotient (AQ). We conducted a preliminary analysis of group differences in the change in Inhibitory Index; and tested the prediction that the change in Inhibitory Index would be correlated with the extent of autistic symptoms rated using the Autism Quotient (AQ) across the entire cohort.
Results: There was a trend-level group difference in the tianeptine induced change in the inhibitory index ($p = 0.08$). This masked a highly significant negative correlation between AQ score and the change in inhibitory index ($r = -.617$, $p < 0.01$). Scrutiny of this relationship revealed that there was essentially 'no change' in inhibitory index in individuals with AQ = 24, a recognised population 'cut-off' score for ASD. However, tianeptine decreased the inhibitory index in individuals with AQ > 24; and those with the highest AQ scores had the greatest decrease. In contrast, tianeptine increased the inhibitory index in individuals with AQ < 24; and those with the lowest AQ had the greatest increase.
Conclusions: Thus, E/I balance can be shifted acutely in the adult brain through the mu-opioid system. However, the direction and extent of E/I change depends on the extent of autistic features measured using the AQ. This study is still in progress. A larger sample size will allow us to assess whether modification of E/I balance through the mu-opioid system could provide a means to identify more 'pharmacologically homogeneous' sub-groups of people with ASD. It may also support further work to confirm the mu-opioid system as a treatment target for ASD. In that event, repurposing well-tolerated drugs with a known safety profile, including tianeptine, should be explored.

69 **107.069** Repetitive TMS Effects on Autonomic Balance in Children with Autism

M. F. Casanova[1], *Y. WANG*[2], *E. L. Casanova*[3] *and E. M. Sokhadze*[4], *(1)Greenville Campus Greenville Health Systems, University of South Carolina School of Medicine, Greenville, SC, (2)State Key Laboratory of Cognitive Neuroscience and Learning,BeiJing Normal University, Beijng, China, (3)Biomedical Sciences, University of South Carolina, Greenville, SC, (4)Biomedical Sciences, University of South Carolina School of Medicine, Greenville, SC*

Background:
Autism is a pervasive developmental disorder marked by difficulty in social interaction, impairments or lack of communication, and restricted range of interests. In addition, many children with autism exhibit symptoms associated with autonomic dysfunctions, which are presented as abnormalities in regulation of blood pressure, temperature, heart rate, and other body functions by the autonomic nervous system (ANS). The main findings of autonomic abnormalities studies in Autism Spectrum Disorders (ASD) point at reduced baseline parasympathetic activity in association with evidence of increased baseline sympathetic tone resulting in an autonomic imbalance, which negatively affects physiological functions and manifests in alterations of various electrophysiological measures.
Objectives:
The aim of the study was to investigate electrophysiological measures reflecting ANS activity in two cohorts of children with ASD during 12 and 18 weekly sessions of low frequency repetitive Transcranial Magnetic Stimulation (rTMS) over the dorsolateral prefrontal cortex (DLPFC). The underlying hypotheses were: (1) low frequency (0.5 Hz) rTMS over the prefrontal cortex lowered ANS hyper-activation in children with autism through activation of frontal inhibitory tone controlling ANS, and (2) lower ANS arousal post-TMS will be manifested as a decrease of skin conductance level (SCL), heart rate (HR), and increased HR variability and in improvement of behavioral evaluation scores.
Methods:
We investigated autonomic activity in 30 children with ASD during 12 sessions of rTMS and 18 children with ASD during 18 sessions of rTMS over DLPFC. Physiological activity measures such as skin conductance level (SCL), heart rate (HR), HR variability (HRV) were recorded during rTMS sessions with a C-2 J&J Engineering Inc. physiological monitoring system. Behavioral evaluations were conducted using the Aberrant Behavior Checklist (ABC) and the Repetitive Behavior Scale (RBS-R).
Results:
Post-12 rTMS measurements showed a decrease of low frequency (LF) component of HRV with statistical significant changes in HR regression and standard deviation of HR, though without any significant changes in SCL. Post 18 session rTMS outcomes showed slower heart rate accompanied by increase of high frequency (HF) component of HRV (as indicated by R-R intervals of ECG), higher deviation of R-R, and lower LF/HF ratio.
Conclusions:
Our findings show reduced sympathetic activation after rTMS resulting in lower HR predominantly through withdrawal of sympathetic tone (LF of HRV) and increase of parasympathetic cardiac neural control activity post 12 rTMS sessions. Neuromodulation using prolonged 18 session rTMS course in children with ASD resulted in a more pronounced HR slowing, a higher power of HF of HRV and time domain measures of HRV. Behavioral evaluations based on ABC and RBS-R scores showed similar improvements in 12 and 18 sessions of rTMS. Low frequency rTMS activates inhibitory tone of the frontal cortex resulting in a lower excitation of the ANS probably through inhibitory fronto-limbic circuits.

70 **107.070** Salience Network Connectivity Is Related to Brain and Behavioral Markers of Sensory over-Responsivity in ASD

S. Green[1], *L. M. Hernandez*[2], *K. E. Lawrence*[3], *S. Y. Bookheimer*[3] *and M. Dapretto*[3], *(1)UCLA, Los Angeles, CA, (2)University of California Los Angeles, Los Angeles, CA, (3)University of California, Los Angeles, Los Angeles, CA*

Background: Children with autism spectrum disorders (ASD) often exhibit sensory over-responsivity (SOR), which may cause them to react negatively to sensory stimuli such as noisy environments or scratchy clothing (Liss et al., 2006), and SOR is associated with increased functional impairment (e.g., Liss et al., 2006; Pfeiffer et al., 2005). Previous research from our lab suggests that SOR may be related to an overattribution of salience to extraneous sensory information, as individuals with ASD and SOR have hyperactivation and reduced habituation in the amygdala and sensory cortices in response to mildly aversive sensory stimuli (Green et al., 2015). The salience network, an intrinsic brain network which is thought to modulate attention to internal versus external stimuli, has been consistently found to be atypical in ASD (Uddin et al., 2013). Salience network abnormalities during resting-state are thought to underlie some of the difficulties intrinsic to ASD, such as atypical allocation of attention to extraneous sensory stimuli rather than relevant social stimuli (Uddin et al., 2013). However, to-date there is little research on how differences in salience network organization in ASD relates to differences in brain function during information processing. Thus, in the present study we sought to examine how intrinsic connectivity in the salience network relates to SOR by integrating resting-state fMRI, task-based fMRI, and behavioral data.
Objectives: To examine how connectivity with the salience network (with anterior insula as the hub) during resting state relates to symptoms of SOR and to brain response to mildly aversive sensory stimuli.
Methods: Participants were 28 children and adolescents with ASD and 33 TD matched controls, between 8-17 years of age. Children underwent a 6-minute resting-state scan as well as a separate fMRI paradigm, where they were presented with simultaneous mildly aversive auditory stimuli (noisy traffic sounds) and tactile stimuli (scratchy sweater rubbed from wrist to elbow). Parents completed the tactile, auditory, and visual scales of the Short Sensory Profile (REF) and SenSOR Invenstory (REF) and scores were standardized and combined into an SOR composite. Whole-brain connectivity with a 5-mm spherical seed in the right anterior insula (AI) was examined, with SOR composite scores as a regressor to determine resting state connectivity as a function of SOR severity. Correlations between resting-state salience network connectivity and brain response to mildly aversive tactile and auditory stimuli were examined.
Results: SOR in youth with ASD was related to increased resting-state functional connectivity between salience network nodes and brain regions implicated in primary sensory processing and attention (somatosensory cortex and amygdala). Further, the strength of this connectivity at rest was related to the extent of brain activity in these same areas in response to auditory and tactile stimuli.
Conclusions: Results support an association between intrinsic brain connectivity and specific atypical brain responses during information processing. Additionally, findings suggest that basic sensory information is overly salient to individuals with SOR, leading to over-attribution of attention to this information. Clinical implications include incorporating sensory coping strategies into social interventions for individuals with SOR.

71 **107.071** Specificity of Atypical Neural Response to Language in Infants at Risk for ASD

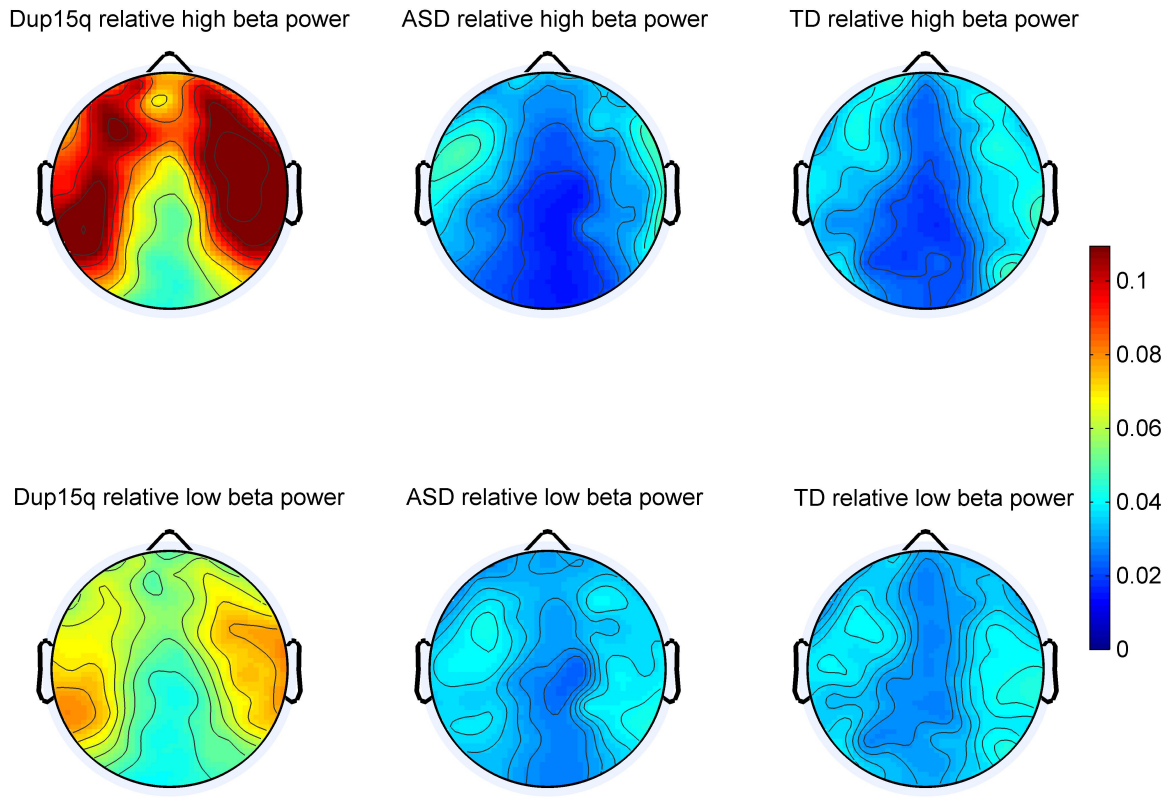
C. Chuang[1], *M. Rolison*[1], *J. F. Yang*[1], *E. D. Brooks*[1], *P. Hashim*[2], *R. Travieso*[3], *J. Terner*[4], *K. K. Stavropoulos*[1], *D. M. Steinbacher*[3], *N. Landi*[5], *L. C. Mayes*[1], *J. A. Persing*[3] *and J. McPartland*[1], *(1)Child Study Center, Yale School of Medicine, New Haven, CT, (2)Department of Dermatology, Mount Sinai School of Medicine, New Haven, CT, (3)Section of Plastic Surgery, Yale School of Medicine, New Haven, CT, (4)Division of Plastic Surgery, Montefiore Medical Center, Bronx, NY, (5)Department of Psychological Sciences, University of Connecticut College of Liberal Arts and Sciences, Storrs, CT*

Background: Language delay impairing communication is a primary feature of autism spectrum disorder (ASD). Children with ASD display social and communicative impairments, and present with varying levels of language functioning (Kjelgaard et al., 2001). One approach to studying language processing in infants at high risk for ASD is the use of auditory event-related potentials (ERPs). Previous work has demonstrated irregularities in the P150 component in infants at high risk for ASD as an indicator of abnormal speech processing (Guiraud et al., 2011). Outside of ASD, study of language development is of interest in craniosynostosis, a congenital condition of premature skull fusion in infants causing abnormal skull shape and distribution of brain volume. Craniosynostosis (CSO) has been associated with delayed speech and decreased abilities in both reading and spelling (Knight et al., 2014). This study seeks to compare language processing in infants across two disorders associated with language impairment—infants at high-risk for ASD with infants with CSO.
Objectives: Compare auditory ERPs during an auditory oddball paradigm in infants at high risk for ASD (HR), infants with craniosynostosis (CSO), and infants at normal risk for ASD (NR).
Methods: 49 infants (12 HR, 13 CSO, and 24 NR) completed an EEG recorded with a 128-channel Hydrocel Geodesic sensor net. Infants listened to a series of 100 speech sounds – the dental /da/ versus the retroflex /da/ phoneme, each presented 50 times. Data was segmented to 100ms pre-stimulus, and ERPs were extracted over 100-300ms post-stimulus for the P150 component and 400-550ms for the N450 component. Magnitudes of the P150 and N450 component amplitudes were compared between the study groups. Statistical analyses were performed using repeated measures analysis of variance (ANOVAs) with participant group as a between-subjects factor and brain hemisphere as a within-subjects factor.
Results: No significant differences ($p>0.05$) were observed in the P150 or N450 component amplitudes in response to the dental versus retroflex phonemes within each of the HR, CSO, and NR groups. At the N450, a significant hemisphere by group interaction was observed ($p<0.05$). NR infants displayed lateralized response to language ($p<0.01$), while HR and CSO infants did not evidence significant hemispheric lateralization ($p=0.32$ and $p=0.60$, respectively). At the P150 ERP, a marginal hemisphere by group interaction was observed ($p=0.06$). NR infants displayed lateralized response to language ($p=0.04$), while HR and CSO infants displayed no detectable hemispheric lateralization ($p=0.25$ and $p=0.57$, respectively).
Conclusions: This study compared infants at high risk for autism with infants with craniosynostosis, another congenital condition characterized by language impairments. We found that both HR and CSO infants lacked hemispheric lateralization of neural response to language at multiple auditory ERPs, in contrast with control infants who displayed expected patterns of lateralization. Shared patterns of abnormal auditory processing in these two clinical populations suggest that atypical language lateralization may reflect a general disruption in language development, not specific only to ASD.

72 **107.072** Spontaneous Beta Oscillations Are a Biomarker of Duplication 15q11.2-q13.1 Syndrome

J. Frohlich[1], *D. Senturk*[2], *P. Golshani*[3], *R. Sankar*[4] *and S. S. Jeste*[5], *(1)University of California, Los Angeles, Los Angeles, CA, (2)Biostatistics, University of California, Los Angeles, Los Angeles, CA, (3)Neurology, University of California, Los Angeles, Los Angeles, CA, (4)Pediatrics, Neurology, University of California, Los Angeles, Los Angeles, CA, (5)Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA*

Background: Duplications of 15q11.2-q13.1—referred to as Dup15q syndrome—account for roughly 1% of autism spectrum disorder (ASD) cases while also conferring strong risk for intellectual disability (ID) and epilepsy. Interstitial cases of Dup15q syndrome feature extra copies of duplicated genes on the q-arm of chromosome 15, generally resulting in partial trisomy. Isodicentric cases of the same disorder feature an extranumerary chromosome and generally result in partial tetrasomy as well as greater overall clinical impairment [Battaglia 2008]. All cases of Dup15q syndrome include duplications of gamma-aminobutyric acid($GABA)_A$ receptor subunit genes *GABRA5, GABRB3,* and *GABRG3*. Recently, case reports have identified spontaneous beta oscillations (SBOs) resembling benzodiazepine-induced activity in clinical electroencephalography (EEG) recordings from children with Dup15q syndrome [Ageeli et al 2014; Urraca et al 2013].
Objectives: Herein, we sought to quantify SBOs in resting-state EEG recordings from children and compare a cohort of children with Dup15q syndrome with (A) a comparison group of age-matched typically developing (TD) children and (B) another comparison group of age and intelligence quotient (IQ) matched children with nonsyndromic ASD.
Methods: We measured SBOs from resting-state EEG recordings of children with Dup15q syndrome ($n = 11$) using 129 channel high-density EEG nets and compared these recordings to those from TD children ($n = 9$) and children with nonsyndromic ASD ($n = 10$). Because beta is traditionally examined as two frequency bands, we quantified SBOs as both low beta and high beta power. Relative power in delta (1 – 4 Hz), theta (4 – 8 Hz), alpha (8 – 12 Hz), low beta (12 – 20 Hz), high beta (20 – 30 Hz), and gamma (30 – 48 Hz) frequency bands was computed for 9 scalp regions of interest (ROIs). Any child being treated with benzodiazepines—drugs which induce beta oscillations and enhance inhibitory currents through $GABA_A$ receptors—was excluded from analysis.
Results: High beta power was significantly higher in children with Dup15q syndrome compared with both the TD ($p < 1.0 \times 10^{-4}$, FDR corrected) and ASD ($p < 1.0 \times 10^{-4}$, FDR corrected) comparison groups. Similarly, resting low beta power was significantly higher in children with Dup15q syndrome than in either comparison group (TD, $p = 0.0108$, FDR corrected; ASD, $p = 6.5 \times 10^{-3}$, FDR corrected). Delta power was also significantly lower in children with Dup15q syndrome than in either comparison group (TD, $p = 8.1 \times 10^{-3}$, FDR corrected; ASD, $p= 0.0126$, FDR corrected).
Conclusions: SBOs represent a clear diagnostic biomarker of a genetically distinct subgroup of children with neurodevelopmental disorders. Given evidence that beta oscillations relate to GABAergic tone [Gaetz et al., 2011; Van Lier et al., 2004], these SBOs represent a potential biomarker of cortical inhibition in this population that may facilitate not only the diagnosis but also treatment monitoring in a subgroup of children within the autism spectrum. Our finding of lower delta power in children with Dup15q syndrome may relate to a shift in spectral energy from slow to fast frequencies (i.e., delta to beta) resulting from $GABA_A$ receptor gene upregulation in this disorder.



73 **107.073** State-Dependent Reductions in Brain Network Modularity and Behavioral Inflexibility in Childhood Autism Spectrum Disorder

C. J. Lynch[1], *A. Breeden*[2], *X. You*[3], *R. Ludlum*[1], *W. D. Gaillard*[3], *L. Kenworthy*[3] *and C. J. Vaidya*[1], *(1)Department of Psychology, Georgetown University, Washington, DC, (2)Interdisciplinary Program in Neuroscience, Georgetown University, Washington, DC, (3)Children's Research Institute, Childrens National Medical Center, Washington, DC*

Background: Behavioral inflexibility, the inability to shift to a different thought or action following a change in a situation, is a hallmark of autism spectrum disorders (ASD). Emerging evidence in healthy adults suggests that the dynamic nature of the brain's large-scale functional network architecture enables adaptive goal-oriented behaviors. With this principle in mind, we hypothesized that behavioral inflexibility in ASD is associated with an aberrant adaptation of brain networks during cognitive states requiring this ability. Graph theory metrics, such as modularity, may be particularly well-suited to capture these atypical patterns of whole-brain communication.
Objectives: Use a multi-state approach to test for state-dependent brain network modularity reductions in ASD children.
Methods: Seventeen children with ASD and age-, IQ-, gender-matched typically developing (TD) children performed three functional magnetic resonance imaging (fMRI) tasks. The first task consisted of passive fixation (i.e., resting-state). The second task required monitoring a central visual stream of shapes and responding to a target shape. The third task utilized visual stimuli that were identical to those used in the second but imposed behavioral flexibility demands through an alternative set of instructions. This manipulation allowed testing whether differences in brain network modularity between ASD and TD children are specific to a cognitive state requiring behavioral flexibility (Task 3) versus a perceptually invariant cognitive state not requiring behavioral flexibility (Task 2) or a resting-state (Task 1). For each participant, a whole-brain functional connectivity (FC) matrix was generated for each state using the regions-of-interest created by Power et al. (2011) with the effects of participant motion, physiological noise, and task structure regressed. FC matrices were decomposed into distinct modules by implementing the Newman–Girvan quality function *Q*. This function was optimized using the Louvain algorithm, as implemented in the brain connectivity toolbox (https://sites.google.com/site/bctnet/), and iterated 1000 times. Independent sample t-tests were applied to test for differences in modularity (i.e., *Q*) between ASD and TD children for each state. In addition, average ASD and TD FC matrices were entered into network visualization software to compare how network topologies, represented as spring graphs, reconfigured between states.
Results: Brain network modularity was reduced in ASD children relative to TD children [$t(33) = 1.70$, $p<0.05$] in the cognitive state requiring behaviorally flexibility (Task 3), but not in the cognitive state requiring no behavioral flexibility (Task 2) or the resting-state (Task1). In line with this finding, spring graphs revealed a striking pattern of cross-module signaling specific to Task 3 in the ASD group.
Conclusions: Our results suggest that behavioral inflexibility in ASD may be associated with reductions in brain network modularity (i.e., less segregation of networks). However, this work has broader implications for ASD brain connectivity research, which often assumes the resting-state captures intrinsic brain network abnormalities. In contrast, our findings highlight the importance of understanding the influence of specific cognitive states on brain networks in ASD.

74 **107.074** Subtype Classification of Autism Spectrum Disorder Via Resting-State fMRI Reveals Distinct Brain Network Endophenotypes

J. A. Richey[1], *K. M. Gates*[2], *S. Lane*[2], *A. D. Valdespino*[3], *R. A. Müller*[4] *and A. Di Martino*[5], *(1)Virginia Tech, Blackbsurg, VA, (2)Psychology, University of North Carolina - Chapel Hill, Chapel Hill, NC, (3)Psychology, Virginia Tech, Blacksburg, VA, (4)San Diego State University, San Diego, CA, (5)NYU Child Study Center, New York, NY*

Background: Phenotypic heterogeneity has presented a significant obstacle to MRI/fMRI-based diagnostic classification because most optimization algorithms assume a single, mutually exclusive distinction between ASD and typically developing groups. However, extant literature very clearly indicates that autism is not a single clinical entity, but a manifestation of dozens or more likely hundreds of genetic and genomic disorders (Betancur, 2011). Lack of information about subgroups of ASD is a problem in both diagnostic and treatment domains, because effects of interest may only be observed in only a subset of cases, thereby reducing statistical power and obscuring mechanisms of change in currently available treatments.
Objectives: The primary objective of this project was to apply a novel group search algorithm (Group Iterative Multiple Model Estimation [GIMME]; Gates & Molenaar, 2013) to resting-state fMRI data to determine whether brain-based heterogeneity within ASD can actually be *useful information*, that facilitates the identification of subgroups whose brain network properties are similar. A second objective is to then identify whether ASD symptoms within subgroups also cluster together.
Methods: We evaluated resting-state fMRI from individuals with ASD (N=70) from the NYU site in the Autism Brain Imaging Data Exchange (ABIDE; DiMartino et al., 2014). Data were preprocessed in AFNI (motion corrected, censored/scrubbed[0.05 FD], lowpass filtered). We applied GIMME to timeseries data extracted from seven brain regions in the default mode network (DMN). GIMME identifies contemporaneous and temporally lagged paths that are (1) common to all members of the sample and (2) unique to subsets of cases.
Results: Three distinctive subgroups of ASD emerged from our analysis of the DMN. Consistent with previous work on brain connectivity of DMN related to social-cognitive deficits (Lynch et al., 2013; Uddin et al., 2013), group 1 demonstrated hyperconnectivity of posterior cingulate, precuneus and left angular gyrus, perhaps relating to deficits in theory of mind and difficulty in episodic memory and self-related processing. Group 2 demonstrated increased connectivity between midline regions (dorsomedial PFC, rostral anterior cingulate), which has been previously linked to repetitive behaviors (Weng et al., 2010). Finally, group 3 demonstrated similar patterns to groups 1 and 2, but also enhanced connectivity of rostral anterior cingulate and posterior cingulate/precuneus. Preliminary analysis of phenotyping data indicates that groups differ on Vineland

subscales (Deficits in Daily Living Skills domain: Grp 1; Deficits in Socialization domain: Grp 2).
Conclusions: Effective connectivity maps at the individual level can be aggregated into verifiably homogeneous subgroups/communities, which share similar brain network properties. Analyses relating phenotyping data available through ABIDE are ongoing, and indicate that brain-derived subgroups meaningfully map onto symptoms.
Funding: This work was supported by R03 MH102651 "*Data Mining for Autism Endophenotypes in a Large-Scale Resting State fMRI Repository.*" PI: Richey.

75 **107.075** Temporal and Spatial Neural Correlates of Theory of Mind in Children with ASD

V. Yuk[1,2]*, R. Leung*[1,2]*, E. Anagnostou*[3,4] *and M. J. Taylor*[1,2,4]*, (1)Diagnostic Imaging, The Hospital for Sick Children, Toronto, ON, Canada, (2)Psychology, University of Toronto, Toronto, ON, Canada, (3)Bloorview Research Institute, Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada, (4)Paediatrics, University of Toronto, Toronto, ON, Canada*

Background: Theory of mind (ToM), or the ability to recognize the different mental states of others, is characteristically impaired in children with autism spectrum disorder (ASD), which is thought to contribute to their social cognitive deficits. Functional MRI studies have investigated the neural mechanisms underlying ToM, implicating the precuneus, temporoparietal junction (TPJ), and the medial prefrontal cortex (mPFC) as core regions of the ToM network. Studies in adults with ASD have shown atypical activation in these areas. However, only a few studies have examined the timing of brain activity during ToM reasoning, and none have explored this aspect in ASD, nor how it differs in children, even though deviations in the latency and duration of brain activity during development can also be responsible for the social impairments observed in ASD.
Objectives: This study determined the temporal and spatial properties of brain regions active during a false-belief ToM task in children with and without ASD using magnetoencephalography (MEG).
Methods: Participants included 22 typically-developing (TD) children and 19 age- and sex-matched children with ASD between the ages of 8 and 12 years. We studied the timing of ToM-related neural processes using a false-belief task adapted from Dennis et al. (2012) for MEG, which has precise temporal and spatial resolution on the order of milliseconds and millimetres, respectively.
Results: While the two groups of children did not differ in performance on the false-belief task, whole-brain analyses revealed distinctive neural patterns. Whereas TD children activated familiar ToM regions, such as the right precuneus (150-225 ms and 325-400 ms) followed by the left TPJ (300-400 ms and 425-475 ms), children with ASD appeared to utilize verbal abilities to complete the same task, activating the left inferior frontal gyrus (IFG; 275-375 ms and 450-600 ms), while simultaneously relying on working memory, attention, and inhibition areas, such as the right dorsal TPJ overlapping with the right superior parietal lobule (275-375 ms and 450-600 ms) and the right IFG (300-600 ms).
Conclusions: Using MEG, we were able to detect a unique temporospatial recruitment of brain regions involved in understanding false belief in our participants with ASD, which suggests that children with ASD make use of alternative strategies to compensate for their deficits in ToM. As our group of children with ASD did not differ from controls on measures of working memory and inhibition, and given that the brain areas they activated are typically involved in these processes, these children may have employed these preserved executive functions to perform similarly to their peers on the ToM task. These results not only inform how ToM can be conserved in some children with high-functioning ASD, but they also demonstrate processes that could be harnessed in interventions to improve ToM and social cognition in children with ASD. Future work will expand our findings to the connectivity domain, as individuals with ASD have been shown to have atypical patterns of connectivity, and the interaction between executive functioning and ToM will be explored.

76 **107.076** The Impact of Child Characteristics on EEG Data Quality in Infants at Risk for and Children with ASD

E. Baker[1] *and S. S. Jeste*[2]*, (1)UCLA Center for Autism Research and Treatment, Los Angeles, CA, (2)Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA*

Background:
Electroencephalography (EEG) is a promising functional imaging method to identify biomarkers of outcome in children at risk for and with ASD. EEG data are susceptible to artifact and can be rendered unusable due to slight movements, such as head turning, blinking, or even smiling. During initial stages of data processing, artifacts commonly result in trial loss. Currently, no standardized measures exist to quantify participant behavior and its effects on data quality. Additionally, it is undetermined if variability in social communication impairment and cognitive function impacts data quality.
Objectives:
We asked whether cognitive ability and behavior of children with or at risk for ASD related to percentage of useable trials garnered from session. We developed a rating of child's behavior during session through a 5-point likert scale of perceived mood. Primary use of the scale was to quantify in-session perceived mood and overall compliance. We investigated two samples of children from the Autism Centers for Excellence (ACE) study. The two groups included: (1)"ACE Project 2:" 12-24 month-old infants at risk for ASD, defined by elevated scores on the Autism Diagnostic Observation Schedule-Toddler Version (ADOS-T) and (2) "ACE Project 3:" children aged 6-11 years-old with ASD who are minimally verbal. We focused on these cohorts due to marked cognitive impairment and varied symptom expression, resulting in challenges during EEG recording.
Methods:
Forty-seven children from ACE Project 2 (mean age=18.6 months) were presented with familiar and novel photos of faces while EEG was recorded. Sixteen children from ACE Project 3 (mean age=88.2 months) listened to an auditory statistical learning task while EEG was recorded. EEG recording was performed using a high-density system (128-channel, EGI Inc.). Developmental quotients (DQ) were acquired from the Mullen Scales of Early Learning and social communication impairment was calculated with the total score from the ADOS-T and ADOS-2. Behavior rating was performed during EEG tasks. Useable data were defined as the percentage of trials available after automated artifact detection; channels were rejected if amplitude difference was greater than 150 mV.
Results:
ACE Project 2 and ACE Project 3 participants did not differ in amount of useable data provided (t=1.36,p=.262). Within ACE Project 2, age (r=.128,p=.509), ADOS-T score (r=-.12,p=.536), and DQ (r=-.083,p=.668) did not relate to amount of usable data collected from participants. Similarly, within ACE Project 3, age (r=.200,p=.950), ADOS-2 score(r=.074,p=.747), and DQ (r=-.465,p=.128) did not significantly relate to useable data. Behavioral rating significantly correlated with amount of useable data in both groups [ACE Project 2 (r=-.404,p=.030) and ACE Project 3 (r=-.734,p=.01)].
Conclusions:
Clinical characteristics, including cognitive ability and social communication impairment, are not useful constructs to measure data quality in EEG. However, perceived mood and behavior of the child during session does predict useable data. As EEG and other experimental measures serve as functional biomarkers in ASD, measurement of a child's behavior and mood during testing sessions will be critical to improve signal quality. Practices to standardize behavior and improve mood during recording should be implemented. Future directions involve measuring impact of behavioral regulation techniques on data quality.

77 **107.077** The Influence of Biological Sex on Neurobiological Mechanisms Underlying Autism Spectrum Disorder

M. Kirkovski[1,2]*, P. Enticott*[1]*, N. Rogasch*[3]*, T. Saeki*[4]*, B. Fitzgibbon*[2]*, J. Maller*[2]*, M. Hughes*[5]*, S. Rossell*[5] *and P. Fitzgerald*[2]*, (1)Deakin University, Melbourne, VIC, Australia, (2)Monash Alfred Psychiatry Research Centre, Monash University, Melbourne, Australia, (3)Monash Biomedical Imaging, Monash University, Clayton, Australia, (4)Monash University, Melbourne, Australia, (5)Swinburne University, Hawthorn, Australia*

Background: Autism spectrum disorder (ASD) is highly heterogeneous condition, particularly when considering neurobiological function. There is, however, evidence to suggest that biological sex contributes to this neurobiological heterogeneity, and that females may be more profoundly affected.
Objectives: This study investigated the role of biological sex on neural mechanisms underlying ASD, including neural activity and connectivity, with a specific focus on brain regions and mechanisms underlying social cognition.
Methods: 66 males and female adults with high-functioning ASD and age, sex and IQ matched controls took part in this study. Participants completed various measures, including: neurocognitive/neurobehavioural assessment; structural (anatomical and diffusion weighted imaging [DWI]), functional (resting state [investigating the default mode network; DMN], and task related [investigating ToM]) magnetic resonance imaging (MRI); and combined transcranial magnetic stimulation (TMS) and electroencephalography (EEG; TMS-EEG) of right lateralised dorsolateral-prefrontal cortex (rDLPFC), primary motor cortex (rM1) and temporo-parietal junction (rTPj).
Results: : DWI data revealed no differences between groups in any major white matter (WM) tracts throughout the brain. At rest, we did not identify any differences in functional connectivity (FC) between the key DMN structures, between groups, nor any effect of sex. Reduced FC in the ASD group, however, was noted between the posterior cingulate cortex (PCC) and the right lateralised somatosensory and temporal cortices. While processing social interactions, there were no group differences in hemodynamic response in core "mentalising" regions (medial prefrontal cortex, rTPj), but the ASD group displayed a reduced response in the neighbouring right posterior superior temporal sulcus (pSTS). Gender analysis indicated that this was apparent for males with ASD, but not females with ASD. TMS-EEG data did not reveal any group differences in neurobiological response to TMS at any of the sites investigated, or any effect of sex.
Conclusions: These findings provide important information with regard to the heterogeneity of ASD, specifically around the notion of a mediating role of biological sex in ASD. The findings of this study indicate that the perceived sex differences in ASD are not consistently replicated across measures of neurobiological mechanisms. This highlights the importance of investigating sex differences in ASD across a variety of measures and mechanisms, and also across different domains implicated in the autism spectrum.

78 **107.078** Voice Processing in High-Functioning Autism Spectrum Disorder: Neuronal and Behavioral Mechanisms

S. Schelinski[1], *C. Roswandowitz*[1,2], *K. Borowiak*[1,3] *and K. von Kriegstein*[1,4], *(1)Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, (2)International Max Planck Research School on Neuroscience of Communication, Leipzig, Germany, (3)Berlin School of Mind and Brain, Humboldt University of Berlin, Berlin, Germany, (4)Humboldt University of Berlin, Berlin, Germany*

Background: The ability to recognize the identity of others is an evolutionary conserved process and a key requirement for successful communication. In autism spectrum disorder (ASD), a condition that is associated with difficulties in social interaction, there is good evidence that the ability to identify another person by face is deficient (Weigelt et al., 2012). Previous research suggests that voice identification processing is also impaired in ASD (Schelinski et al., 2014). However, the underlying neuronal and perceptual mechanisms of this voice processing deficit are unknown.
Objectives: Here, we systematically investigated the behavioral and neuronal mechanisms of voice processing in high-functioning ASD.
Methods: Sixteen adults with high-functioning ASD and sixteen typically developed controls (matched pairwise on age, gender, and IQ) participated in two fMRI experiments and a comprehensive behavioral test battery on voice recognition. In the first fMRI experiment (vocal sound experiment), participants passively listened to blocks of vocal (speech and non-speech) and non-vocal sounds (e.g. musical instruments, nature, animals) (Belin et al., 2000). In the second fMRI experiment (voice recognition experiment), participants performed voice identity recognition and speech recognition tasks on the same stimulus material (von Kriegstein & Giraud, 2004). The behavioral test battery included tests on (i) recognition of newly learned voices, unfamiliar voice discrimination and famous voice recognition, (ii) acoustic processing abilities that are associated with voice recognition (i.e. tests on vocal pitch and timbre discrimination), (iii) control tasks (i.e. tests on musical pitch and timbre perception, and face identity recognition). Results were considered as significant at $\alpha = .05$ (fMRI: $p < .05$ family wise error (FWE) corrected for region of interest).
Results: The behavioral results showed that the ASD group had particular difficulties with discriminating, learning, and recognizing unfamiliar voices, while recognizing famous voices was comparable to controls. Difficulties with unfamiliar voices correlated with similar difficulties in recognizing unfamiliar faces. Tests on acoustic processing abilities showed that the ASD group had a specific deficit in vocal pitch discrimination that was dissociable from otherwise intact acoustic processing (i.e. musical pitch, musical timbre, and vocal timbre perception). The vocal sound experiment showed that passive listening to vocal sounds in contrast to non-vocal sounds elicited similar activity in voice-sensitive cortices in the superior temporal sulcus and gyrus (STS/STG) in the ASD and the control group. The voice recognition experiment showed reduced BOLD responses to the voice identity recognition in contrast to the speech recognition task in the ASD compared to the control group in the right posterior STS/STG—a region that has been previously implicated in processing acoustic voice features.
Conclusions: Our results allow, for the first time, a characterization of the voice recognition deficit in ASD: Both the behavioral and neuronal findings indicate that in high-functioning ASD, the ability to recognize voices is impaired because of difficulties with processing acoustic aspects of voices, that is, difficulties with integrating the acoustic characteristics of the voice into a coherent percept. A deficit in voice processing might contribute considerably to the development of communication difficulties - a core hallmark of ASD.

79 **107.079** White and Grey Matter Abnormalities in Autism Spectrum Disorder Associate with Verbal Performance

S. V. Huemer[1], *F. Kruggel*[2], *V. Mann*[2] *and J. Gehricke*[3], *(1)University of CA - Irvine, Rancho Palos Verdes, CA, (2)University of California, Irvine, Irvine, CA, (3)University of California, Irvine, Santa Ana, CA*

Background: Recent diffusion tensor imaging (DTI) studies point to impairments in most or all major neural networks rather than isolated, discrete brain regions in ASD (McAlonan et al., 2005; Mueller, 2007; Shukla, Keehn, & Mueller, 2011). Several brain regions have been implicated consistently in ASD but results often differ on whether there are increased or decreased brain volumes and whether differences can be found at all in certain regions. The discrepancies may result from differences in imaging protocols, data analysis, subject ages, and samples sizes, but the overall inhomogeneity of ASD samples, which disregard neurological and diagnostic subtypes, may play a bigger role than generally assumed.
Objectives: ASD subjects may vary in the extent of verbal impairment, and the potential anatomical correlates of this are a concern of this paper along with the general profile of white and gray matter anomalies associates with ASD.
Methods: Twenty participants (ages 12 – 20 years 5 female, 15 male) with a previous diagnosis of an autism spectrum disorder and 10 typically developing (TD) participants (ages 12 – 18 years, 1 female, 9 male) were enrolled in our study. This whole-brain structural magnetic resonance imaging (MRI) investigation used voxel-based morphometry to analyze white and grey matter concentration (VBM-GM and VBM-WM) and tensor based morphometry (TBM) to analyze shape differences. Diffusion tensors were computed from the registered diffusion-weighted images using a nonlinear procedure and tensors were converted into fractional anistropy (FA), mean diffusivity (MD), and radial diffusivity (RD) values (method DTI-FA, DTI-MD, DTI-RD).
Results: For adolescents with ASD, VBM and TBM revealed regions of lower GMC alongside higher WMC in the left and right precentral gyrus, lower GMC with decreased WMC in the left anterior cingulate, as well as lower GMC in the left operculum, the left superior frontal gyrus, the right and left superior temporal gyrus, and WM shape differences in the left frontal lobe and the right and left claustrum. TBM also indicated significant expansion in areas that are in overprojection with the uncinate fasciculus. When subjects were defined by a measure of receptive verbal ability (PPVT-III), we found increased GMC in the parahippocampal gyrus, along with an increased WMC and increased FA in the adjacent WM of the temporal lobe. Increased WM density, increased FA, and decreased MD and RD were also found in the lower scoring subjects in frontal WM of both hemispheres, along the left and right arcuate fascicle and the uncinate fascicle.
Conclusions: Our findings of significant differences in white and grey matter concentration and shape largely support prior research. We found even more pronounced differences when we used verbal ability as an independent variable, which also revealed FA and RD differences widely described in previous DTI studies.

80 **107.080** Working Memory Load-Dependent Activation Differences Between ASD and TD Children: An fNIRS Study

F. A. Fishburn[1], *R. Ludlum*[2], *K. M. Dudley*[3], *A. B. Ratto*[4], *A. V. Medvedev*[5], *L. Kenworthy*[6] *and C. J. Vaidya*[2], *(1)Interdisciplinary Program in Neuroscience, Georgetown University, Washington, DC, (2)Department of Psychology, Georgetown University, Washington, DC, (3)Children's National Medical Center, Center for Autism Spectrum Disorders, Ellicott City, MD, (4)Children's National Medical Center, Silver Spring, MD, (5)Center for Functional and Molecular Imaging, Georgetown University Medical Center, Washington, DC, (6)Children's Research Institute, Children's National Medical Center, Rockville, MD*

Background: Autism Spectrum Disorder (ASD) is characterized by difficulties with social interaction, communication, and restricted and repetitive interests – however the disorder also manifests as disturbances in executive function. ASD subjects have been shown to have atypical brain activation on executive function tasks even where there are no differences in task performance. These studies have typically used fMRI, which is of limited use in children due to its sensitivity to head motion. In this study, we use fNIRS (functional Near-Infrared Spectroscopy), a method robust to head motion, to measure activation differences between ASD and typically-developing (TD) children during a working memory task. In addition, we examine whether brain activation correlates with executive function in daily-life using the Behavior Rating Inventory of Executive Function (BRIEF).
Objectives: Determine whether activation in response to increasing working memory load differs between ASD and TD children, and whether activation differences correlate with real-world measures of executive function in daily life.
Methods: Forty-one age- and IQ-matched subjects (19 ASD, 22 TD) of ages 7-15 and IQ >80 were given a 7-minute n-back task with loads of 0-, 1-, and 2-back. Each load condition contained 3 blocks of 9 consonant letter stimuli, with block sequence pseudorandomized. Optical data were recorded on a two-wavelength (690 and 830 nm) continuous-wave CW6 imaging system (TechEn, Inc., Milford, Massachusetts). The 60 optical channels covered the anterior and lateral frontal, temporal, parietal, and occipital cortices. *Preprocessing:* Raw signals were corrected for motion by spline interpolation, band-pass filtered, and converted to changes in deoxygenated hemoglobin concentration. *Activation:* Subject reaction times for correct target trials were z-scored and an average was taken for each condition. These values were then used to create a load-dependent regressor for each subject. A GLM was performed at each channel using NIRS-SPM and the t-statistic for load-dependent activation was computed, regressing out the covariates age, gender, and IQ. Group difference was statistically evaluated by 2-sample t-test. P-values were corrected using the false discovery rate (FDR) procedure. The channel with peak group difference in activation was then correlated with the Behavioral Regulation (BRI) and Metacognition (MI) indices from the BRIEF.
Results: Group x load ANOVAs on task accuracy and reaction time both revealed a main effect of load ($F_{(2,74)} = 9.144$, $p < .0005$; $F_{(2,74)} = 7.616$, $p < .001$) but no significant main effect of group or group x load interaction. ASD subjects exhibited greater load-dependent activation than TD in left lateral prefrontal cortex ($t_{(39)} = 3.893$, $p < .05$; Figure 1). Activation in this region correlated with the BRI in ASD subjects ($r_{(15)} = .542$, $p < .05$) but not controls.
Conclusions: ASD subjects showed greater load-dependent activation than TD subjects in left lateral PFC while completing the task with equivalent performance. Activation in this area correlated with daily-life executive functioning for ASD subjects. These data suggest that executive functions require greater effort from ASD subjects than their TD counterparts and these differences may extend to everyday tasks and behaviors.

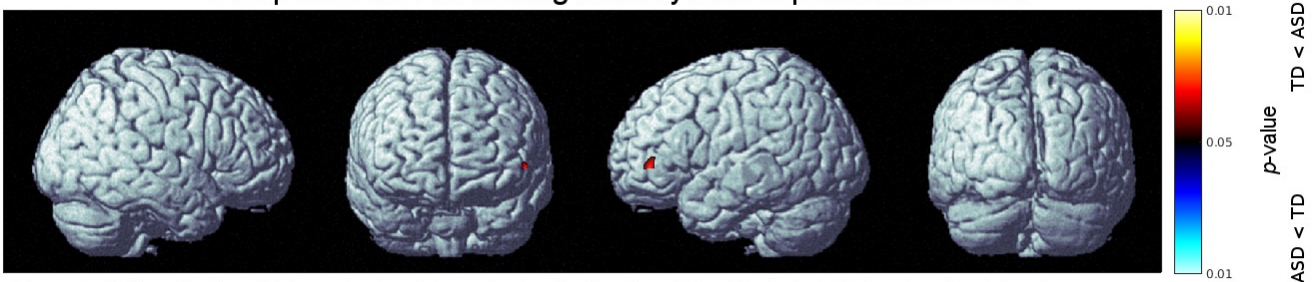


Figure 1. ASD subjects exhibit greater load-dependent activation than TD subjects in left lateral prefrontal cortex.

Poste[illegible]

108 - Interventions Non-Pharmacologic - Preschool

11:30 AM - 1:30 PM - Hall A

81 **108.081** Are Fathers Active Playmates with Their Children with ASD, and Why This Is Relevant for Therapy?

P. Venuti[1]*, A. Bentenuto*[2] *and C. Furlanello*[3]*, (1)University of Trento, Trento, Italy, (2)University of Trento, Trento, TN, Italy, (3)FBK - Fondazione Bruno Kessler, Trento, Italy*

Background:
Healthy parent-child interaction is essential for child development. In particular, parents play a central role in the acquisition of social and communicative skills, both in typical as well as in atypical children (Flippin & Crais, 2011). While mothers tend to rise play level (both for exploratory or symbolic play), fathers usually tune their play level closer to the child one (de Falco et al. 2009, 2010) . It is thus relevant, also for potential application, to assess quantitatively the relevance of fathers engagement with children with Autism Spectrum Disorders (ASD), who are characterized by social and communication deficits.
Objectives:
The aim of the study is to evaluate comparatively interactive behaviours and play of mothers and fathers with their children with ASD in a structured experimental setup. We search for patterns of interaction that are consistently tuned closely to child actual level and does can serve sustaining long interaction time.
Methods:
This study involved 60 parent-child dyads: 30 children with ASD (M chronological age= 45.7 months [range: 23-68]; SD=12.80; M mental age = 34 months, [range: 13-72],SD=15.43) in interaction with their mothers and their fathers, separately. To assess parent-child interaction, data were collected during two consecutive video recorded 10 min play sessions. A play code (Bornstein et al 1997, Venuti et al, 2008) was applied to the child's play and to the parent's play. Finally, the emotional profiles in parent-child dyads were evaluated using the Emotional Availability Scales (EAS4thEdition, Biringen 2008).
Results:
Regarding the construct of emotional availability, in this study no significant difference was found between mothers and fathers. Children with ASD mainly engaged in exploratory play, both with fathers and mothers. We found that mothers prefer symbolic play levels, while fathers use significantly more exploratory play. As a consequence, we measured longer average interaction time with fathers.
Conclusions:
As fathers are active playmates with their ASD children, they can achieve longer and richer interaction also when symbolic level is not attained and it is hard to engage the child. Taking into account this advantage, the involvement of the father should became a solid base ground in early autism intervention.

82 **108.082** Brief Parent Training in PRT during Jumpstart, a Community Implemented Parent Education and Empowerment Program: Parent and Child Outcomes

N. L. Matthews*, B. C. Orr, B. Harris and C. J. Smith, Southwest Autism Research & Resource Center, Phoenix, AZ*

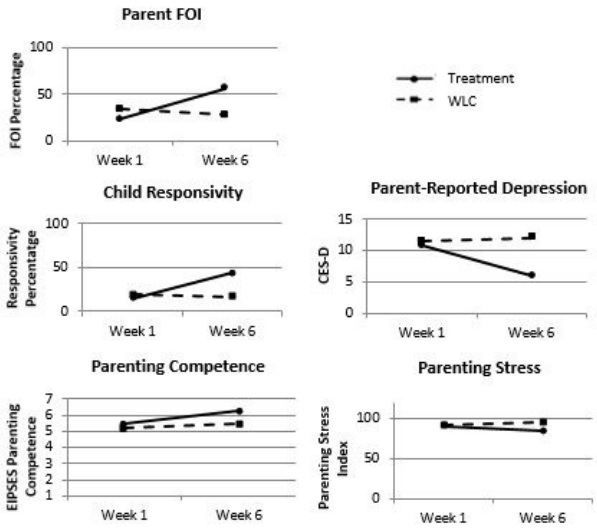
Background: Beginning behavioral intervention for autism as early as possible is important for facilitating optimal outcomes (e.g., Dawson et al., 2012). This effort is often hindered by long waitlists, lack of qualified interventionists, and cost. JumpStart is a short-term, group-format education and empowerment program for parents of recently diagnosed children. It is implemented by community practitioners at a non-profit autism center, includes brief parent training in pivotal response treatment (PRT), and equips families to navigate service systems.
Objectives: (1)To compare change in parent fidelity of implementation (FOI) of PRT, child responsivity, parent-reported well-being, and parent-reported self-efficacy between treatment and waitlist control (WLC) groups, and to determine the percentage of parents who achieved FOI within the full sample; (2) To discuss strengths and challenges of this program.
Methods: Participants were 36 parent-child dyads recruited from the JumpStart waitlist, matched on child age, and enrolled in the treatment (n = 18) or WLC (n= 18) group. Children had an ASD diagnosis (83%) or an 'at-risk for autism' classification. Diagnostic distributions were identical and Vineland composite scores did not differ between groups at study entry. See Table 1 for participant demographics.
JumpStart meets twice weekly over a 4-week period (weeks 2-5). It includes didactic lessons on autism, obtaining services, and brief training in PRT (i.e., 1.25 hours didactic, 5 hours guided observation, and 5 hours in-vivo coaching). At a study visit 4-6 weeks prior to the program (WLC group only), orientation (week 1), 1-week follow up (week 6), and 3-month follow-up (week 18), parents completed the Parent Stress Index (Abidin, 1995), the Early Intervention Self-Efficacy Scale (Guimond et al., 2008), the Center for Epidemiological Studies Depression Scale (Radloff, 1977), and a 10-minute videotaped probe with their child coded for child responsivity and parent FOI. Of note, 'week 6' probes were collected during week 5 due to program restraints and thus reflect only 3.75 hours of in-vivo coaching. Parents completed 1.25 additional hours of coaching after probes were collected.
Results: Depicted in Figure 1, the treatment group demonstrated greater increases in parent FOI (F(1, 33) = 40.43, p < .001) and child responsivity (F(1, 33) = 26.80, p < .001) and decreases in parent-reported depression (F(1, 33) = 4.19, p = .05) compared to WLC. Approaching statistical significance were increases in parenting competence (F(1, 32) = 3.95, p = .06) and decreases in parenting stress (F(1, 33) = 2.99, p = .10). Within the full sample, average FOI at week 6 was 57% (SD = 17.57) and 23% of parents achieved FOI (> 75%).
Conclusions: Parents who participate in JumpStart can begin intervention earlier while arranging a more comprehensive treatment program. Findings suggest that JumpStart yields meaningful outcomes, including gains in child responsivity, parent FOI, and parenting competence, and decreased parent depression and stress. Three-month follow-up data will indicate whether these changes are maintained. Additionally, strengths and challenges of the program will be discussed, including number of families served (60-84 annually), quality of parent training, funding, and a growing waitlist.

Table 1. Participant Demographics

Variable		Treatment (n = 18) $M(SD)$	WLC (n = 18) $M(SD)$
Child			
	Age (months)	40.83 (11.30)	40.72 (11.61)
	Gender (percent male)	100.00	94.44
	Vineland ABC	65.67 (8.60)	67.83 (11.85)
	Race (percent)		
	Caucasian	77.77	66.67
	Hispanic	5.55	22.22
	Asian	11.11	11.11
	African American	5.55	0.00
Parent			
	Age (years)	34.61 (5.61)	36.77 (7.05)
	Percent mothers	83.33	88.90

Note. WLC = Waitlist control group. ABC = Adaptive Behavior Composite.

Figure 1. Change in Primary Outcome Variables



Note. WLC = Waitlist control group. FOI = Fidelity of Implementation. CES-D = Center for Epidemiological Studies Depression Scale. EIPSES = Early Intervention Parenting Self-Efficacy Scale. For WLC, data represent change over 4-6 week period prior to JumpStart participation.

83 **108.083** Comparative Efficacy of Parent Training Plus Individual Targeted-ABA Therapy Versus Parent Training Alone: A Preliminary Analysis

R. Embacher[1], *T. W. Frazier*[1], *T. N. Gray*[2] *and A. Y. Hardan*[3], *(1)Cleveland Clinic Center for Autism, Cleveland, OH, (2)Center for Autism, Cleveland Clinic Children's, Cleveland, OH, (3)Stanford University, Stanford, CA*

Background: Extensive support exists in the literature for early intensive behavioral intervention following an autism spectrum disorder (ASD) diagnosis. Demand for services far exceeds availability, especially for young children with a recent diagnosis. Low access and high expense of intensive behavioral intervention programming creates the need for effective treatment modalities. Parent training has been shown to be effective for improving child skills and decreasing challenging behavior; however it is not yet clear to what extent simultaneous individual behavior therapy adds to this model. In addition to the type and frequency of services provided, a number of variations on behavior therapy teaching approaches exist and have been implemented as both parent training and individual therapy packages. These include structured Applied Behavior Analysis (ABA) approaches and methods that are more child-led and involve the use of natural opportunities and reinforcers, such as Pivotal Response Training and the Early Start Denver Model. A known weakness of structured ABA is that the therapist-driven structure of sessions can decrease spontaneous responding. Conversely, a weakness of child-led, naturalistic approaches is that low functioning children may not be able to lead interaction and instead prefer to engage in repetitive sensory motor behavior. Targeted ABA (T-ABA) blends structured ABA and naturalistic, child-led approaches by emphasizing the approach which matches most closely to the child's abilities and needs.
Objectives: The primary aim was to compare the efficacy of T-ABA therapy delivered using a combination of parent-training and individual sessions versus parent-training alone.
Methods: The study uses a 20-week, randomized, two-group, cross-over design. During the first 10 weeks of the study, both groups received five T-ABA parent training sessions followed by five parent-therapist in vivo coaching sessions (1 hr each). The T-ABA parent training plus individual therapy group also received eight individual therapist-child sessions (1 hr each). During the final 10 weeks, the T-ABA parent training alone group crossed-over to receive individual therapy sessions. Eight outcome measures were examined in this preliminary analysis including measures of autism symptoms, communication skills, and quality of life.
Results: To date, 15 parent-child pairs have been recruited and completed treatment and an additional 8 parent-child pairs are in progress. Preliminary analyses indicated that both treatment arms produced improved manding, tacting, echoic behavior, motor imitation, and listener responding measured by the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP), and improved overall quality of life ($p<.05$) as measured by the Child and Family Quality of Life-Second Edition. Adding individual therapy resulted in greater improvements in autism symptoms ($p<.001$) as measured by the Social Responsiveness Scale and a trend toward greater improvements in visual matching ($p=.082$) as measured by the VB-MAPP relative to the T-ABA parent-training alone group.
Conclusions: T-ABA parent-training alone or in combination with individual therapy appears to be an effective less-intensive treatment approach for young children with ASD. Improvements in autism symptoms may be stronger with the addition of individual therapy sessions. Sample size is small and results should be considered very preliminary.

84 **108.084** Consensus Among Early Intervention Autism Experts Regarding Context for Success and Strategies for Suddenly Inclusive Early Education Childcare Settings

M. P. Maye[1], *A. K. Stone-MacDonald*[2], *V. E. Sanchez*[2], *J. A. Galler*[2] *and A. S. Carter*[3], *(1)University of Massachusetts Boston, Boston, MA, (2)University of Massachusetts, Boston, Boston, MA, (3)Department of Psychology, University of Massachusetts Boston, Boston, MA*

Background: A recent national survey of parents of preschool aged children found that 91% of children with ASD were receiving care in community settings (e.g., family-based child care, preschools, child care centers). Compared to parents of typically developing children (9%) and parents of children with developmental delay (16%), parents of children with ASD (39%) were significantly more likely to report that childcare challenges contributed to employment accommodations (e.g., quit a job, did not take a job, greatly changed their job) at a significantly elevated rate (Montes & Halterman, 2008). Thus, many community early educators in childcare settings may not be prepared to meet the needs of children with ASD. Working towards the development of an intervention that targets strategies early educators can use within the context of a center-based childcare setting could be a partial solution to this problem. Such an intervention should focus on identifying and including *active ingredients* of early interventions for children with ASD (Kasari, 2002) that can be integrated with best practices for early education.
Objectives: To identify potential active ingredients of early interventions that can be taught to early educators working in childcare settings to support toddlers with ASD.
Methods: Sixteen of 26 early intervention autism experts, identified based on published early intervention autism research articles over the past 20 years, participated in

semi-structured interviews regarding early intervention development (e.g., key strategies, training of early educator/child care provider interventionists). Two additional expert interviews will be completed for the final poster presentation. These interviews were one part of a larger project to develop a brief intervention for early educators in child care settings. Interviews were independently transcribed and coded by three people. Ongoing analysis with NVIVO is focused on exploring themes. Thorough systematic coding, categories and themes will be generated and researchers will check for saturation.
Results: Preliminary analysis highlights the following two themes: 1. creating a context for success (including sub-themes such as child engagement [e.g., toy options, child choice] and awareness of child developmental level [e.g., play above and below child's developmental level, activities at different levels] and 2. specific strategies critical to the intervention process (including sub-themes such as pausing [e.g., expectant pausing, waiting] and using routines [e.g., routines to the third power, structure]). Additional sub-themes as well as quotes to substantiate each of these themes will be provided in the final presentation.
Conclusions: A number of early intervention models were represented in the expert interviews (e.g., ESDM, Children's Toddler School, JASPER, LEAP, Walden School). The level of consensus regarding the context required for a successful intervention is compelling. These themes lend support for common training needs among early educators that could be addressed by an intervention for use in suddenly inclusive early education childcare settings. Additionally, the level of agreement present regarding "the most important intervention strategies" provides researchers with a potential starting point for future studies that should analyze the relative impact of individual intervention strategies and their interaction with one another when used simultaneously.

85 **108.085** Earlier Intervention Is Better for Toddlers with ASD: Evidence from a Randomized Controlled Trial of the Early Social Interaction Project

W. Guthrie[1,2], *A. M. Wetherby*[1], *J. Woods*[1], *C. Schatschneider*[1], *R. Holland*[1], *L. Morgan*[1] *and C. Lord*[3], *(1)Florida State University Autism Institute, Tallahassee, FL, (2)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (3)Weill Cornell Medical College, White Plains, NY*

Background: Early diagnosis of autism spectrum disorder (ASD) is on the rise, spurred by advances in early detection methods and recommendations for screening at 18 and 24 months (Johnson & Myers, 2007). Naturalistic developmental behavioral interventions (NDBIs) have been shown to improve language, cognitive, and/or social outcomes for toddlers diagnosed with ASD (Dawson et al., 2010; Kasari et al., 2010; Wetherby et al., 2014). Although there is agreement that intervention before age three is important, empirical evidence for the notion that "earlier is better" is limited and comes almost entirely from observational studies (Granpeesheh et al., 2009; Harris & Handleman, 2000). There is a critical need for experimental treatment studies that test timing effects to guide the optimal age of intervention for ASD.
Objectives: To report on findings from a randomized controlled trial (RCT) designed to test timing effects of early intervention for toddlers with ASD under age three. This study compared improvement during Early Social Interaction (ESI) between toddlers randomized to receive individualized treatment early (~18 months) or 9 months later (~27 months).
Methods: A complete crossover RCT design was employed in which toddlers (*N*=82) received ESI-Individual at either 18 or 27 months of age. At 18 months, toddlers were randomly assigned to either ESI-Individual or ESI-Group as their first treatment condition. After 9 months, children received the other treatment condition for an additional 9 months, totaling 18 months of treatment. Child outcome measures were administered at baseline, crossover, and end of treatment: Communication and Symbolic Behavior Scales (CSBS), Mullen Scales of Early Learning (MSEL), Vineland Adaptive Behavior Scales, Second Edition (VABS-II), and Autism Diagnostic Observation Schedule (ADOS).
Results: Generalized linear models revealed that toddlers who received ESI-Individual at 18 months showed greater gains during this treatment than those who received ESI-Individual at 27 months. These timing effects were demonstrated for receptive language (MSEL and VABS-II), expressive language (VABS-II), social communication (CSBS), symbolic skills (CSBS), and daily living skills (VABS-II). Timing effects were not observed for autism symptoms (ADOS), motor skills (MSEL and VABS-II), or visual reception skills (MSEL).
Conclusions: These findings extend current knowledge on efficacy of NDBIs by demonstrating that ESI-Individual treatment leads to greater gains when initiated at 18 months compared to 27 months. This study represents the first effort to use RCT methods to rigorously test whether earlier is better for toddlers with ASD, allowing for strong causal conclusions to be made. This study is also the first to examine timing effects under age two. Previous studies have generally examined the effect of treatment started by age three, but this study examined even younger children in order to determine the optimal age for treatment. Results provide strong support for treatment beginning at 18 months and suggest that even a narrow window of 18 versus 27 months may have a critical impact on early intervention. These findings also underscore the importance of screening for ASD early in the second year of life and referring toddlers to autism-specific intervention programs by 18 months.

86 **108.086** Early Intervention Program Participation By Preschool Children with Autism Spectrum Disorder

J. Shenouda[1], *J. Solis*[2], *K. Sidwell*[1], *D. Lincer*[2], *R. Baltus*[2] *and W. W. Zahorodny*[3], *(1)Rutgers University, Newark, NJ, (2)Pediatrics, Rutgers University, Newark, NJ, (3)New Jersey Medical School, Westfield, NJ*

Background: Early Intervention Programs (EIP) are critical to the overall outcome of children with Autism Spectrum Disorder (ASD). Through early intervention, children make gains in cognitive ability, social functioning and even in the core symptoms of ASD. The efficacy of EIP is also increased when at-risk children are placed early.
Objectives:
This study endeavored to investigate the number, proportion and demographic distribution of preschool age children with ASD receiving services through Early Intervention Programs (EIP) in a large, metropolitan, population-based, sample and analyzed demographic differences among children receiving EIP services.
Methods:
Data were from the New Jersey Autism Study (NJAS), a population-based ASD surveillance investigation carried out in Essex and Union Counties. The current findings represent 4-year olds (2006-born) with surveillance-defined ASD, in 2010. ASD ascertainment was by an active, retrospective, multiple-source, Centers for Disease Control and Prevention (CDC)-designed case-finding method, based on review and analysis of information contained in health and education records. Demographic variables and case-specific data, including information on use of EIP services, were analyzed. Chi-square tests were used to test associations.
Results:
We identified 352 four-year-old children with ASD in 2010. Of those, 211 ASD children (60%) received EIP services. Overall, sex, race/ethnicity and SES were not associated with receipt of EIP services. We found no variation EIP service by cognitive impairment. Children with a mild degree of impairment due to ASD were less likely to receive EIP services ($p<.05$). Children with the Autistic Disorder pattern were more likely to receive EIP services than children with the PDD-NOS pattern (92% vs. 8%, $p<.001$, respectively). Children with ASD receiving EIP services were more likely to be diagnosed with ASD before school age (64% vs. 35%, $p<.01$). Our findings showed that the average age of ASD diagnosis of preschool children with ASD receiving EIP services was 30 months, while the average age for children not receiving EIP services was 38 months ($p<.001$). Also, children with ASD receiving EIP services had their first evaluation at 23 months, while children not receiving EIP services had their first evaluation by 36 months ($p<.001$).
Conclusions:
Our findings show that a significant minority of children with ASD (40%) do not receive Early Intervention Program services. Our findings also indicate that children with ASD receiving EIP services are likely to have a higher degree of impairment than other ASD children.

87 **108.087** Early Start Denver Model (ESDM) Informed Treatment in Israeli ASD Preschools – a Pilot Study

T. Gev[1,2], *Y. Gavrilov-Sinai*[1,2], *C. Colombi*[3], *I. Mor Snir*[2] *and O. Golan*[1,2], *(1)Department of Psychology, Bar-Ilan University, Ramat-Gan, Israel, (2)Association for Children at Risk, Givat-Shmuel, Israel, (3)Psychiatry, University of Michigan, Ann Arbor, MI*

Background:
The Early Start Denver Model was previously shown to be effective as an intensive home-based intervention (Dawson et al., 2010). However, in Israel, the majority of young children diagnosed with ASD attend state funded autism daycares and preschools. It is therefore of high importance to assess the efficacy of the ESDM when applied in this setting. Recent attempts to implement this model in a preschool setting have shown encouraging results in terms of children's developmental gains and the overall feasibility and practicality of the program (Vivanti et al., 2014).
Objectives:
The current pilot study aimed to examine an ESDM informed adaptation to an existing ASD preschool setting in Israel.
Methods:
The intervention included 12 children (aged 36-45 months) from three ASD preschools, and was comprised of 2 hours/week of individual ESDM-informed sessions with a therapist in training and a weekly session of parent-child "live-training". Integration of the ESDM-informed adaptation in the daily preschool routine included presentation of the model, the curriculum and learning objectives to the therapeutic and educational staff, and an ongoing demonstration of teaching techniques at various contexts (1:1 sessions, group activities, playground, mealtimes etc). Changes in children's social communication (BOSCC), cognitive ability (MSEL) and adaptive behaviors (VABS-II) were measured before and after 6 months of intervention.
Results:
After 6 months, children showed significant gains in MSEL receptive language, expressive language and visual reception developmental quotients. Significant gains were also shown in VABS-II scales of communication, socialization and daily living skills, and the Adaptive Behavior Composite. Significant improvements on BOSCC total score were found, as well as improvement in child responsiveness to parent and a reduction in unusual sensory interests.
Conclusions:
Results indicate the ESDM may be adapted successfully for use in preschools for children with ASD, with positive child outcomes. Future research should focus on parent,

and child-parent interaction outcomes, as well as on cultural adaptation and widespread dissemination of the model in a controlled study-design.

88 **108.088** Effectiveness of a Parent-Child Developmental Behavioral Training Program in a Community-Based Clinic

M. Kinnear[1], *M. J. Baker-Ericzen*[2], *N. Murphy*[3], *R. Linn*[1], *M. Fitch*[4], *S. M. Kanne*[5] *and M. O. Mazurek*[6], *(1)Rady Children's Hospital San Diego, San Diego, CA, (2)Child and Adolescent Services Research Center, Rady Children's Hospital San Diego, San Diego, CA, (3)Research, Rady Children's Hospital San Diego, San Diego, CA, (4)Child & Adolescent Services Research Center, Rady Children's Hospital, San Diego, San Diego, CA, (5)Thompson Center for Autism & Neurodevelopmental Disorders, Columbia, MO, (6)University of Missouri - Columbia, Columbia, MO*

Background: There has been increasing support for the efficacy of parent-mediated interventions to improve social communication in young children with Autism Spectrum Disorder (ASD)(Kasari et al., 2010). An initial efficacy trial for a specific model of parent-child developmental behavioral training (PCDBT) demonstrated an increase in child language associated with increased parent use of intervention techniques (Ingersoll & Dvortcsak, 2010). There continues to be a need for studies of effectiveness of interventions when implemented in diverse community settings (e.g., National Advisory Mental Health Council, 2001; National Research Council, 2001; Rogers, 1998). Thus, this study examines the effectiveness of PCDBT implemented in an ethnically diverse community-based clinic.
Objectives: To investigate 1) treatment outcomes in a community clinic parent training therapy program, and 2) child characteristics that may moderate treatment outcomes.
Methods: Preliminary data are drawn from a comprehensive baseline assessment of an ongoing R01 study conducted in a community clinic parent training therapy program. Parents completed the Autism Impact Measure (AIM; Kanne et al., 2014), Social Responsiveness Scale, 2nd edition (SRS-2; Constantino & Gruber, 2012) and demographic forms. The Autism Diagnostic Observation Schedule, 2nd edition (ADOS-2; Lord et al., 2012) and Vineland Adaptive Behavior Scales, 2nd edition (Vineland-II; Sparrow, Cicchetti & Balla, 2005) were administrated by trained, research reliable project staff. This sample includes 34 children (82% male) ages 2-9 years (M = 4.4 years; SD = 2.2) and their primary caregivers. All children had a diagnosis of Autism Spectrum Disorder (all cases validated by positive ADOS-2), and 63% identified as racial or ethnic minority. Paired sample t-tests were conducted to examine treatment outcomes on selected measures. Hierarchical blocked regressions were conducted to identify predictors for treatment outcomes.
Results: There was significant improvement post treatment as measured by the ADOS-2 Social Affect subscale, the ADOS-2 overall score, the AIM frequency total score, the AIM impact total score, and the Vineland-II Communication domain (see Table 1 for results). Other measures of social functioning and behavior did not capture significant change. Additionally, age, minority status, and IQ were tested as potential predictors of treatment outcome. None of these variables were significant predictors after controlling for baseline functioning (Age: β=-0.08, p=0.63; Minority: β=0.08, p=0.62; IQ: β=-0.29, p=0.14).
Conclusions: Findings demonstrate that parent-child developmental behavioral training offered in a community clinic results in moderate improvements in social functioning and communication. This finding is consistent with the literature demonstrating effectiveness of parent training programs targeting social communication in community settings (e.g., Baker-Ericzén, Stahmer, & Burns, 2007). Further, the treatment outcomes are consistent with efficacy trials of other parent-mediated training programs (Oono, Honey, & McConachie, 2013). It is also important to note that individual characteristics, such as age, minority status, and IQ, did not moderate treatment outcomes in this diverse community sample. A current limitation of this study is the small sample size; the sample will be doubled by the submission of the poster.

Table 1

Differences on outcome measures pre- and post- treatment

Measures	n	Pre (*M*)	Post (*M*)	Effect Size (Cohen's d)
ADOS: Social Affect	33	11.3	9.21	**0.48****
ADOS: RRB	33	3.82	3.48	0.19
ADOS: Total	33	15.12	12.7	**0.53****
AIM: Frequency	33	117.27	106.58	**0.68****
AIM: Impact	33	96.24	86.82	**0.43***
SRS: Total (T-score)	34	68.68	68.74	-0.01
SRS: SCI (T-score)	34	69.56	69.59	0
SRS: Social Awareness (T-score)	34	69.33	70.09	-0.05
SRS: Social Cognitive (T-score)	34	67.77	67.77	0
SRS: Social Communication (T-score)	34	67.94	69.09	-0.09
SRS: Social Motivation (T-score)	34	65.03	62.79	0.23
SRS: RRB (T-Score)	34	63.68	63.27	0.03
Vineland-II: Communication (T-score)	20	79.95	85.65	**-0.61***
Vineland-II: Daily Living (T-score)	23	85.78	84.74	0.10
Vineland-II: Socialization (T-score)	18	74.11	76.44	-0.22
Aberrant Behavior Checklist	31	43.61	38.81	0.26

Note. * $p < .05$, ** $p < .01$

89 **108.089** Effects of School-Based Early Literacy Interventions for Preschoolers with ASD

R. Hudson*, E. Sanders, R. Greenway, C. Gasamis and J. Martini, University of Washington, Seattle, WA*

Background:
It is well-established that readers need to develop proficiency in word reading and general language comprehension to read with comprehension (Oakhill, Cain, & Bryant, 2003). This study compares two school-based interventions that target one side of the simple view of reading. Both interventions were 1:1, 4 days a week for 20 weeks. One intervention was Interactive Book Reading (IB), hypothesized to increase expressive and receptive vocabulary. The other intervention was phonological awareness (PA), hypothesized to increase PA skills.
Objectives:
What are the immediate effects of treatments for preschool children with Autism Spectrum Disorder?
Methods:
This study followed a sequential cohort design. Across the three years, children diagnosed with ASD were randomly assigned to IB (n = 48), PA (n= 43) or BAU control (n = 44) group. The inclusion criteria were (a) a medical diagnosis of ASD or an educational identification, (b) an active IEP and receive services for ASD, (c) enrolled in their last year of preschool, (d) no known co-occurring neurological or genetic disorders, and (e) a minimum standard score of 55 on the OWEPVT.
Results:
A multilevel modeling approach for testing differences among three conditions was employed to account for dependencies in the data due to classroom and site. Although some teachers participated in more than one cohort, teachers and sites were treated as separate for each cohort for the purpose of controlling for cohort differences. No child participated in more than one year. Standard scores were employed in all analyses to ensure comparability of scores across cohorts and provide a similar scale across all measures. After controlling for classroom and site, pretest differences were detected on the Woodcock Johnson Understanding Directions subtest. This is not surprising that one measure found one difference among the three groups, since random assignment does not guarantee group equivalence across a number of measures. The subsequent posttest analyses controlled for pretest to provide greater precision in estimating group mean differences. Ultimately, results showed that Interactive Book Reading (IB) group significantly outperformed the BAU control group on two language measures (oral communication and listening comprehension) and further, showed a consistent trend ($p < 0.10$) to have higher scores on expressive vocabulary as well. There were group differences favoring the IB group over the PA group on three of the five language measures: expressive vocabulary, receptive vocabulary, and listening comprehension.
Given that early language measures – rather than early literacy measures – have been shown time and again to more accurately predict later reading comprehension outcomes in typically developing students, these findings indicate that interactive book reading may be a more promising intervention for children with autism in particular (compared with phonological training or business-as-usual) since these are the students who traditionally can decode but have difficulty comprehending text.
Conclusions:
Our next steps are to test whether treatment effects are moderated by pretest (baseline) scores, as well as to incorporate fidelity and classroom observation data into our

models. These future models will help pinpoint whether treatment effects are maximized under varied conditions.

90 **108.090** Effects of a Parent-Implemented Developmental Reciprocity Program for Children with Autism Spectrum Disorder

G. G. Baldi[1], *C. Ardel*[2], *R. A. Libove*[2], *S. Schapp*[3], *S. Burton*[3], *J. M. Phillips*[2], *A. Y. Hardan*[2] *and G. W. Gengoux*[2], *(1)Children's Health Council, Palo Alto, CA, (2)Stanford University, Stanford, CA, (3)PGSP-Stanford PsyD Consortium, Palo Alto, CA*

Background: Developmental approaches to autism treatment are based on the premise that establishing strong interpersonal relationships through natural play will foster developmental progress and reduce symptomatology. A variety of developmental approaches are used in community treatment; however, there is limited empirical literature documenting the procedures or demonstrating their effectiveness. Well-designed studies using standardized outcome measures are needed to better understand whether these treatments are effective and how they compare to other available interventions for ASD.
Objectives: The current pilot study evaluated the effectiveness of a 12-week parent-delivered Developmental Reciprocity Program (DRP) on standardized outcome measures including Vineland Adaptive Behavior Scales-Second Edition (Vineland-II), Social Responsiveness Scale (SRS), MacArthur Communicative Development Inventories (CDI), Short Sensory Profile (SSP), and the Clinical Global Impression: Improvement scale (CGI-I).
Methods: Twenty-four children with ASD (mean age=45.5 months, SD=13.4) and a primary caregiver participated in 12 weekly sessions (90 minutes each) of parent training in the DRP model, covering topics including introduction to developmental approaches, supporting attention and motivation, sensory regulation and sensory-social routines, imitation/building nonverbal communication, functional language development, and turn taking. Parent questionnaires and a structured lab observation were completed at baseline, week 6, and week 12.
Results: Twenty-four subjects completed baseline measures and began the DRP treatment program. Twenty-two subjects completed the 12-week treatment and post treatment assessments; two subjects ended their participation in the study after week 6 and all available data were included in the analyses. Preliminary findings revealed improvement in communication skills (Vineland-II Communication Domain standard score; Baseline: 78.0 ± 14.5; Week 12: 81.2 ± 18.9; F(1,16): 6.251, p=.024). Trends toward significance were found in the overall Vineland-II Adaptive Behavior composite score (Baseline: 73.6 ± 10.5; Week 12: 77.1 ± 13.9; F(1,19): 4.116, *p*=0.061). Differences on the SRS raw scores were observed (Baseline: 80.8 ± 21.5; Week 12: 72.1 ± 18.7; F(1,19):7.620, *p*=.012) but not on the SRS T-scores (Baseline: 75.0 ± 9.9; Week 12: 73.6 ± 10.3; F(1,19):1.218, *p*=.284). Differences were also observed on the words produced out of 680 on CDI (Baseline: 243.4 ± 145.1; Week 12: 310.3 ± 237.3; F(1,18):18.104, *p*=.000). No significant differences in sensory sensitivity were observed as measured by the SSP. Finally, overall improvements were measured using the CGI-I, with 10 participants being judged as “Much Improved”, 13 as “Minimally Improved”, and only 1 showing “No Improvement.”
Conclusions: Preliminary findings from this pilot study indicate that the DRP model shows promise in the treatment of children with ASD with possible improvement in communication deficits and adaptive skills. Randomized controlled trials are needed to determine whether the effects observed here will be replicated in a larger sample. These results will be discussed with respect to the need for future research in the area of developmentally-based interventions and the implications for autism early intervention services including parent training programs.

91 **108.091** Evaluating a Coach-the-Coach Model with Community Childcare Providers to Support Social Communication Development with Children

C. Watts, ***N. D. Bond****, T. Nelson, J. Stapel-Wax and E. Wang, Marcus Autism Center, Atlanta, GA*

Background:
The National Research Council (2001) found that early detection and 25 hours a week of active engagement promoted and encouraged success for all children entering Kindergarten. Using principles guided by the SCERTS framework, (Prizant et.al,2005), a coach-the-coach model was implemented to guide front-line workers by training and providing feedback related to their use of transactional supports. Using strategies for adult learning to enhance collaboration amongst providers and coaches has been successful in early intervention to support positive developmental trajectories for children (Friedman & Woods, 2012).
Objectives:
This project looked at improving the coaching abilities within Georgia’s Bright from the Start (BFTS) Department of Early Care and Learning (DECAL) professionals by utilizing a multi-phase coach-the-coach model focusing on increasing knowledge of typical child-development and detection of ASD and developmental disabilities using transactional supports to promote active engagement in early childcare settings.
Methods:
This project tracked the progress of 14 ECP’s (Early Childcare Providers) from Bright from the Start and 5- Infant Toddler Specialists and 9- Inclusion Specialists from the second year. Through the coaching and collaboration strategies to promote adult learning, the project focused on increasing active engagement in the classrooms and an increased awareness of red flags for ASD to provide the support the children needed to be successful. Coaching was conducted in three (3) 12-week phases that started out with heavier support and moved to less frequent support. Classrooms were observed at the start of the project and after a three-month period in order to determine if practices increased or decreased and sustained in community settings. Effectiveness of practice 1) rate of support and coaching provided by the ECP’s during video-recorded independent-classrooms sessions with childcare providers throughout the coaching process. period and (2 number of children identified at risk for ASD. The Social Emotional Engagement-Knowledge Skills (SEE-KS) rating form was used to determine an increase or decrease in the following domains; Fostering Engagement, Presenting Information in Multiple Ways, and Allowing Students to Act and Express Themselves in Multiple Ways(Prizantet.al,2005)
Results:
The data from this coaching model yielded an increase in all three areas of that were measured. Fostering engagement increased by <0.0001, presenting information in multiple ways increased by 0.0002 and allowing students to act and express themselves in multiple ways 0.00018. Over two years of coaching, 14 children were identified as showing red flags for ASD.
Conclusions:
These results show the coach-the coach model enhanced the use of the transactional supports used in the childcare settings. Seeing an increase in the amount of this coaching model yielded an increase in the coaching and support provided by the ECP’s increased awareness of red flags for ASD. Throughout this coaching project, the ECP’s were proficient coaching and collaborating with others and used this to increase the knowledge in the childcare settings.

92 **108.092** Evaluating a Coach-the-Coach Model with Early Childcare Providers to Support Children with Social Communication Impairments

N. D. Bond[1], *C. Watts*[1], *T. Nelson*[1], *T. Ryan*[2], *M. Costo*[1], *E. J. Wang*[3], *J. Stapel-Wax*[1] *and S. K. Fuhrmeister*[1], *(1)Marcus Autism Center, Atlanta, GA, (2)Marcus Autism Center, Duluth, GA, (3)Pediatrics, Emory University, Atlanta, GA*

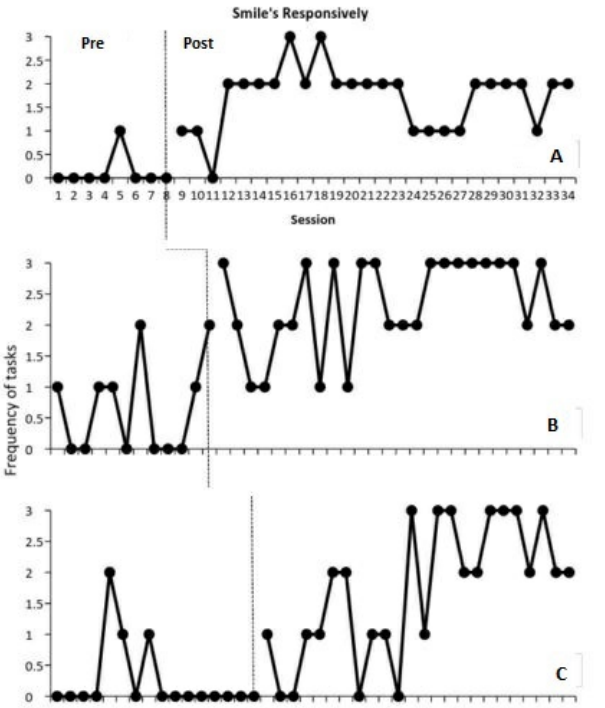
Background: The National Research Council (2001) found that early detection and 25 hours a week of active engagement promoted and encouraged success for all children entering Kindergarten. Using principles guided by the SCERTS framework, (Prizant et.al,2005), a coach-the-coach model was implemented to guide front-line workers by training and providing feedback related to their use of transactional supports. Using strategies for adult learning to enhance collaboration amongst providers and coaches has been successful in early intervention to support positive developmental trajectories for children (Friedman & Woods, 2012).
Objectives: This project looked at improving the coaching abilities within Georgia’s Bright from the Start (BFTS) Department of Early Care and Learning (DECAL) professionals by utilizing a multi-phase coach-the-coach model focusing on increasing knowledge of typical child-development and detection of ASD and developmental disabilities using transactional supports to promote active engagement in early childcare settings.
Methods: This project tracked the progress of 14 ECP’s (Early Childcare Providers) from Bright from the Start and 5- Infant Toddler Specialists and 9- Inclusion Specialists from the second year. Through the coaching and collaboration strategies to promote adult learning, the project focused on increasing active engagement in the classrooms and an increased awareness of red flags for ASD to provide the support the children needed to be successful. Coaching was conducted in three (3) 12-week phases that started out with heavier support and moved to less frequent support. Classrooms were observed at the start of the project and after a three-month period in order to determine if practices increased or decreased and sustained in community settings. Effectiveness of practice 1) rate of support and coaching provided by the ECP’s during video-recorded independent-classrooms sessions with childcare providers throughout the coaching process. period and (2 number of children identified at risk for ASD. The Social Emotional Engagement-Knowledge Skills (SEE-KS) rating form was used to determine an increase or decrease in the following domains; Fostering Engagement, Presenting Information in Multiple Ways, and Allowing Students to Act and Express Themselves in Multiple Ways(Prizantet.al,2005)
Results: The data from this coaching model yielded an increase in all three areas of that were measured. Fostering engagement increased by <0.0001, presenting information in multiple ways increased by 0.0002 and allowing students to act and express themselves in multiple ways 0.00018. Over two years of coaching, 14 children were identified as showing red flags for ASD.
Conclusions: These results show the coach-the coach model enhanced the use of the transactional supports used in the childcare settings. Seeing an increase in the amount of this coaching model yielded an increase in the coaching and support provided by the ECP’s increased awareness of red flags for ASD. Throughout this coaching project, the ECP’s were proficient coaching and collaborating with others and used this to increase the knowledge in the childcare settings by applying the transactional supports to promote active engagement with children at risk for ASD in the classrooms.

93 **108.093** Evaluation of a Novel Curriculum Targeting Early Social Communication Skills in Minimally Verbal, Preschool Aged Children with Autism Spectrum Disorder (ASD): A Pilot Study

K. T. Sterrett[1], *K. Hayashida*[2], *J. Kim*[3], *T. Paparella*[4] *and S. Freeman*[4], *(1)Graduate School of Education and Information Studies, University of California Los Angeles, Los*

Angeles, CA, (2)Child Psychiatry, Semel Institute for Neuroscience, Los Angeles, CA, (3)Semel Institute for Neuroscience, Los Angeles, CA, (4)University of California Los Angeles, Los Angeles, CA

Background: Some of the most enduring impairments in children with autism spectrum disorder (ASD) fall within the domain of social communication. Distinguishing characteristics of delays include difficulties with social orienting and joint attention (Dawson et al., 2004). Preverbal social communication skills have been linked to improved developmental trajectories including spoken language and adaptive functioning that may be maintained throughout adolescence (Kasari et al., 2008; McGovern & Sigman, 2005). However, only a small amount of research has been devoted to the treatment of preverbal social communication skills in minimally verbal children with ASD. With such potentially promising outcomes, there is a clear need for empirically-based early interventions targeting this core deficit domain. As a good portion of time for young preschool-aged children takes place in a classroom environment, these interventions need also be easily implemented and generalized by classroom personnel.
Objectives: To carry out a pilot study evaluating the efficacy of The Preverbal Communication and Social Expressive Skills (PCSES) curriculum, a newly manualized intervention targeting behavior regulation, joint attention, and interaction skills in minimally verbal preschool children with ASD. Each target skill required 5 consecutive days of lessons that included behavioral modeling, rehearsal and feedback.
Methods: Three children with ASD ages 4-5 years were recruited from an early intervention preschool program to participate in the PCSES curriculum and subsequent evaluation. Each day, PCSES was carried out using two non-consecutive didactic sessions. These small group sessions were composed of naturalistic lessons based on the principles of ABA and Milieu based treatment. Pilot data were collected on all three participants. Pre-treatment assessments included the Early Social Communication Scales (ESCS) and a semi-structured play assessment (SSPA). The SSPA was designed to provide opportunities for the children to exhibit each targeted PCSES skill (attending to adults face, smiling responsively, regarding self in mirror, orienting to adults, following points, reaching and giving to request). All children were then given the SSPA following the five days of treatment to monitor the acquisition and maintenance of the skill. The ESCS was then re-administered post-maintenance.
Results: A non-concurrent multi-baseline design was used to analyze pre- and post-treatment SSPA data. Pre-treatment skills varied per child but overall, all children performed better following the implementation of the PCSES curriculum, with the frequency of target skills trending in a therapeutic direction (see Figure 1). These conclusions were further supported by an analysis of effect size using percentage of data exceeding the median (PEM) (Lenz, 2013). For two children, intervention was shown to be moderately to very effective (effect sizes .66-1) on 5/5 needed skills. For the other child, intervention was very effective (.83-.92) for 4/5 skills, with one showing debatable effectiveness (.5). Preliminary analysis of the ESCS demonstrates a positive change in early social gestures.
Conclusions: The current findings show that the PCSES curriculum may result in positive trends of growth in certain behavior regulation and joint attention skill that have been shown to impact developmental trajectory. A RCT with additional standardized measures is needed to explore these results further.



94 **108.094** Examining the Potential Reach and Engagement with a Self-Directed Telehealth Parent-Mediated Intervention for Children with ASD in Community Settings

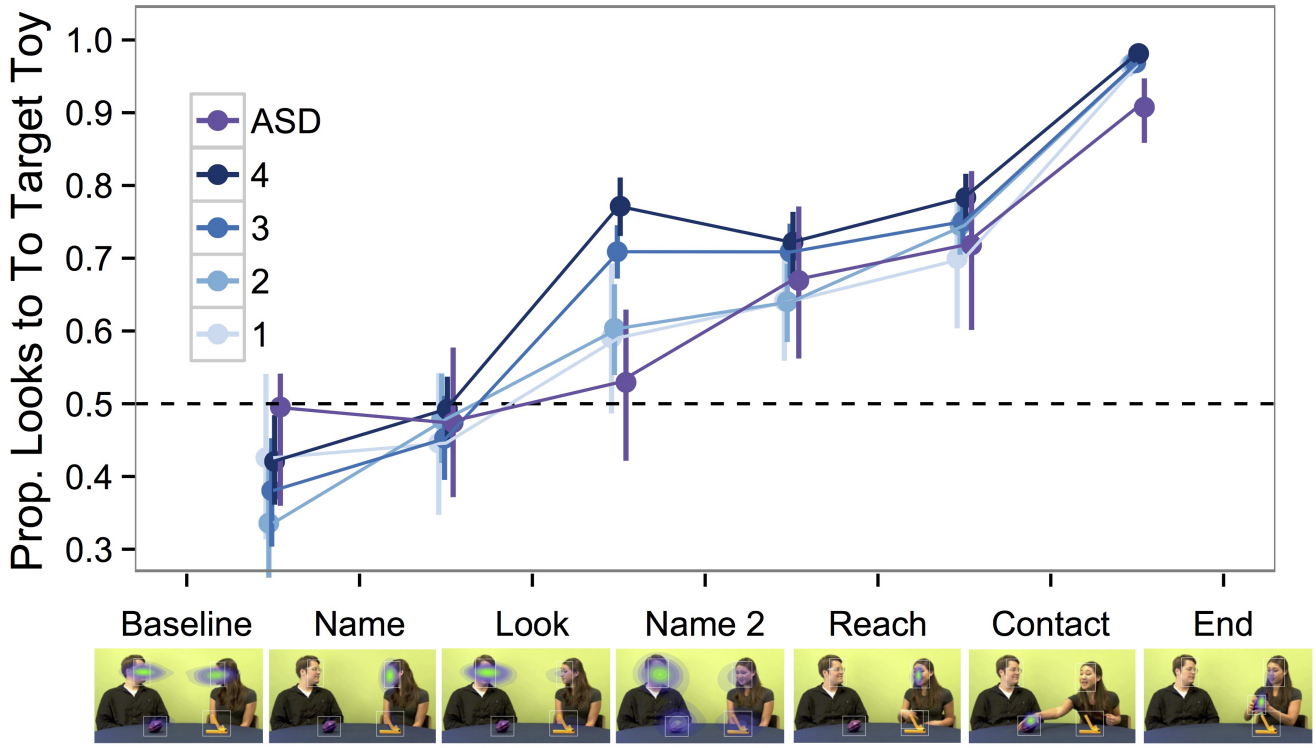
K. F. Shannon[1], *N. I. Berger*[2], *B. E. Holtz*[3] *and B. Ingersoll*[2], *(1)Psychology, Michigan State University, Ada, MI, (2)Michigan State University, East Lansing, MI, (3)Department of Advertising & PR; Department of Media & Information, Michigan State University, East Lansing, MI*

Background: Initial lab-based trials of self-directed, telehealth parent-mediated interventions (SDT-PMIs) for families of children with ASD demonstrate high levels of program acceptability, program engagement, and improvements in parent and child behaviors, indicating their potential as a low-cost universal intervention. However, little is known about the potential reach of and parent engagement with such programs outside of a lab setting.
Objectives: This study conducted a field trial of ImPACT Online, a SDT-PMI for families of children with ASD to: 1) Examine the potential reach of the program; 2) Compare the demographics of families who enrolled in a field trial (FT) to families who enrolled in lab-based trial (LT) of ImPACT Online; 3) Compare metrics of program engagement for FT and LT families; and 4) Examine the relationship between program engagement and changes in parents' intervention knowledge.
Methods: FT families were recruited by: 1) a flyer with a link to the program website which was provided to families during the feedback session at several community autism diagnostic clinics; 2) a link to the program website which appeared on a Statewide autism center website; or 3) word of mouth and/or internet search. Parents enrolled through the program website, and did not have direct contact with research staff. One diagnostic clinic tracked referrals to obtain an estimate of reach. Sixty-two parents completed a survey of family demographics and intervention knowledge at intake and 21 (34%) completed a 6-month follow-up survey. Program engagement (% of program components completed) was recorded by the website. Data were compared to families who participated in a lab-based trial of ImPACT Online (n=27).
Results: 18.71% of parents referred to the program by the diagnostic center enrolled in the program; these children did not differ significantly in age or gender from the referral sample. Parent demographics did not significantly differ between FT and LT groups; the majority of participants in both groups were female (FT: 87%; LT: 96%), married (FT: 81%; LT: 82%), with a college degree or higher (FT: 57%; LT: 56%), were employed outside the home (FT: 58%; LT: 62%), and felt fluent with computer/internet technology (FT: 35.95, SD=3.71; LT: M=35.57, SD=4.25), all *ps*>.05. FT child participants were slightly older (FT: 52.0 months; LT: 43.26 months, t(84.04)=2.24, p<.05) and marginally more likely to be male (FT: 87%; LT: 70%; X^2 (n=89)=3.57, p=.059) and a minority (FT:44%; LT: 22%; X^2(n=89)=3.67, p=.056) than LT children. FT parents had significantly lower program engagement (M=20.51%, SD=28.80) than LT parents (M=81.31%, SD=30.46), t(72)=6.84, p<.001. Program engagement was a significant predictor of post-treatment intervention knowledge, controlling for pre-treatment knowledge and group, β=.41, t=3.37, p=.002.
Conclusions: Families who enrolled in the field trial of ImPACT Online were demographically similar to families who enrolled in the lab-based study. However, parent engagement was much lower, and the reach was limited. Given the relationship between program engagement and gains in intervention knowledge, strategies for increasing engagement with SDT-PMIs in real-world settings are a priority.

95 **108.095** Eye-Tracking of Social Information Processing As an Outcome Measure for Clinical Trials

D. Yurovsky[1], *G. W. Gengoux*[1], *A. Y. Hardan*[1], *T. W. Frazier*[2] *and M. C. Frank*[1], *(1)Stanford University, Stanford, CA, (2)Cleveland Clinic Center for Autism, Cleveland, OH*

Background: Social information processing is both a central impairment in autism spectrum disorder (ASD) and also a key target for clinical intervention. Measures of social information processing typically rely either on parent reports or in-person interactions in an unfamiliar laboratory context, neither of which is ideal for providing objective and generalizable measurements. Parent report may be biased (and will likely not be blind to treatment condition for many treatments); clinical interactions, especially with an unfamiliar experimenter, can underestimate social information processing abilities because of the challenging nature of the context. Eye-tracking measures provide one promising alternative approach for measurement: Eye-trackers are inexpensive, but yield substantial amounts of high-reliability data in even a short measurement session. Thus, eye-tracking may be an important tool for assessing the effectiveness of social information processing interventions.
Objectives: Our goal was to develop a fast, reliable, low-demand eye-tracking measure for estimating children's social information processing and word learning abilities, and to use this measure as an exploratory endpoint for an ongoing clinical trial.
Methods: We created a 5-minute video of actors engaging in monologues and dialogues, in which the labels for two novel toys were introduced. While children watched these videos, their eye-gaze was tracked using a 120Hz SMI corneal reflection eye-tracker. To quantify children's ability to follow speakers' social cues, we measured their proportion of time looking to the toy that the actors were talking about. Subsequently, we measured whether children learned the correct label for each toy via their gaze during a two-alternative word recognition test.
Results: We first used our paradigm to measure social information processing in a group of 236 typically developing children aged 1-5. We found that individual differences in following social cues during the monologues and dialogues were highly correlated with individual differences in word learning ($r = .56$). We then tested a group of 40 1-8 year-old children diagnosed with ASD. As expected, these children were less skilled at both following social cues and learning the words for toys than their typically-developing counterparts (Figure), but their social information processing was again highly correlated with their ultimate word learning ($r = .6$). Finally, in on-going work we have used this measure as part of a randomized controlled trial of a Pivotal Response Treatment program (PRT-P). So far, 18 children have been tested 3 times at 6-month intervals. Preliminary analyses show that children in the intervention group performed better on both social information processing and word learning relative to the control group at the second and third time-points.
Conclusions: Individual differences in social information processing can be quantified reliably with short free-viewing eye-tracking measures. These individual differences predict learning in both typically-developing children and those with ASD. Further, preliminary results from our on-going randomized controlled trial show that these measure are sensitive enough to pick up effects of a PRT intervention. Our measure---and measures like it---are thus a promising direction for the rapid assessment of changes in social information processing targeted by clinical interventions.



96 **108.096** Impact of Collaborative Caregiver Training Models on Caregivers, Children, and Early Interventionists

A. Stainbrook[1], *A. Vogel*[1], *A. Spiess*[1], *K. Dorris*[1], *Z. Warren*[2] *and P. Juarez*[3], *(1)Vanderbilt Kennedy Center, Nashville, TN, (2)Vanderbilt University, Nashville, TN, (3)Vanderbilt University Medical Center, Nashville, TN*

Background:
Children identified with Autism Spectrum Disorder during toddlerhood often turn to their state Part C early intervention (EI) system for care. Recommended practices in EI emphasize the use of family routines as the intervention context and the role of the EI in teaching parents to embed intervention strategies into daily routines. As a result, there has been an increased emphasis on the value of caregiver-implemented intervention approaches. Therefore, EI providers are charged with a need to not only be knowledgeable in evidence-based treatment strategies for young children with ASD but also how to teach and coach caregivers to use these strategies.
Objectives:
This program evaluation study assesses the impact of a university-driven caregiver training model that includes opportunities for collaboration and consultation with state level EI providers.
Methods:
Approximately 90 families will be provided with services following participation in a psychological evaluation for ASD. All participating families receive 2 home-based evaluation support sessions led by a professional in the field of applied behavior analysis which include focused consultation and training on evidence-based practices for children with ASD. Following completion of this initial service, families are recommended for an additional 2 to 12 caregiver training sessions dependent on location and age at the time of referral. This second round of services includes 2 to 4 live and/or remote collaborative sessions with each family's EI and well as ongoing remote consultation opportunities. Surveys were developed to assess caregiver perceptions of impact on self and child as well as EI perceptions of impact on self and family.
Results:
63 families have completed or are currently engaged in services. Using a Clinician Global Impression rating of improvement (CGI-I) to rate child behavior, caregivers have provided average ratings of 2.9 on a scale of 1 to 7 with 1 equaling "very much improved" and 4 equaling "no change". In addition, caregivers have assigned high ratings to their overall satisfaction with services as well as their own competence in implementing the strategies with overall ratings averaging 3.4 on a scale of 1 to 4. A general satisfaction survey was sent to EI providers to assess perceptions of benefit to the families they work with; ratings averaged 3.3 on a scale of 1 to 4. In addition to the satisfaction survey, surveys were also sent to EIs to assess knowledge gained through participation in collaborative visits and consultation. Results suggest that EIs used recommended strategies 75-100% of the time. When asked to rate how collaboration with the clinician had impacted the interventionists ability to use those recommended strategies, the interventionists responded with an average rating of 3.8 (1 = not at all, 4 = significantly).
Conclusions:
The preliminary results of this project support effectiveness of caregiver training within the community setting. Early intervention providers as well as caregivers reported high levels of satisfaction with services, and early interventionists indicated that they had opportunities to use learned skills with other children creating potential for an impact on greater numbers of children within systems.

References (not included in the Word Count):

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97 **108.097** Improving Children's Participation in Everyday Home Routines: Results from an RCT Assessing the Effectiveness of a Web-Based Parenting Tutorial

L. V. Ibanez[1], *W. L. Stone*[1], *L. Wallace*[2], *A. Swanson*[3], *Z. Warren*[3] *and K. A. Kobak*[4], *(1)Department of Psychology, University of Washington, Seattle, WA, (2)Vanderbilt Kennedy Center, Nashville, TN, (3)Vanderbilt University, Nashville, TN, (4)Center for Psychological Consultation, Madison, WI*

Background:
Daily routines such as snack time and bath time provide opportunities for families to engage in rich social interactions. Children with ASD often experience difficulty participating in these family activities. This study examined the effectiveness of an interactive, web-based parenting tutorial for improving both proximal outcomes (parent and child behaviors during routines) and broad outcomes (parenting efficacy and stress and child social-communication).
Objectives:
1. To examine the tutorial's effectiveness in improving child and parent behaviors from baseline (T1) to post-tutorial completion (T2; 4 weeks after T1) and 4-week follow-up (T3; 8 weeks after T1).
2. To examine the extent to which the tutorial's effect on broad outcomes at T3 is mediated by change in proximal outcomes from T1 to T2.
Methods:
Parents of children with ASD (2–6 years old) were randomly assigned to the Tutorial (*n*=52) or Control (*n*=52) condition after they completed T1 surveys. Parents completed surveys about their children's positive and negative behaviors during routines, and about their own use of appropriate verbal (e.g., providing praise) and nonverbal strategies (e.g., using visual supports) during routines. Children's social-communication behavior was assessed using four domains of the Parent Interview for Autism-Clinical Version (PIA-CV): Social Relating, Imitation, Nonverbal Communication, and Language Understanding. Parenting stress was assessed using three subscales from the Parenting Stress Index (PSI-SF): Difficult Child, Parental Distress, and Parent-Child Dysfunction. Parenting efficacy was assessed using the Maternal Efficacy Scale.
Results:
An intent-to-treat approach was applied using Maximum Likelihood in Hierarchical Linear Models (HLM) and Bayesian estimates in mediation analyses.
There were no group differences for any outcomes at T1. Children's negative behaviors were significantly lower in the Tutorial group than the Control group at T2 (β=-.32,*p*=.04) and T3 (β=-.42,*p*<.01); there were no significant differences for positive behaviors. Parents' use of appropriate verbal and nonverbal strategies was significantly higher in the Tutorial group than the Control group at T2 (β_{VERBAL}=.35,*p<.01*=;$\beta_{NONVERB}$=.39,*p*<.01) and T3 (β_{VERBAL}=.24,*p*<.01 ;$\beta_{NONVERB}$=.26,*p=.03*).
Children's Social Relating scores on the PIA-CV were significantly higher in the Tutorial group than the Control group at T2 (β=.29,*p*=.04) and T3 (β=.32,*p*=.04). Parent-Child Dysfunction on the PSI-SF was significantly lower in the Tutorial group than the Control group at T3 only (β=-3.91,*p*=.02). Parenting efficacy tended to be higher in the Tutorial group than the Control group at T2 (β=1.63,*p*=.08) and T3 (β=1.65,*p*=.06). No other significant group differences were found.
Increases in parents' use of appropriate verbal strategies and decreases in children's negative behaviors during routines significantly mediated the tutorial effect on Parent-Child Dysfunction (indirect β_{VERBAL}=-3.75,*95%CI*[-5.70,-1.38];indirect β_{NEGBEH}=-1.59,*95%CI*[-3.11,-.56]) and Parenting Efficacy (indirect β_{VERBAL}=1.94,*95%CI*[.84,3.30];indirect β_{NEGBEH}=.71,*95%CI*[.20,1.44]) at T3. Decreases in child negative behaviors mediated the tutorial effect on Social Relating (indirect β=.10,*95%CI*[.03,.20]) at T3. No other proximal outcomes were significant mediators.
Conclusions:
This tutorial was effective in improving key proximal and broad outcomes immediately and one month after its completion. Changes in parents' verbal strategies and children's negative behaviors during routines are potential mechanisms by which the tutorial impacted broad outcomes. Overall, the tutorial appears to be a promising, accessible way for empowering parents and improving parent-child interactions.

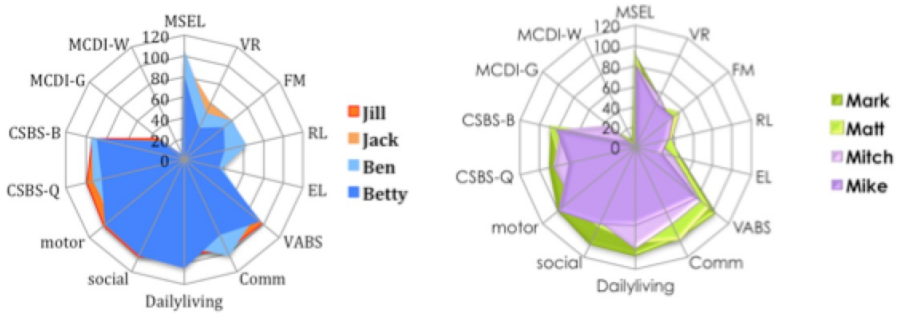
98 **108.098** Influential Factors on Response to Adapted Responsive Teaching Intervention

S. Zheng[1], *L. R. Watson*[2], *E. Crais*[2], *G. T. Baranek*[3] *and A. M. Carroll*[4], *(1)University of North Carolina at Chapel Hill, Carrboro, NC, (2)University of North Carolina at Chapel Hill, Chapel Hill, NC, (3)UNC Chapel Hill, Chapel Hill, NC, (4)Occupational Science, University of North Carolina at Chapel Hill, Chapel Hill, NC*

Background: Most early intervention studies focus on efficacy testing by examining main effects on children's developmental outcomes and parental behavior changes. However, with the wide heterogeneity of Autism Spectrum Disorder (ASD), it is important to match interventions with children and families based on their characteristics. There is limited research exploring the influential factors on response to ASD interventions.
Objectives: The objective of the current study is to explore what family, child, and parent factors may function as moderators of the effects of participation in the Adapted Responsive Teaching (ART) intervention.
Methods: ART is a parent-mediated early intervention program designed to facilitate the development of children at risk for ASD by improving parental responsiveness. Eighty-seven infants, screened by the First Year Inventory (FYI) at 12-months of age as at risk for ASD, participated with their families in a RCT efficacy study. They were randomized to either the ART group or the control group (referral to early intervention and monitoring, REIM group). Based on their gains in standard scores on the Communication and Symbolic Behavior Scales Behavior Sample (CSBS-B; Wetherby & Prizant, 2002), two children in each group who had made the most progress were identified as responders (in the ART group) or developers (in the REIM group); two who had the poorest outcomes were identified as non-responders or non-developers. A multiple case study method was employed to explore the similarities and differences in children, parent and family characteristics between responders and non-responders and to generate a profile for responders.
Results: The responders to the ART intervention showed few early markers of ASD (based on the AOSI), low formal language skills but average social-communication skills, and typical sensory processing patterns, while the two non-responders had more uneven profiles of developmental/adaptive skills, somewhat more autism markers, and atypical sensory processing patterns. Both responders received speech-language therapy in addition to ART. Sensory patterns, autism symptoms, and the community service they received may have influenced the children's response to ART. Moreover, both the responders came from families with higher income and fewer children at home compared to non-responders, and mothers (primary caregivers) of responders had higher education levels. Mothers of the ART responders showed high initial responsiveness, higher level of consistency and fidelity in implementing ART at home than mothers of non-responders, and little change in responsiveness but increases in directiveness when interacting with their children over the course of the study. There was no clear pattern for developers or non-developers in the REIM group. Additional cases (n = 26) meeting pre-established criteria of 95% confidence interval for responders (n=9) /non-responders (n=5) and developers(n=9) /non-developers (n=3) will be analyzed to examine the generalizability of the current findings.
Conclusions: The current findings address the potential importance of both child and parent factors in influencing the effectiveness of ART and similar interventions, and thus, suggest that researchers and practitioners need to focus on tailoring intervention strategies to be more family-centered and individualized.

Table 1 Extra Information for the Eight Cases at Pre-test

	ART				REIM			
	Responders		Non-responders		Developers		Non-developers	
Alias	Jack	Jill	Ben	Betty	Matt	Mark	Mike	Mitch
Community service	SLT	SLT	N/A	N/A	N/A	N/A	DT	DT, SLT
Autism Markers	1	1	2	4	0	6	3	6
Hypo-responsive	Typical	Typical	Parent: Mildly	Typical	Typical	Parent: Significantly	Parent: Significantly	Typical
Hyper-responsive	Typical	Typical	Observation Significantly	Parent: Significantly	Typical	Parent: Significantly	Typical	Observation Significantly
Sensory Seeking	Typical	Typical	Typical	Typical	Typical	Typical	Typical	Observation Mildly



a. b.

Figure 1 Radar plots for developmental measures for ART (a) and REIM (b) groups

99 **108.099** Jumping the Hurdle: Children with ASD and Symbolic Play

Y. C. Chang[1], *S. Y. Shire*[2], *C. K. McCracken*[3], *W. I. Shih*[4] *and C. Kasari*[2], *(1)Division of Special Education and Counseling, California State University, Los Angeles, Los Angeles, CA, (2)University of California Los Angeles, Los Angeles, CA, (3)University of California, Los Angeles, El Segundo, CA, (4)UCLA, Monrovia, CA*

Background:
Children with autism spectrum disorder (ASD) demonstrate delays in social communication, play and language, and these abilities are targeted in early interventions. While gains can be made after brief interventions of 3 to 6 months, gaining symbolic play skills are more difficult in children who begin intervention as minimally verbal (Goods et al, 2012; Kasari et al, 2013). Language abilities and social communication skills have both been associated with children's mastery of symbolic play skills, and may travel alongside improvements in play skills.
Objectives:
The current study investigates whether improvement in social communication helps children jump the hurdle from functional play to symbolic play in a sample of preschoolers all receiving the same targeted social communication intervention.
Methods:
Participants included 85 children with autism spectrum disorder (*M*= 46.10 months; *SD*= 7.49 months) who have completed an evidenced-based early social communication intervention program, Joint Attention Symbolic Play Engagement Regulation (JASPER), that ranged from three to six months.
All children were administered the Autism Diagnostic Observation Schedule (ADOS) to confirm their autism diagnosis and to determine their verbal abilities. Children who had less than five spontaneous words on the ADOS were defined as "minimally verbal". Children with more than five words, or children who scored "0" or "1" on Module 1 (using phrase speech and word combinations), or children who scored "0" or "1" on Module 2 and 3, were defined as "verbal".
The *Early Social Communication Scale* (ESCS; Mundy et al., 2003) was used to measure spontaneous initiations of joint attention (IJA) skills. Children's joint attention skills were categorized as "nonverbal IJA", including gestures such as pointing, showing, and giving, or "IJA" which included both gestures and language.
The *Structured Play Assessment* (SPA; Ungerer & Sigman, 1981) was used to assess spontaneous play skills. Children's play behaviors including the number of different spontaneous novel play types and frequency were coded from videotaped SPAs by blind raters. Children who demonstrated at least two types and five times of symbolic play acts were defined as mastered "symbolic play".
Results:
Forty-nine children were defined as "minimally verbal" and 36 were "verbal". Sixty-nine percent of the children who were "verbal" mastered symbolic play at the end of their intervention, and only 38% of children who were "minimally verbal" mastered symbolic play.
Using logistic regression, nonverbal IJA was associated with increased odds of having any symbolic play after adjusting for language, entry symbolic play, and intervention dose (p=0.04).
Conclusions:
These results suggest that it is more difficult for children who are minimally verbal (less than five words) to make that jump from functional play to symbolic than children who are more verbally skilled. This is in line with previous research that shows that language and symbolic play are associated. It is also promising to note that some children who were minimally verbal are making that jump from functional to symbolic. Future research should continue to target social communication and play skills in children who are minimally verbal.

100 **108.100** Mu Suppression to Biological Motion Predicts Pivotal Response Treatment Response in Young Children with Autism Spectrum Disorder

M. J. Crowley[1], *J. Wu*[2], *C. A. Paisley*[3], *M. L. Braconnier*[3], *S. M. Abdullahi*[3], *L. C. Mayes*[4], *K. Pelphrey*[3] *and P. E. Ventola*[3], *(1)Yale School of Medicine, New Haven, CT, (2)Yale Child Study Center, New Haven, CT, (3)Yale Child Study Center, Yale School of Medicine, New Haven, CT, (4)Child Study Center, Yale School of Medicine, New Haven, CT*

Background: Advances in cognitive neuroscience offer promise for personalized treatment to improve outcomes in individuals with ASD. As a treatment with established clinical efficacy, Pivotal Response Treatment (PRT) is a naturalistic behavioral intervention that uses Applied Behavior Analysis (ABA) principles to target social communication deficits in individuals with Autism Spectrum Disorder (ASD) (Koegel et al., 1987). Work from our group (Ventola et al., 2014) has found significant benefit in pragmatic language, social engagement, and adaptive functioning skills for children with ASD and corresponding brain-based normalization (Ventola et al., 2015). Employing electroencephalography (EEG), this study aims to detect pre-existing functioning in the brain circuitry supporting biological motion that predicts which children benefit most from a 16-week course of PRT. Such predictive power could lead to the establishment of a stratification biomarker to help precisely match patients to treatments.
Objectives: We present preliminary findings from an ongoing clinical trial to be completed in the spring of 2016. We investigated the degree to which EEG neurobiomarkers predict treatment response in a sample (*N* = 7) of children (4-7 years; 3 girls, 4 boys) with ASD (Mean IQ=87.13 SD=20.53) who participated in a 16-week trial of PRT.
Methods: Treatment included 6 hours per week of individual work with the child plus parent training. Our Primary clinical outcome was the SRS-2 Total Raw Score (parent report). Participants sat for a high-density EEG session (128-channel Hydrocel Geodesic sensor net), before treatment. During EEG recording, participants were presented with well-validated stimuli depicting point light displays of coherent biological or scrambled biological motion. We evaluated the extent of suppression in the EEG alpha frequency band range (8-12 Hz, mu suppression) in response to viewing biological or scrambled biological motion at baseline and how this measurements predicted the change in the SRS score from baseline to the treatment endpoint. We spectrally analyzed EEG measured over the left and right central regions (corresponding to C3 and C4).

Following standard procedures for data normalization (natural log) and computation of mu suppression. We computed difference between biological motion and rest and the difference between scrambled biological motion and rest considered as a ratio (Bernier, Dawson, Webb, & Murias, 2007).
Results: A 16-week course of PRT resulted in a significant improvement in levels of social impairment as measured via the SRS-2, $t(6) = 3.520$, $p = .013$. Moreover, considering mu suppression to biological motion at EEG site C3, repeated measures indicated a significant time (pre vs. post SRS) by mu suppression interaction, $F(1, 5) = 9.29$, $p = .028$. Scatter plots for the association between C3/C4 and SRS change are presented in Figure 1.
Conclusions: Our preliminary findings suggest functioning in the neural circuitry that supports social perception predicts who will show the most clinical benefit from a 16-week course of PRT. Effects were similar for both lateralized cortical regions, though stronger on the left. These results lead the way to help develop stratification and target engagement biomarkers for ASD clinical trials.

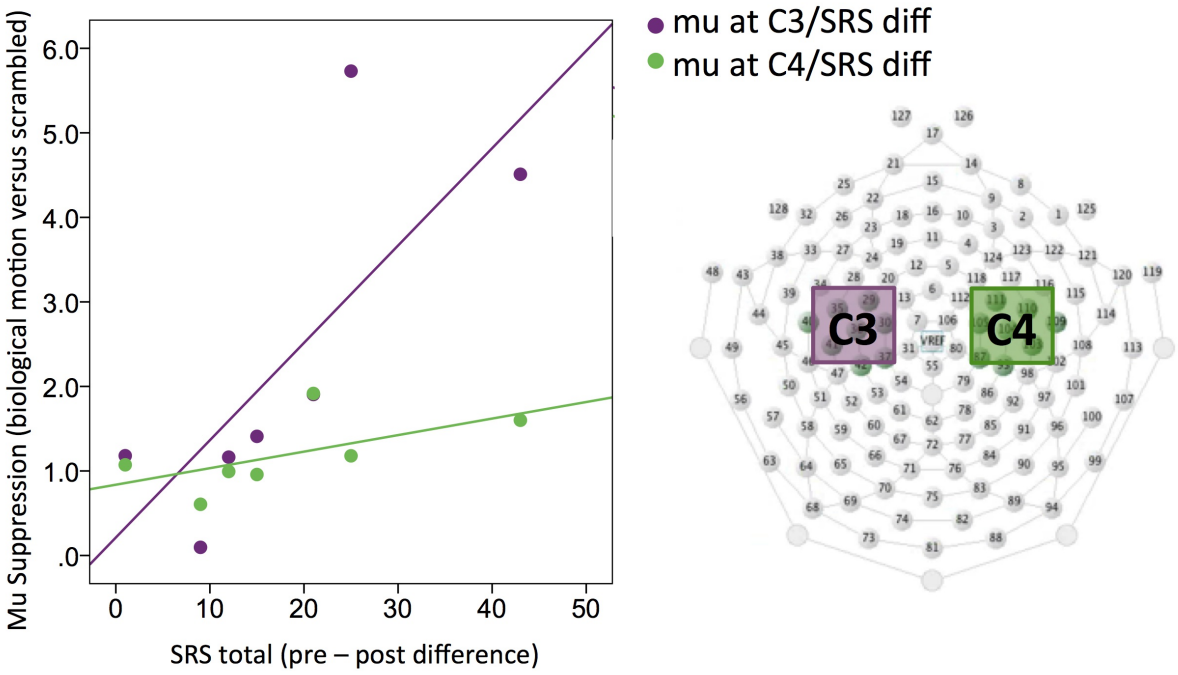


Figure 1. Mu suppression plotted against pre-post change in SRS and EEG scalp location.

101 **108.101** Neuroimaging Predictors of Benefits from Pivotal Response Treatment

A. Y. Hardan[1], *G. W. Gengoux*[1], *J. Hegarty*[1], *J. M. Phillips*[1], *S. Tanaka*[1], *T. W. Frazier*[2] *and A. L. Reiss*[1], *(1)Stanford University, Stanford, CA, (2)Cleveland Clinic Center for Autism, Cleveland, OH*

Background: Autism spectrum disorder (ASD) is a heterogeneous disorder and several neurobiologic measures have been examined to identify potential subgroups, with limited success thus far. Applying neuroimaging methodologies to identify prognostic markers or indicators of treatment response may be an alternative approach to address this heterogeneity. To date, no biomarker of treatment response has been identified for any biological or behavioral intervention in autism. Additionally, there is a growing need for innovative, efficient, cost-effective treatment models guided by biological markers of treatment response to optimize results and long-term outcome. This is particularly true for very young children with ASD when the brain is most plastic and time should not be wasted in implementing treatments that might not be beneficial.
Objectives: The goal of this investigation is to use a hypothesis-generating approach and apply multimodal imaging techniques to help identify biomarkers of treatment response. In this investigation, we aim at applying structural magnetic resonance imaging (MRI) and diffusion tensor imaging (DTI) to identify biomarkers of pivotal response training (PRT) treatment response. The development of biosignatures of treatment response is critical and the present study is the first step in providing evidence supporting the possibility of identifying biomarkers to predict response to behaviorally- and biologically-based treatments.
Methods: The PRT intervention consisted of teaching parents behavioral techniques to facilitate language development. PRT training lasted at least 12 consecutive weeks with one session per week. Sessions included in-vivo coaching of parent implementation of PRT techniques with their child, as well as review and feedback on videos of parents practicing PRT at home. Objective and subjective outcome measures were obtained at baseline and at the end of treatment. High-resolution anatomical MRI and DTI scans are being obtained on children with ASD before and after their participation in PRT. Correlations between neuroimaging measures (volume and fractional anisotropy (FA)) in language areas (e.g. superior longitudinal fasciculus(SLF)) and changes in outcome measures were examined.
Results: Eighteen children with ASD have participated in this study to date. Anatomical MRI and DTI scans have been obtained on all individuals at baseline (prior to treatment). Five follow-up scans (post-treatment) have successfully been collected. Neuroimaging and treatment data are available on 8 participants as the additional scans and behavioral information are being processed. Preliminary findings revealed no relationships between the size of any brain regions implicated in language development and response to PRT treatment. However, associations between FA in the SLF and changes in several language measures were observed including the number of utterances during structured laboratory observation and number of words produced out of 396 on the MacArthur-Bates Communicative Development Inventories.
Conclusions: Preliminary findings from this pilot study suggest that neuroimaging measures are potentially useful as predictors of treatment response. Additional analyses will be completed as more data become available. We will discuss these findings and highlight the advantages and challenges of using neuroimaging information in clinic trials to assess treatment response and biologic changes due to the intervention.

102 **108.102** Neuroprediction of Treatment Effectiveness in Young Children with Autism Spectrum Disorder

D. Yang, *K. Pelphrey, C. A. Paisley, M. L. Braconnier, S. M. Abdullahi, D. G. Sukhodolsky, M. J. Crowley and P. E. Ventola, Yale Child Study Center, Yale School of Medicine, New Haven, CT*

Background: Advances in genetics, molecular biology, and cognitive neuroscience offer promise towards personalized treatment to improve outcomes in individuals with ASD. Recent clinical trials have shown favorable results; however, the promise of precision medicine is hindered by a lack of sensitive, objective measures to identify subgroups likely to respond to specific treatments. Instead, our field relies on availability of service, trial-and-error, and clinical judgment to make treatment decisions. Here we built upon our prior research characterizing the neural-systems-level basis of core social communication symptoms in ASD to identify a potential stratification biomarker.
Objectives: We investigated the degree to which fMRI neurobiomarkers predict treatment response in a sample ($N = 17$) of children (4-7 years; 5 girls, 12 boys) with ASD (Mean IQ=102.82, SD=16.72) who participated in a 16-week trial of Pivotal Response Treatment (PRT), a behavioral treatment focused on social communication skill development.
Methods: Treatment included 6 hours per week of individual work with the child plus parent training. Primary clinical outcome was the SRS-2 Total Raw Score. During a 5-minute fMRI scan at 3 Tesla, conducted at baseline, the participants viewed well-validated neuroimaging stimuli depicting point light displays of coherent biological (BIO) or scrambled biological (SCRAM) motion. We evaluated the extent to which activation in response to viewing BIO vs. SCRAM at baseline predicted the change in the SRS score from baseline to the treatment endpoint, while controlling for the baseline SRS score.
Results: Using a whole-brain group analysis (mixed-effects modeling using FSL's FLAME1+2, voxel-level thresholding $Z > 2.33$, cluster-level thresholding $p < .05$, controlling for sex), we estimated the correlation between change in SRS total raw score from baseline to treatment endpoint and magnitude of pre-PRT brain response to BIO vs. SCRAM. This revealed three clusters of neuropredictive activity (Figure 1). Cluster 1 (green) was centered in the right ventrolateral prefrontal cortex, orbitofrontal cortex, anterior insula, and temporal pole. Cluster 2 (blue) was centered in the right fusiform gyrus, inferior and middle temporal gyri, and superior temporal sulcus. Cluster 3 (red) was centered in the left putamen, pallidum, hippocampus, amygdala, and ventral striatum/nucleus accumbens. Figure 2 showed the scatter plot of the improvement in social

communication skills (y-axis) vs. pre-PRT BIO > SCRAM activity (x-axis) for each of the three clusters. Strikingly, none of the demographic (age, IQ, sex) or baseline behavioral (ADOS, ADI-R, SRS, Vineland-II, CELF) variables predicted response to treatment.
Conclusions: We discovered a neuroimaging-based biologically informed stratification biomarker that predicts magnitude of response to an evidence-based behavioral treatment in young children with ASD. Neurosynth results suggest that baseline levels of activity in well-known emotional regulation (cluster 1), social perception and face recognition (cluster 2), and social reward/motivation and emotion (cluster 3) networks predicted the magnitude of clinical response to PRT. Importantly, these biomarkers outperformed pre-treatment behavioral measures of social functioning, language level, and cognitive abilities. Our results provide the first-ever clear evidence of a neuroimaging-derived stratification biomarker in ASD and help the field progress to the goal of targeted, personalized treatment for individuals with ASD.

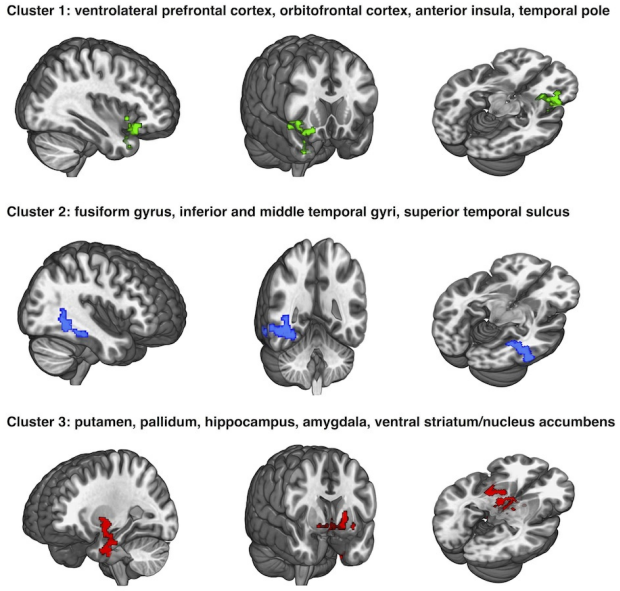


Figure 1. Brain regions of the pre-treatment neuro-predictors of treatment effectiveness

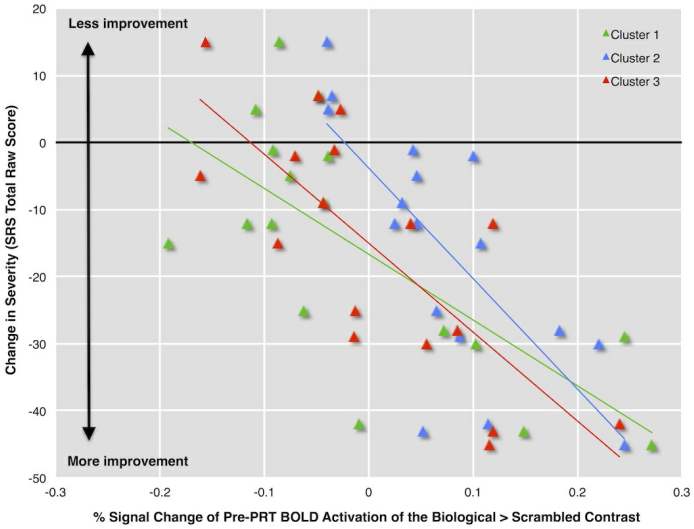


Figure 2. Scatterplot of activation in the pre-treatment neuro-predictors vs. treatment effectiveness

103 **108.103** Outcomes of a 10-Hour per Week Interdisciplinary Early Intervention Program for Young Children with Autism

A. Tanner[1] *and C. Ganam*[2]*, (1)Monarch House, Vancouver, BC, Canada, (2)Monarch House, BUrnaby, BC, Canada*

Background: There are currently no biological markers for diagnosing autism spectrum disorder (ASD) therefore the diagnosis relies solely on behavioral features, and although it is understood that early diagnosis and intervention can maximize the outcomes of children with ASD, children are often not diagnosed until they are between 3 and 6 years of age (Johnson & Myers, 2007). MacDonald, Parry-Cruwys, Dupere & Adhern (2014) found that 90% of children who started intervention prior to 2 years of age made significant gains in their first year of early intensive behavior intervention (EIBI) whereas only 30% of children who began EIBI after 30 months of age made significant gains in their first year of treatment. Monarch House is a multi-disciplinary clinic where children under the age of 6 with a diagnosis of ASD receives a minimum 10 hours of behavior intervention weekly, overseen by an interdisciplinary team consisting of a Behavior Analyst, a Speech and Language Pathologist and an Occupational Therapist.
Objectives: This study reviews the specific clinical model and evaluates the effectiveness of a 10 hour, per week interdisciplinary model using The Autism Diagnostic Observation Schedule (ADOS) and The Verbal Behavior Milestone Assessment and Placement Program (VB-Mapp).
Methods: A single-subject, multiple baseline across participants design was used to evaluate the key outcomes of 30 children with ASD in their first year of intervention. The rate of acquisition (number of milestones achieved per month) for the first year of treatment was evaluated and compared across three intervention groups: those who began intervention prior to age 3, those who began intervention between the 3 and 4 years of age, and those who began intervention after 4 years of age.
Results: Preliminary results suggest that those who began treatment prior to the age of 3 achieved significantly more VB-Mapp Milestones in their first year of intervention than those who began treatment after three years of age.
Conclusions: The effects and benefits of a 10 hour per week interdisciplinary early intervention program will be discussed.

104 **108.104** Peer Versus Teacher Talk in Early Intervention Classrooms: Case Studies Suggest That Inclusion Might be Different

E. F. Ferguson[1]*, A. S. Nahmias*[2]*, L. Bateman*[1]*, K. J. Payton*[1]*, D. S. Mandell*[3]*, R. T. Schultz*[4] *and J. Parish-Morris*[1,5]*, (1)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (2)University of Pennsylvania, Philadelphia, PA, (3)University of Pennsylvania School of Medicine, Philadelphia, PA, (4)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (5)Suite 860, Children's Hospital of Philadelphia, Philadelphia, PA*

Background: Children with autism spectrum disorder (ASD) may benefit from being placed in classrooms with their typically developing peers. For example, children who do not floor on language measures in preschool demonstrate steeper rates of cognitive growth in inclusion classrooms than in mixed-disability or autism-specific classrooms (Nahmias et al., 2014). It may be that neurotypical children talk more than children with disabilities, and model and interact with verbal children with ASD to their benefit. Teacher talk may also help; teachers in inclusion classrooms may direct more talk to children with ASD than teachers in autism-only or mixed-disability classrooms. We explore these questions by assessing the language environments of children with ASD in three different classroom types.
Objectives: Measure speech produced by and directed at preschoolers with ASD in three classroom types (inclusion, mixed disabilities, autism-only); measure the association between natural language and standardized assessments.
Methods: Samples have been collected from 25 children; these results concern the first 5 (all others will be transcribed and included before May 2016). Average age was 3.8 years (range=3.7-4.4), Mullen Scales of Early Learning (MSEL) Early Learning Composite scores ranged from very low to below average (mean=60.8, range=49-83), and autism-related symptoms on the ADOS ranged from moderate to high. Participants wore digital language recorders during a normal school day. We transcribed words produced by participants during ~20 minutes of circle time and ~20 minutes of free play (Total Mean=39.2 minutes, SD=2.6, range: 35-42) and language directed toward participants by peers and teachers. Nonparametric correlation analyses assessed associations between natural language production and standardized language tests. Words per minute (WPM) are described in a case-study style for inclusion and autism-only classrooms (N=1 each) and at the mean level for mixed disability classrooms (N=3).
Results: Participants' WPM correlated with expressive language scores, Spearman=.87, p=.05, and teachers' WPM toward participants was positively associated with participants' receptive language scores, Spearman=.89, p=.04. Peers talked more with participants who produced more words themselves, Spearman=.90, p=.04. More peer talk was directed toward participants in the inclusion classroom (8.3 WPM), than in the autism-only classroom (4.1 WPM). The inclusion classroom had the lowest rate of teacher talk directed toward participants (29.8 WPM), while teacher talk in the mixed disability classroom (48.4 WPM) was similar to the autism-only classroom (51.0 WPM).
Conclusions: Short language samples from children with ASD in preschool classrooms correlate significantly with standardized language measures, suggesting that they assess the same underlying construct. Interestingly, the inclusion classroom had both the highest rate of peer talk and the lowest rate of teacher talk directed toward participants. This preliminary finding suggests that inclusion classrooms may feature increased opportunity for peer interaction and modeling, which could benefit some children. Other children with ASD may benefit from higher rates of teacher talk found in the mixed disability and autism-only environments. Future analyses with a much larger sample will include longitudinal moderation analyses to assess the differential effects of classroom language environment on cognitive and social growth over 9 months in children of varying language profiles.

105 **108.105** Preliminary Efficacy of Relationship Development Intervention® and Parent-Implemented Applied Behavior Analysis/Verbal Behavior on Joint Attention and Communication of Preschool Children with Autism

M. Kerwin[1]*, M. E. Soreth*[1]*, C. Gangemi*[2] *and B. Coleman*[1]*, (1)Rowan University, Glassboro, NJ, (2)Family First, LLC, Haddonfield, NJ*

Background: Acquiring joint attention (JA) and functional spoken language by the time a child with autism enters school around the age of 5 years old are critical. Involving parents in treatment maximizes the child's opportunities to learn. Relationship Development Intervention® (RDI) is a relationship-based intervention focusing on recreating developmental milestones through meaningful interactions with parents with a primary goal of increasing JA. However, little research has evaluated the efficacy of this

intervention. In contrast, a model based on Skinner's Analysis of Verbal Behavior (ABA/VB) increases spoken language directly when implemented by therapist and teachers; however, this approach has not been evaluated when implemented by parents. RDI and ABA/VB have different primary targets for intervention; however, both approaches assume that language and JA, respectively, will emerge as a corollary effect of the intervention.
Objectives: The purpose of this pilot study is to compare the efficacy of two parent-implemented adjunctive interventions, RDI and ABA/VB, against Services As Usual (SAU) on JA and language in children 2-6 year old with ASD.
Methods: Participants were 36 children diagnosed with autism spectrum disorder (ASD) by community providers and the Autism Diagnostic Observation Schedule-2™. Participants were randomly assigned to RDI, parent-implemented ABA/VB, or SAU conditions. All parents, regardless of assigned condition, reported weekly on the type and extent of services delivered. The intervention consisted of 16 sessions over 14 weeks delivered in the home. Assessments were conducted pre-treatment and end of treatment (3 months). The primary outcome measure was direct observation of parents and children interacting under different scenarios designed to implement conditions most likely to produce the behavior targeted by the interventions (e.g., joint attention, specific language skills) including prompts that involved having the child ask the parent for preferred items and engaging the child in a conversation about family photographs. The direct observations were coded by research assistants blind to treatment condition and trained to interobserver reliability levels of 80% or above on a coding taxonomy that included an array of parent and child behavior related to joint attention, language, and problem behavior. In addition, two standardized assessments were also administered (Mullen Scales of Early Learning and Communication and Symbolic Behavior Scales).
Results: All participants for the study have been recruited and 29 children have completed the treatment and post-assessment. Preliminary results indicate that both RDI and ABA/VB produced gains in the child's following of bids for joint attention, three-point gazes, and initiating verbalizations while SAU did not result in any gains for any of these behaviors.
Conclusions: This pilot study examines the efficacy of parent-implemented RDI and ABA/VB against SAU on social and emotional communication and language via direct observation and standardized measures. Preliminary results indicate that both interventions are able of producing gains in joint attention and verbal behavior, even though the two interventions differ in primary intervention targets. Furthermore, children in SAU condition did not show evidence of change. These results support that parents can serve as effective agents of change in the implementation of empirically supported early interventions for ASD.

106 **108.106** Project Impact Implementation Fidelity: Researcher, Clinician, and Parent Measures Relative to Child Outcomes

A. B. Barber[1], *H. Noble*[2], *C. H. Cook*[3] *and B. Ingersoll*[4], *(1)University of Alabama, Tuscaloosa, AL, (2)Vanderbilt University, Nashville, TN, (3)Communicative Disorders, University of Alabama, Tuscaloosa, AL, (4)Michigan State University, East Lansing, MI*

Background:
Documented intervention gains resulting from the Project ImPACT intervention model (Ingersoll & Dvortcsak, 2009) include increased spontaneous language (Ingersoll & Wainer, 2013), decreased social impairments (Ingersoll & Wainer, 2011; Stadnick et al., 2015) and increased social engagement (Pierucci, 2013). Further, parents demonstrate adherence to Project ImPACT strategies (Ingersoll & Wainer, 2011, 2013; Pierucci, 2013; & Stadnick, et al., 2015), and report improved parenting efficacy, a critical component to child and parent outcomes (Karst et al., 2012). Little is known about the contributions of implementation fidelity to intervention outcomes (Stahmer et al., 2015), although systematic measurement of treatment fidelity is essential when interpreting intervention efficacy (Zwaigenbaum et al., 2015).
Objectives:
To measure fidelity of Project ImPACT at three levels: researcher, clinician, and parent.
To measure child and parent outcomes and implementation fidelity across two dosage groups: one versus two hours per week of Project ImPACT intervention.
Methods:
Six children with ASD (mean age = 32 months) participated. Group 1 received Project ImPACT for 2 hours per week, for twelve consecutive weeks, group-based parent coaching, an individualized session with a clinician and more dense individual parent coaching. Group 2 received intervention 1 hour per week, group-based parent coaching, an individualized session with a clinician, and less personalized parent coaching. Social engagement, language, and play were assessed using the Social Communication Checklist (SCC; Ingersoll & Dvortcsak, 2009). The Parental Sense of Competency Scale (PSOC) measured parent satisfaction (anxiety, motivation, frustration) and efficacy (competence, problem solving, and capability). Finally, developmental and vocabulary measures were administered. All measures were completed pre-and post-intervention. Fidelity was measured at three levels: group sessions, parent implementation, and clinician implementation.
Results:
An 80% average was considered implementing the strategy with fidelity (Ingersoll & Wainer, 2013). The primary researcher achieved an average of 95% fidelity across both groups. Clinician implementation fidelity during individual sessions averaged 60.7 % and 52.3% in Groups 1 and 2, respectively. Parent implementation fidelity averaged 72% and 54% in Groups 1 and 2, respectively. Fidelity was elevated for both clinicians and parents in the higher dose group. Higher parent fidelity was related to better child outcomes. A Mann-Whitney U test revealed no clinically significant differences in social engagement, (U= 5.50 p=1.0), language (U= 4.00, p=1.0), or social imitation (U=3.50, p=1.0) domains across dosage groups, though all children demonstrated gains. Interestingly, parents with higher fidelity scores reported lower sense of efficacy on the PSOC. Parent sense of satisfaction increased across all parents, though no group differences were found for efficacy or satisfaction. Potential influences of demographic variables will be discussed. Visual analysis of outcomes will be presented.
Conclusions:
Intervention fidelity may be a more accurate predictor of intervention outcomes than dose, at least within this modest comparison. Fidelity outcomes are higher when material is more structured (Stahmer et al., 2015), such as in instructional group settings, and with more experienced clinicians. These findings contribute to growing literature supporting the efficacy of Project ImPACT intervention for young children with ASD and their parents.

107 **108.107** Relations Between Parental Use of Esdm Intervention Techniques and Communication Growth in Toddlers with ASD

M. R. Talbott[1], *K. Moomey*[2], *J. Greenson*[2], *K. S. Davlantis*[3], *C. D. Zierhut*[4], *J. Munson*[2], *N. Lange*[5], *A. M. Estes*[6] *and S. J. Rogers*[7], *(1)University of California, Davis, Sacramento, CA, (2)University of Washington, Seattle, WA, (3)Duke Center for Autism and Brain Development, Duke University School of Medicine, Durham, NC, (4)UC Davis MIND Institute, Sacramento, CA, (5)McLean Hospital, Cambridge, MA, (6)University of Washington Autism Center, Seattle, WA, (7)University of California at Davis, Sacramento, CA*

Background: Communication difficulties are a core domain of impairment for young children with autism spectrum disorders (ASD), and some of the earliest appearing symptoms and most frequently reported parental concerns (Zwaigenbaum et al., 2013). Parent-implemented interventions can be effective in promoting communication skills, but the specific features of parent delivery that underlie developmental change are not well understood.
Objectives: Here, we investigate relations between toddlers' communication skills and two parental variables hypothesized to contribute to treatment-related communication gains: parental use of treatment techniques (fidelity) and the rate of high quality learning opportunities. We hypothesized that parental use of these two delivery features would explain significant variation in toddlers' communication skills. These questions are examined in the context of parent-implemented Early Start Denver Model (P-ESDM), a comprehensive developmental-behavioral intervention for young children with ASD.
Methods: 30 Toddlers with ASD and their parents completed the study. Following baseline assessments, families received 12 weeks of coaching in ESDM followed by a 12 week maintenance phase and a final post-maintenance assessment. Standardized assessments were collected pre-treatment, post-treatment, and post-maintenance. Communication skills were measured monthly using an adapted version of the ESDM Curriculum Checklist (Rogers and Dawson, 2010). Parent treatment delivery was coded from video captured by families in their home at several points over the course of the study. From each video, 3-minute clips of each of three activity types were used for scoring song and game routines, toy-based interactions, and caregiving activities (ex. bath or meal).
Fidelity scores were obtained from ratings of parent techniques used across 13 domains. Learning opportunity scores were calculated for both the rate of successful learning opportunities provided, where success was defined as providing an appropriate response to child behavior (i.e. reinforcing desired behavior and ignoring/correcting unwanted behavior) as well as the percentage of attempted opportunities scored as successful. Successful learning opportunities were further characterized as either parent-initiated or child-initiated to examine effects of parental responsiveness versus elicitation, respectively, in promoting learning.
Results: 30 families contributed data both pre-treatment and post-maintenance. Learning opportunity data pre- and post-maintenance (n=23), and fidelity (n= 30) has been scored. Paired t-tests demonstrate that 1) toddlers made significant gains in standardized measures of language, t(29) = 6.11, $p<.0$, and 2) parents demonstrated significant increases in both ESDM fidelity and percentage of successful, high-quality learning opportunities (Fidelity: t(17) = 2.57, p = .02, Percent successful opportunities: t(10) = 4.68, p = .001). Marginally increases in the frequency of parent-initiated learning opportunities were also observed (t(10) = 2.19, p= .054).
Conclusions: These data demonstrate that a low-intensity parent coaching intervention results in significant increases in parent behaviors hypothesized to support language and communication development and replicate previous reports of child behavior change. Hierarchical models of the relations between parent and child behavior will be discussed.

108 **108.108** Standardized Measures of Improvement in Language Across Two Randomized Clinical Trials of Pivotal Response Treatment

G. W. Gengoux[1], *M. B. Minjarez*[2], *J. M. Phillips*[1], *K. L. Berquist*[1], *C. Ardel*[1], *R. A. Libove*[1], *M. E. Millan*[1], *R. Schuck*[1], *T. W. Frazier*[3] *and A. Y. Hardan*[1], *(1)Stanford University, Stanford, CA, (2)Seattle Children's Hospital, Seattle, WA, (3)Cleveland Clinic Center for Autism, Cleveland, OH*

Background: Pivotal Response Treatment (PRT) is an evidence-based naturalistic behavioral intervention. Support for its use in improving language abilities has historically

come from single-case studies using primarily behavioral observation measures. There is a critical need for examination of outcomes from larger samples and from objective measures which can be more easily compared across trials and to normative developmental trajectories.
Objectives: This presentation will review standardized language outcomes from two randomized controlled trials of PRT, including a 12-week trial of PRT Group treatment (PRTG) and a 24-week PRT package treatment (PRT-P) which combines parent training with clinician-delivered in-home treatment. Our aim is to highlight new data demonstrating how standardized measures of language and cognitive abilities can be used to assess treatment response in clinical trials.
Methods: Participants include children with ASD and significant language delay, ages 2-6 years. Participants in the first trial were randomly assigned to either PRTG or a parent psychoeducation control group. Participants in the second trial were randomly assigned to either PRT-P or delayed treatment. Dependent measures include objective tests of language and cognitive abilities as well as Clinical Global Impression Improvement (CGI-I) ratings by raters blinded to treatment condition and standardized parent questionnaires.
Results: The PRTG trial has been completed and the PRT-P trial is ongoing; data are currently available from 47 participants from PRTG and 28 from PRT-P. Findings from the PRTG trial revealed significant improvement on Vineland Adaptive Behavior Scales Communication Scale in the active group compared to control ($F(2,19) = 3.80$, $p = .041$). CGI-I ratings focusing on communication also indicated greater improvement in the PRTG compared to controls ($F(1, 44) = 15.97$, $p < .001$). A non-significant trend was observed for MacArthur-Bates Communicative Development Inventories (CDI) mean length of longest utterance ($F(2, 32) = 3.09$, $p = .059$). Three-month follow-up data revealed that children maintained their improvement on the Vineland Communication Domain Standard Score ($F(2, 12):11.74$, $p=.001$) and cognitive improvement was observed on the Mullen Scales of Early Learning Composite score ($F(1, 20)= 5.43$, $p=.03$). Similarly, preliminary findings from the PRT-P trial revealed children in the active group are acquiring greater vocabulary as evidenced by an average gain of over 150 words on the CDI between baseline ($M=126.6 \pm 111.2$) and post treatment ($M=281.0 \pm 194.3$), which was significantly greater than changes observed in the control ($F(1,20)=5.267$, $p=0.037$). CGI-I ratings indicate that the PRT-P group is showing more overall improvement compared to controls ($X^2= 9.363$; $p=0.025$). Finally, we present data from using the Language ENvironment Analysis (LENA) system to assess generalized language improvements from automated analysis of natural environment audio recordings.
Conclusions: These data provide support for the application of PRT to improve child language and cognitive abilities. At the same time, comparison of standardized language measures across trials reveals clear differences in outcomes which may be attributed to differences in treatment delivery models and to sample characteristics. We will discuss these differences by highlighting the advantages and challenges of specific standardized measures, and provide recommendations for the design of future trials.

109 **108.109** The Differential Relationship Between Competence and Stress Across Parent Groups for Caregivers of Children with Autism Spectrum Disorder

B. Harrison[1], *S. Iadarola*[2], *T. Smith*[3], *K. Bearss*[4], *C. R. Johnson*[5], *L. Lecavalier*[6], *N. Swiezy*[7], *D. G. Sukhodolsky*[8] *and L. Scahill*[9], *(1)University of Rochester, Pittsford, NY, (2)University of Rochester Medical Center, Rochester, NY, (3)Division of Neurodevelopmental and Behavioral Pediatrics, University of Rochester Medical Center, Rochester, NY, (4)Marcus Autism Center, Children's Healthcare of Atlanta & Emory University School of Medicine, Atlanta, GA, (5)Dept of Clinical and Health Psychology, University of Florida, Gainesville, FL, (6)The Ohio State University, Columbus, OH, (7)University of Indiana, Indianapolis, IN, (8)Yale Child Study Center, Yale School of Medicine, New Haven, CT, (9)Pediatrics, Marcus Autism Center, Atlanta 30329, GA*

Background: Parents of children with autism spectrum disorder (ASD) report exceptionally high levels of stress compared to parents of children with other medical or developmental conditions. Stress patterns relate to core symptomatology as well as externalizing behavior (Davis & Carter, 2008), particularly challenging behavior. Although parent training (PT) seems applicable to these concerns, data on the effects of PT on parenting stress are mixed (Strauss, 2012). Because parent characteristics are likely to influence treatment outcomes, parent variables should be evaluated as potential mediators and moderators. One promising variable is parent competence. In the literature on externalizing disorders and challenging behavior in typically developing children, PT results in increased parent competence (de Graaf et al., 2008; Graf, 2014), which is a mediator of improvement in parent and child behavior (Dekovic, 2010; Graf et al., 2012).
Objectives: Evaluate the extent to which change in parent competence relates to change in parent stress and statistically test if this relationship significantly differs between PT and a control condition (psychoeducation; PE).
Methods: Children with ASD (age 3-7 years) and their families were randomly assigned to parent training (PT; n=89) or to psychoeducation (PE; n=91) for six months. Competence was measured with the Parent Sense of Competence (PSOC), and stress was measured with the Parenting Stress Index (PSI-SF) and Caregiver Strain Questionnaire (CGSQ). The primary child outcome measure was the Aberrant Behavior Checklist – Irritability (ABC-I). Parents completed these rating scales at baseline, week 12, and week 24 (post-treatment). A latent difference score (LDS) approach (McArdle, 2009) was used to examine group differences in initial competence and later stress, as well as whether change in competence predicted change in stress and if this relationship differed across groups.
Results: At Week 24 (post-treatment), parents in PT showed a significant advantage over parents in PE on the PSOC (ES=.34), CGSQ (ES=.50), and Difficult Child subscale of the PSI-SF (ES=.44), although not PSI-SF total (p=.07; ES=.25). Parents in PT and PE began treatment with comparable levels of competence ($p > .05$) and significantly increased competence from baseline to week 12 ($ps<.01$), with parents in PT making greater gains than those in PE ($z=1.99$, $p<.05$). Both groups also reduced stress from Week 12 to Week 24 ($ps<.05$); this amount of change did not significantly differ between PT and PE. Change in competence was not significantly associated with change in stress in either PT or PE. Change in competence predicted favorable change in ABC-I ($p<.05$), but this relationship did not differ across groups.
Conclusions: The differentially greater increase in competence at week 12 in PT (versus PE) did not confer incremental benefit in terms of decreased stress post-treatment. This suggests that while further exploration of competence in this population is warranted, other potential parent variables that may impact treatment outcomes for children with ASD should be explored.

110 **108.110** The Frankfurt Early Intervention Program for Preschool Children with Autism Spectrum Disorder (FFIP) - First Results on the Two Year Development

J. Kitzerow[1], *K. Teufel*[1], *C. Wilker*[1] *and C. M. Freitag*[2], *(1)Autism Research and Intervention Center of Excellence Frankfurt, Goethe University Hospital, Frankfurt, Germany, (2)Department of Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy, Johann Wolfgang Goethe-University Frankfurt/Main, Frankfurt, Germany*

Background: Several studies have shown that early intervention can result in improved development for young children with autism spectrum disorder (ASD). The Frankfurt early intervention program (FFIP) is an individual developmental and behavioral approach with low training intensity (2h/week) and intensive parental involvement which is currently manualized (Teufel et al., in preparation).
Objectives: The aim of this study was to assess the 2-year outcome of FFIP on autism severity (ADOS), adaptive behavior (VABS), mental age (DQ) and additional psychiatric symptoms (SRS, SCQ, ABC, CBCL) in a pre-/post-study. As the present study lacks a control group, the results of FFIP are compared with the results of the RCT ESDM study (Dawson et al., 2010) which showed similar baseline data in most variables.
Methods: N = 27 children with ASD (ADOS severity score = 7.3; SD = 1.4), aged M = 55.5 month (SD = 12.2) took part in the 2-year FFIP study. Difference scores of T2-T1 measures were calculated for the variables of interest and the value was compared to H0: $\mu = 0$, i.e., no change. For mental age, the t-test value μ was set to the expected yearly development (7.9 months/year). To compare the study results with the ESDM groups, μ was set to the relevant change value after 2 years reported in the ESDM study.
Results: The ADOS severity score showed a decline of 0.9 points after 2 years of FFIP which was significantly more than the ESDM control group achieved ($t = -3.44$; $p = .002$) and slightly better than the results of the ESDM treatment group ($t = -1.98$; $p = .059$). No significant change in VABS-II total standard score was observed, but compared with the ESDM groups this result is significant better than the loose of standard scores the control group showed in the total score ($t = 8.3$; $p < .001$) and comparable with the gains of the ESDM treatment group ($t = 1.90$; $p = .070$). After two years of FFIP a cognitive development of 23.5 month was observed. This was significantly more than expected ($t = 3.80$; $p = .001$). The developmental quotient increased by 8.9 points, showing no difference to the ESDM control group ($t = .72$; $p = .478$) and less improvement than the ESDM treatment group ($t = -3.33$; $p = .003$).
Conclusions: This study shows the 2-year development in children who received FFIP. Results on adaptive behavior and autism severity are comparable with the development of children in the ESDM RCT study. This is a conservative comparison, as better therapeutic gains would be expected in the younger ESDM comparison group which received more hours of intervention. Similar to previous reports, variability in outcome was large and the lack of a matched control group is a strong limitation of the study. A randomized-controlled trial needs to be performed to proof its effectivity compared to community-based early intervention programs in Germany.

111 **108.111** The Sequential Oral Sensory Approach Intervention in Treating Children with Autism Spectrum Disorder and Limited Food Repertoire. a Pilot Study

S. Smile[1,2], *M. Pena*[1], *K. Perry*[1], *R. Perlin*[1], *C. Raffaele*[1], *A. Munoz*[2], *M. Lynch*[1] *and A. Dupuis*[3], *(1)Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada, (2)Bloorview Research Institute, Toronto, ON, Canada, (3)The Hospital for Sick Children, Toronto, ON, Canada*

Background:
Food selectivity is one of the most common feeding challenges noted within Autism Spectrum Disorder (ASD). This phenomenon is inclusive of food refusal, limited food repertoire (LFR) and high frequency single food intake. Its etiology is thought to be multifactorial, involving sensory, motor and mealtime behavioural idiosyncrasies. Excessive weight gain and nutritional deficiencies have been linked to poor feeding behaviours in ASD. Currently there is a lack of evidence based treatments to address these feeding challenges. Most hospital based interventions used to address this issue are limited to a multidisciplinary team approach which may have economic and human resource limitations. There are a myriad of behavioural interventions targeting feeding challenges; among them, the Sequential Oral Sensory Approach (SOS) is a commonly used approach used within the community. However, SOS is most commonly administered in a dyad (individual and clinician) construct which could be costly to the family. Its application in a group setting to mitigate cost and maximize human resources has not been studied.
Objectives:
This pilot study's aim is to evaluate the feasibility and effectiveness of the SOS approach intervention in increasing the food repertoire in children with ASD and LFR.
Methods:
Children 4 to 8 years with ASD were recruited. LFR was defined as eating less than 20 foods identified in a 3 day food diary. Participants were randomized to receive the 12

SOS intervention sessions (inclusive of a parent education sessions) or to a control group where parents were provided with educational material and three feeding education sessions over a 12 week period.
Results:
Fifteen children completed the study (n=8 in the SOS group and n=7 in the control group). A study participant and a parent attended eighty one percent (81%) of sessions in the SOS group. There is a trend towards an increase in the number of foods eaten over a 12 week period in the SOS group and a decrease in the Brief Autism Mealtime Behaviour Inventory score and reduction of parental stress. All parents met individual goals established at the start of the intervention.
Conclusions:
This study supports the overall feasibility of the SOS intervention in a group based setting to address feeding challenges in ASD based on only 1 participant (12.5%) being unable to complete the 12 week intervention program. This study suggests that participation in the SOS intervention program may help to increase the number of foods eaten by a child with ASD and LFR over time. A larger randomized control trial is needed to further evaluate the effectiveness of the SOS intervention in children with ASD.

112 **108.112** The Use of Mirroring to Improve Social Engagement in Young Children with ASD

K. Radonovich *and K. Reese, University of Florida, Gainesville, FL*

Background: Reduced social engagement in young children with autism spectrum disorder (ASD) can be particularly challenging to treat. If not treated, social deficits could ultimately hinder a child's development, ability to establish meaningful relationships, and engagement in learning opportunities. Interventions that target social skills and social interaction are key in reducing negative outcomes associated with these deficits, and may ultimately improve the quality of life for individuals with ASD. Mirroring is a component of dance-movement therapy (DMT) that is somewhat comparable to imitation. Anecdotal and case study reports suggest the effectiveness of the use of mirroring and DMT to positively engage children with ASD. However, little to no objective data on outcomes of such interventions are available. There is empirical support for imitation interventions in improving play, movement, vocalization, and engagement in children with ASD. Thus, we were interested in objectively determining the effectiveness of mirroring to engage minimally-verbal children with ASD.
Objectives: We sought to measure the effectiveness of a mirroring intervention on the social engagement skills of young, minimally-verbal children with autism.
Methods: A multiple baseline across participants design, with replication was used to measure the effects of the intervention. Thus far, four participants (three boys and one girl) with ASD ages 3-4 years have participated in this study. Prior to intervention, children attended baseline sessions in which no mirroring of the child's behaviors occurred. During baseline the interventionist engaged in non-contingent movement and vocalization. During the intervention phase, the interventionist engaged in mirroring and attunement of the child's movements, vocalizations, and mood throughout the session. Sessions were videotaped and operationalized definitions of dependent measures (e.g., initiations, gaze toward the interventionist, and positive affect) were coded throughout. Data were analyzed using visual inspection and calculation of change in level, trend, immediacy of effect, stability, variability, and degree of overlap. Inter-observer agreement and treatment integrity data were also calculated.
Results: Results indicated that this non-intensive intervention increased all participants' social engagement behaviors almost immediately. A stable and functional relationship between the mirroring intervention and increases in target social engagement skills by all four children was demonstrated. Additionally, results indicate that the intervention was implemented with fidelity.
Conclusions: Overall, findings support the use of mirroring to improve the social engagement skills of young, minimally-verbal children with ASD. This study is one of very few in the literature to quantify and objectively measure the effects of this technique. Additionally, it addresses a gap in research on minimally verbal, young children with ASD using non-intensive implementation. Establishing empirical support for this technique, when implemented by a clinician trained in mirroring is vital. This study has important implications for theoretical basis of mirroring and DMT, as well as clinical and practical implications. Once further empirical support is established, future studies may expand on this technique by training parents, clinicians, and other professionals to utilize mirroring techniques to engage children with ASD.

113 **108.113** Training Caregivers in PRT: Lessons Learned in Private Practice

R. E. Daniels*, Chicago Children's Clinic, Winnetka, IL*

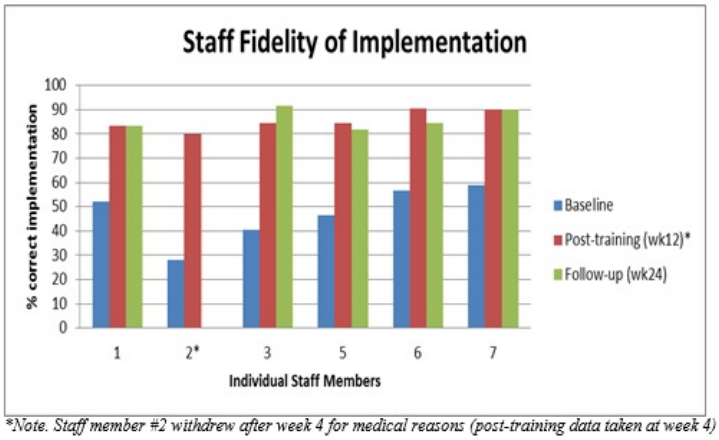
Background: Training parents in evidence-based behavioral intervention techniques can amplify the effect of direct behavioral therapy and improve the developmental trajectory of children with autism spectrum disorder (ASD; Coolican, Smith, & Bryson, 2010; Green et al., 2010; Kasari, Gulsrud, Wong, Kwon, & Locke, 2010; Schreibman et al., 2015). Additionally, parent implemented interventions are associated with reduced costs (Koegel, Bimbela, & Schreibman, 1996; Symon, 2001). Community studies of parent training programs revealed that parents were capable of implementing evidence-based treatments with fidelity and were able to train other caregivers and providers in acquired techniques, thus multiplying the effects of parent training exponentially (Symon, 2005).
Objectives: (1) To identify logistical hurdles encountered in private practice and community settings, (2) To present strategies used at a small, fee-for-service private practice to overcome these hurdles, and (3) To provide recommendations for efficient training of caregivers who possess multiple learning styles, strengths and challenges.
Methods: A review of the caseload at a small, fee-for-service private practice over the past 9 years was conducted to identify characteristics associated with the following outcomes: (1) Clinical outcome; (2) Efficiency of acquisition of treatment procedures with fidelity, and (3) High coordination of care with school and other agencies and providers.
Results: (1) Clinical outcome: When parent training was mandated prior to assignment of an in-home therapist, some parents opted not to work with the practice, but those who did were highly engaged, satisfied, and experienced positive child and family outcomes; (2) Efficient acquisition of treatment procedures occurred when sessions occurred in the home setting; however, the ability to acquire general parenting skills occurred most efficiently in multi-family group settings; (3) Brief, concise treatment plans that included baseline and outcome data, with specific recommendations for how components of PRT could be implemented in additional settings resulted in higher levels of coordinated care. Video examples were very effective at convincing agencies and schools to align their practices with those occurring at home. Parents with multiple children with ASD and/or limited finances required significant support when working with their school district to receive appropriate services.
Conclusions: Although logistical hurdles exist, such as parent compliance and arranging coordinated care with schools, brief parent training in PRT within a private practice setting is feasible for many families and results in positive child and family outcomes. Varying skills (i.e., PRT implementation vs. general parenting skills) may be learned more efficiently in specific settings, and family characteristics may impact the relative ease of coordinating care. This review supports the notion that PRT is a cost-effective intervention that can be adopted widely in community settings, including private practice.

114 **108.114** Training Early Childhood Educators in the Social ABCs Toddler Autism Intervention in a Community Child Care

J. A. Brian[1]*, K. Bernardi*[1]*, E. M. Dowds*[2] *and S. E. Bryson*[3]*, (1)Bloorview Research Institute, Toronto, ON, Canada, (2)The Hospital for Sick Children and Bloorview Kids Rehab, Toronto, ON, Canada, (3)Dalhousie University, Halifax, NS, Canada*

Background: The *Social ABC's* is a parent-mediated intervention shown to increase communication and positive emotion sharing in infants/toddlers with emerging autism. We adapted our program for Early Childhood Educators (ECEs) and Special Needs Resource Consultants (SNRCs) in community childcare settings including the addition of a 3-hour workshop on early detection and intervention in ASD. Training childcare personnel provides unique and valuable opportunities to: (1) increase knowledge in early detection, (2) increase the 'dose' of intervention throughout the day, (3) train highly skilled child development experts, and (4) have a long-term 'return-on-investment' via training individuals who can use the techniques with multiple children over time.
Objectives: To disseminate our *Social ABCs* into the childcare setting, with two research questions: (1) Can a directed workshop increase the knowledge of front-line childcare staff regarding signs of emerging autism? (2) Is it feasible to train staff in the *Social ABCs*in a community childcare?
Methods: (1) Present workshop and test knowledge (n=19); (2) Train frontline staff (n=6): 12 weeks of in-centre, live coaching, followed by 12 weeks' implementation, and follow-up at week 24. Paired samples t-tests evaluated change across time-points.
Results: (1) Workshops provided for 22 attendees; 19 wrote the workshop quiz, with mean improvement of 22.26% from pre- (52.63%, SD = 14.76) to post-workshop (74.89%, SD = 12.51), $t = 7.57$, $p < .001$. (2) Significant improvements in fidelity of implementation from baseline (Mean = 47.08%, SD = 11.51) to post-training (Mean = 85.50%, SD = 4.04), $t = 11.44$, $p < .001$. Gains were maintained at follow-up (Mean = 86.30%, SD = 4.19). All staff achieved fidelity > 80% post-training (see Figure 1).
Conclusions: Significant gains were observed in staff knowledge and skills in response to this training package. The model of training frontline childcare staff is feasible and effective, presenting an opportunity for integration of intensive intervention into daily activities for very young children at risk for ASD in community child care settings. Discussion includes perceived barriers to, and potential solutions for, widespread implementation.

Figure 1. Staff fidelity data from ECE training project (Brian et al)



Note. Staff member #2 withdrew after week 4 for medical reasons (post-training data taken at week 4)

115 **108.115** Understanding and Measuring Change and Impact of Novel Early Intervention Programs

S. Bauman[1], *M. L. Iemolo*[1], *Z. Warren*[2], *C. R. Newsom*[3], *A. Stainbrook*[1], *P. Juarez*[4] *and A. S. Weitlauf*[2], *(1)Vanderbilt Kennedy Center, Nashville, TN, (2)Vanderbilt University, Nashville, TN, (3)Pediatrics, Vanderbilt University Medical Center, Nashville, TN, (4)Vanderbilt University Medical Center, Nashville, TN*

Background:
State early intervention systems vary regarding their abilities to offer empirically validated treatments that specifically target ASD symptoms. Randomized controlled trials of manualized interventions have shown promise for some young children but data on their ability to translate into meaningful change in low-resource community settings is lacking. There is a pressing need for (1) enhanced strategies for successful community implementation and (2) better measures of the impact of implemented evidence-based programs for young children with ASD. This work describes one such pilot program that partners a Part C system with behavioral intervention specialists to not only evaluate the impact of the program, but also to understand whether novel metrics for assessing impact may be helpful in program evaluation.
Objectives:

- Assess implementation of evidenced based early intervention program
- Evaluate CGI-I measure as indicator of impact of early intervention program

Methods:
This program evaluation study presents results of use of modified Early Intervention-specific (EI) Clinical Global Impressions of Improvement (CGI-I) scales within the context of a model service delivery program. 58 families were provided with parent education-focused service models through Part C system following a diagnosis of ASD. All 58 families participate in a brief service model that consisted of 2 home-based evaluation support sessions. 19 of these families participate in an extended service that included 12 additional sessions guided by the Early Start Denver Model (ESDM). Clinicians provided CGI-I ratings at the completion of the brief model for each family and again at the completion of the extended model for families that participated in both. Ratings are on a 7-point Likert scale, with higher scores indicating worse functioning and lower scores indicating improved functioning. The CGI-I rating assesses improvement in the following domains: participation in caregiving routines, participation in play routines, verbal and nonverbal communication skills, social skills, engagement in restricted interests and repetitive patterns of behavior, and demonstration of challenging behavior.
Results:
While no significant difference scores were found in pre- and post-service scores on global measures of functioning as indexed by the Vineland Adaptive Behavior Scales-2, both caregivers and clinicians rated children as more improved on the CGI-I for the extended service delivery model, although the clinician reported ($T = 7.56$, $p < .001$) difference was larger than that of the caregiver report ($T = 2.74$, $p < .05$). Follow up comparisons will be presented regarding the main domain drivers of global CGI-I change from pre- to post-intervention within the EI CGI-I .
Conclusions:
The modified CGI scale was able to capture significant changes in total score in an ASD population between pre- and post-intervention. Similar changes were not documented on a common global measure often used as a proxy of change in model programs. Future program implementation and evaluation work may benefit by adopting and validated global and domain relevant CGI rating systems.

116 **108.116** Unity Twelve-Week ABA Parent Training: Weekly Changes in Parent Experiences and Competence

S. Freund[1], *M. N. Gragg*[2], *S. Popovic*[1], *R. Jamil*[1] *and G. Miljevic*[3], *(1)University of Windsor, Windsor, ON, Canada, (2)Psychology, University of Windsor, Windsor, ON, Canada, (3)Summit Centre for Pre-school Children with Autism, Windsor, ON, Canada*

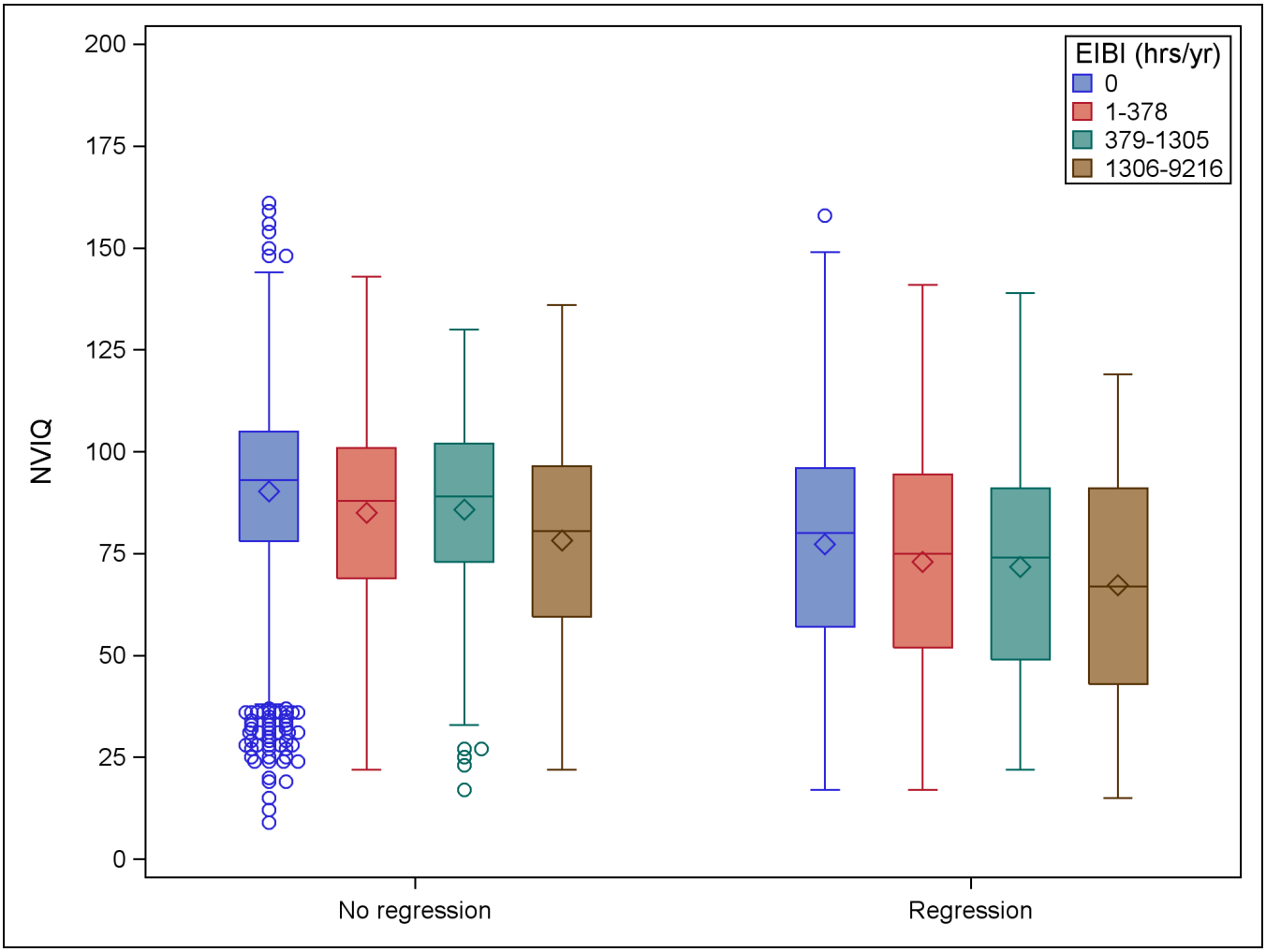
Background: Applied Behavioural Analysis (ABA) has a broad evidence base for improving intellectual and adaptive functioning of children with Autism Spectrum Disorders (ASD). Best outcomes are for children who receive intensive intervention from an early age. Unfortunately, early intervention is often difficult to access due to high demand and scarce resources. Finding alternative ways for parents to access intervention for their children is crucial. Parent training in ABA has gained popularity due to its effectiveness in promoting learned skills, and reducing demands on ABA services through parents serving as co-therapists. Previous findings from the Unity parent training program indicated that parent perceptions of their experiences and competence generally became more positive across the twelve-week program, with temporary dips in ratings during periods of transition.
Objectives: To examine weekly changes in parents' perceptions of their training experiences and competence throughout a twelve-week intensive ABA training program.
Methods: 50 parents/caregivers of preschool children with ASD (90% mothers) who completed the Unity training were participants. Most parents were in the 18-34 year age range (50%), and the 35-44 year range (46%). Only 4% of parents were in the 45-54 year range. 90% of parents had some college education or more, and over 38% reported an annual salary of $75,000+. Their children (80% boys) ranged from 12 to 63 months old; all had a diagnosis of Autism Spectrum Disorder (90%) or PDD-NOS (10%). Participants completed 180 hours of ABA training at an ASD preschool. Each week, participants completed a 17-question survey rating their perceptions of training over the past week (e.g., "How much did you understand the tasks in your child's program?" "How independent were you in carrying out your child's program?")
Results: Overall, parents' belief in the effectiveness of ABA in improving academics, social skills, and difficult behaviours increased significantly from week one to week twelve. Parent perceptions of their own competence increased significantly over the 12-week training program in their understanding of concepts covered and program tasks; independence in carrying out programs, ability to teach ABA concepts to others, confidence, satisfaction in carrying out child's programs, and feeling in control. Other training experiences were rated as more positive over the course of the program, including instructor support, child improvement as result of parent training, and parents'

contribution to their children's programs. Ratings related to training difficulties (challenge in implementation of children's program, stress of the training program, and difficulty in carrying out program tasks) decreased significantly over the twelve weeks.
Conclusions: Parents' perceptions of their experiences and competencies became more positive over the course of the 12-week ABA training program. Ratings in areas of competence (e.g. understanding and implementation of tasks) increased, while ratings in areas of difficulty (e.g., stress, challenge) decreased. Parents consistently reported enjoying their participation in the program. Data collection is ongoing.

117 **108.117** Use of Early Intensive Behavioral Intervention Among Children with ASD: Outcomes for Children with and without a History of Developmental Regression

R. P. Goin-Kochel[1], *S. S. Mire*[2], *L. Berry*[1], *S. M. Kanne*[3], *R. Bernier*[4], *C. G. Minard*[5] *and D. Guffey*[1], *(1)Baylor College of Medicine, Houston, TX, (2)University of Houston, Houston, TX, (3)Thompson Center for Autism & Neurodevelopmental Disorders, Columbia, MO, (4)University of Washington, Seattle, WA, (5)Dan L. Duncan Institute for Clinical and Translational Research, Baylor College of Medicine, Houston, TX*

Background: Children with autism spectrum disorder (ASD) and lower levels of cognitive functioning generally have less favorable outcomes compared to their counterparts with higher cognitive functioning. However, early intensive behavioral intervention (EIBI) has been empirically validated to underlie improvements in cognitive, language, adaptive, social, and academic test scores for children with ASD. Recent evidence confirms that, by middle childhood, children with ASD who exhibit developmental regression (i.e., lose previously mastered skills) within the first three years have significantly lower cognitive and adaptive-functioning scores than those without regression. It seems possible, then, that EIBI could potentially mitigate the deleterious effects of early skill loss and subsequently enhance their long-term outcomes.
Objectives: To determine whether (a) children with ASD +/- regression differentially access EIBI and (b) those with regression respond differently to EIBI, as no studies have compared EIBI-treatment outcomes between regressed and nonregressed groups.
Methods: Data were collected from 2,695 children with ASD (86.6% male; *M* age = 9 years, *SD* = 3.6, range = 4 to17 years, 11 months) who participated in the Simons Simplex Collection (SSC). All were determined to meet CPEA criteria for ASD based on clinical judgement and cutoff scores on the *Autism Diagnostic Interview—Revised* (ADI-R) and the *Autism Diagnostic Observation Schedule*(ADOS). Regression status was operationalized as a language and/or social-engagement loss at/before 36 months of age, per the ADI-R. Use of EIBI at any time between ages 0 to 4 was determined according to parent report on the SSC Treatment History Form. A continuous measure of EIBI intensity was calculated by multiplying the number of hours of treatment per week by the number of weeks treatment was received each year (hrs/wk*wk/yr). Outcomes of interest included cognitive functioning, adaptive behavior, and ASD severity as measured with the ADOS comparison score.
Results: A total of 737 (28.4%) children reportedly experienced a language and/or social regression at/before 36 months, while 770 (28.6%) had participated in EIBI at some time between ages 0 to 4. Children with skill loss consistently accessed EIBI at higher rates than nonregressed children (45% vs. 23%, respectively). EIBI intensity did not differ between regressed and nonregressed groups from ages 0—3; however, by age 4, children with skill loss were receiving more intensive EIBI (med = 520 hrs/wk*wk/yr) than those without loss (med = 480 hrs/wk*wk/yr, *p*= .04). Regression status did not interact with EIBI intensity to predict functional outcomes; however, within groups (loss or no loss), scoring patterns for cognitive and adaptive-functioning were highly similar, with those who received the most intensive EIBI consistently demonstrating significantly poorer outcomes compared to those who received no EIBI.
Conclusions: While children with ASD and regression demonstrate lower average cognitive and adaptive functioning compared to those without skill loss, these groups have comparable functional *patterns* based on EIBI intensity, suggesting similar responsiveness to EIBI. The most intensive EIBI may be implemented for those with the lowest levels of functioning; however, both pre-treatment baseline measures and longitudinal studies are needed to determine EIBI *efficacy* relative to skill loss.



118 **108.118** Use of Objective Behavioral Observation Measures to Evaluate Outcomes of Pivotal Response Treatment

M. B. Minjarez[1], *G. W. Gengoux*[2], *K. L. Berquist*[2], *C. Ardel*[2], *T. W. Frazier*[3] *and A. Y. Hardan*[2], *(1)Seattle Children's Hospital, Seattle, WA, (2)Stanford University, Stanford, CA, (3)Cleveland Clinic Center for Autism, Cleveland, OH*

Background: Behavioral interventions are robustly supported in autism spectrum disorder (ASD) treatment, including those that are parent-administered. There remains a need, however, for objective outcome measures that capture child response to treatment, as well as parent implementation of intervention strategies. Although research in Pivotal Response Treatment (PRT) does often include measures of parent treatment fidelity, detailed information about scoring procedures is sparse in the literature. Other parent training models often do not include information about whether the parents gained the targeted skills and child outcome data are often the sole focus.
Objectives: The goal of this presentation is to review outcomes from an objective behavioral observation measure from two trials of PRT, one randomized controlled trial of the group model of PRT, and one pilot study of a brief model of individual PRT. As there is little description of behavioral observation measures in the literature, especially with regard to parent fidelity of implementation, detailed information will be provided about operational definitions of targeted behaviors, as well as scoring and data analysis procedures.

Methods: In both trials, participants included children, ages 2-6 years, with diagnosis of ASD and significant language delay. In the RCT, 53 participants were randomly assigned to either PRT group or parent psychoeducation control group. In the study of brief individual PRT, child and parent outcomes were evaluated pre- and post-treatment for 13 children. Active treatment included parent training in PRT to target language development across 12 weeks for both studies. Dependent measures included standardized measures and structured lab observation (SLO), which will be the focus of this presentation. The SLO includes several standardized conditions (i.e., standard toys and parent instructions for interaction), designed to evaluate different aspects of parent-child interaction and child language skills. It is video taped and scored by blind raters for several target behaviors, including child language and parent treatment fidelity. This presentation will review administration and scoring procedures in detail, including novel approaches used to score total number as well as types of child utterance and trial-by-trial parent fidelity of implementation.
Results: Outcomes from these studies demonstrate that parent training in PRT was associated with child language improvements, as scored during the SLO, with a significant increase in functional utterances from baseline (34.2 ± 31) to post-treatment (55.9 ± 34; t = -2.922; df =8; p= 0.019) for the brief individual PRT, as well as the RCT of PRT group ($F(2, 43) = 3.53$, $p = .038$). Parents also effectively learned PRT in the RCT, as 84% met fidelity criteria. Fidelity data analyses for the brief PRT trial are ongoing.
Conclusions: Findings from these studies support that parent training programs are effective in teaching parents PRT and children show correlated gains in language. Together with previous studies of PRT, these findings also support the use of SLO procedures to measure parent and child outcomes. Findings will be discussed in light of the structured lab observation's relationship to other standardized measures and its utility as an end point in the study of ASD interventions.

119 **108.119** Using Cluster Analysis to Explore Subgroups in Response to Early Intervention

J. M. Paynter[1] *and A. E. Lane*[2]*, (1)AEIOU for Children with Autism, Moorooka, Australia, (2)University of Newcastle, Callaghan, Australia*

Background: High quality early intervention has been observed to improve outcomes at a group level for children with autism spectrum disorder (ASD) (e.g., Magiati et al., 2012; Warren et al., 2011). However, wide individual variation in response to intervention is also reported (e.g., Kamio et al., 2015). Emerging research suggests subgroups of children with ASD may exist in terms of response to intervention (Szatmari et al., 2015; Stevens et al., 2009). This research is valuable as it may lead to identification of what pre-treatment characteristics predict response to specific interventions, as well as those who may need additional support. The focus of this study is on a Naturalistic Developmental Behavioural Intervention (NDBI; see Schreibman et al., 2015) developed in Queensland, Australia. The program draws from a blend of behavioural and developmental strategies within a centre-based group program and has recently been manualised. Promising outcomes in terms of cognition, language, adaptive behaviour, and ASD symptoms have been found (Paynter et al., 2012; Paynter et al., 2015). However, this included significant variation at the individual level.
Objectives: The aims of this study were to examine (1) subgroups based on response to NDBI intervention; (2) characteristics of subgroups; and (3) intake variables that best predict outcomes.
Methods: Participants included 292 children with ASD aged 2½ to 6 years ($M = 45.19$ months, $SD = 9.61$) who attended the early intervention program between 2010 and 2014. Assessment included adaptive behaviour using the Vineland Adaptive Behaviour Scales-II (VABS-II), cognition using the Mullen Scales of Early Learning (MSEL), and ASD symptoms using the Social Communication Questionnaire completed on intake and exit. Model-based cluster analysis was used to identify potential subgroups based on change scores.
Results: Consistent with previous research, significant improvements in cognitive and adaptive behaviour scores between intake and exit were found for the whole group overall. Model-based cluster analysis identified a four-factor solution based on changes in age-equivalent scores on the VABS-II and MSEL. The majority (96%) of participants fitted into two clusters: a low outcome group ($n = 200$) with significantly lower change scores across all domains; and a high-outcome group ($n = 81$). At baseline, the high outcome group reportedly showed fewer autism symptoms, but were similar in age. Greater differences in groups were seen in verbal and non-verbal cognitive skills, as well as adaptive behaviour. The high outcome group's adaptive behaviour composite was above 70 on average, whereas, the low outcome group was below.
Conclusions: Two distinct clusters were identified with a low-outcome group showing scores on average in line with an intellectual disability, consistent with previous research across a range of interventions grouped together (Szatmari et al., 2015). Different or more intensive interventions may be needed for this group. Intake variables, particularly cognitive and adaptive behaviour skills may provide predictors of response to intervention. There is need for further research to extend this research to explore subgroups on response to intervention across different programs to provide a foundation to inform intervention choice for specific child profiles.

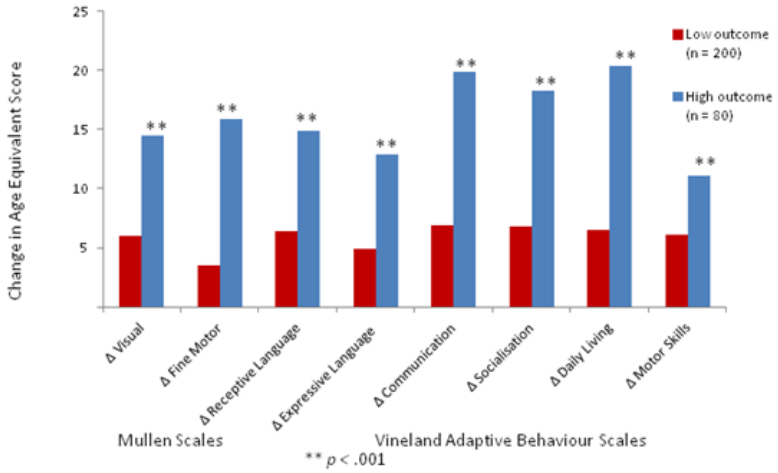


Figure 1: Comparison of Clusters

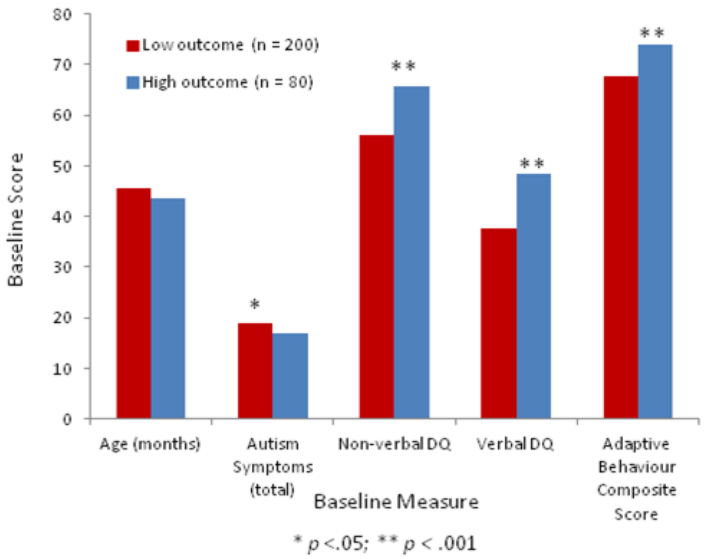


Figure 2: Comparison on intake variables. Note DQ = Developmental Quotient

120 **109.120** A Cellular and Molecular Study Investigating the Fetal Androgen Theory of Autism Using a Human Stem Cell Model

D. Adhya[1], *K. Jozwik*[2], *J. Carroll*[3], *J. Price*[4], *D. Srivastava*[5] *and S. Baron-Cohen*[6], *(1)University of Cambridge, Cambridge, England, United Kingdom, (2)Cancer Research UK Cambridge Research Institute, Cambridge, United Kingdom, (3)Cancer Research UK Cambridge Institute, Cambridge, United Kingdom, (4)Institute of Psychiatry, KCL, London, England, United Kingdom of Great Britain and Northern Ireland, (5)Institute of Psychiaty, King's College London, London, United Kingdom, (6)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom*

Background: Autism spectrum conditions (autism) are associated with elevated fetal steroidogenic levels, suggesting a role for fetal steroids such as testosterone in the development of the autism during fetal development. Fetal testosterone is an androgen that 'masculinizes' the brain and reproductive system, reduces apoptosis, and exerts epigenetic influence on gene expression. Fetal testosterone is produced in two-fold quantities in male compared to female fetuses, and may be an important contributor to the early development of autism, given the established male biased sex ratio on the prevalence of autism.
Objectives: To determine the effect of fetal testosterone on cellular and molecular pathways in neurons derived from an individual with autism, and how this differs from its effect in neurons derived from a typically developing individual.
Methods: We used a human induced pluripotent stem cell (hiPSC) model of autism. Keratinocytes from typical individuals, and individuals with autism were reprogrammed into iPSCs, and then differentiated into cortical neurons using the dual SMAD signalling inhibition strategy. Testosterone was administered to these neurons at an early stage of development at the physiological and supra-physiological levels. Quantitative real time PCR was performed to measure gene expression levels. Immunocytochemistry followed by high throughput screening measured cell counts based on neuronal markers expression.
Results: Preliminary data indicates that neurons from individuals with autism develop differentially, while being more responsive to testosterone than neurons from typical individuals. The androgen receptor (AR) and some of its putative downstream genes such as gonadotropin-releasing hormone (GnRH) and p38 (a class of mitogen-activated protein kinases) were differentially expressed in autism neurons compared to typically developing neurons, predicting differential structural and functional outcomes of neurons in the two groups (Fig1a). Genes indicating neuron cell fates such as T-box brain 1 (TBR1) and BRN2 were also differentially expressed in autism neurons, demonstrating altered characteristics (Fig1b). Long term testosterone administration does not seem to regulate TBR1 and BRN2 expression, and cells positive for TBR1 seemed to increase with time especially in autism neurons, while BRN2 positive cells increased in both (Fig2).
Conclusions: These data suggest that the autism phenotype develops in utero at very early stages of brain development, and that neurons of individuals with autism are programmed, at a molecular level, to react differently to sex steroids such as fetal testosterone. The iPSC model has the power to distinguish genetic predisposition to fetal androgen sensitivity, environmental exposure to fetal androgen level, and interactions mediated via epigenetic influences of fetal androgens on the autistic genome. The current experiment casts light on the first two factors, and future work will test the latter hypothesis using RNA-sequencing.

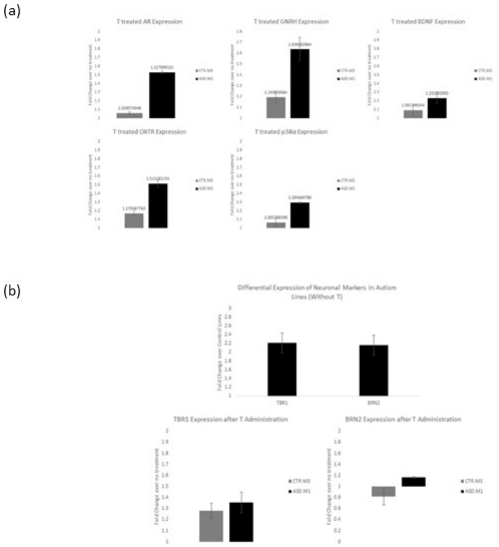


Figure 1: (a) Q-PCR analysis of candidate genes. Autism-derived neurons show significantly more expression of AR, GnRH, BDNF, OXTR and p38α than control-derived neurons at day 35 upon administration of physiological levels of testosterone. **(b)** Q-PCR analysis of neuron development genes. Autism-derived neurons show a higher basal level of TBR1 (early neuron marker) and BRN2 (late neuron marker) than control neurons at D35. Both markers show no significant change in expression levels upon physiological testosterone administration.

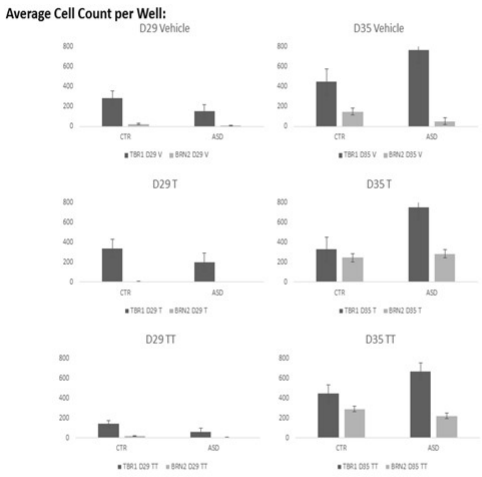


Figure 2: Autism lines have greater TBR1 +ve cells at D35. While TBR1 and BRN2 +ve cells increased from D29 to D35 in autism lines, in the control lines only BRN2 +ve cells significantly increased from D29 to D35. Moreover, there seems to be negligible effect of testosterone (both physiological T and supraphyisological TT) administration on these neuronal markers.

121 **109.121** Alterations in the Autism-Related Gene CEP290 Affects Neurite Formation and Differentiation

M. B. Kilander[1] *and Y. C. Lin*[2], *(1)Suite 301, Hussman Institute for Autism, Baltimore, MD, (2)Laboratory of Neuronal Connectivity, Hussman Institute for Autism, Baltimore, MD*

Background:
While autism is classified as a neurodevelopmental condition, the defined spatiotemporal molecular mechanisms contributing to the establishment of the altered neurophysiology observed in individuals with autism are largely unknown. Large-scale genetic screening implicated several genes, mutations of which may contribute to phenotype found in ASC. CEP290, a protein that is tightly linked to the formation of primary cilium, has been identified among these ASC candidate genes. The primary cilium is a microtubule rich structure protruding out from the cell which has been shown to be crucial for normal cell migration, polarity and division. Moreover, the primary cilium retains a highly specialized nanoenvironment within the cell which serves as the specific compartment for certain types of cell signaling and for cell-environment communication. In particular, Sonic Hedgehog signaling, a cell communication pathway necessary for proper tissue development and maintenance, is preferentially localized to the primary cilium. However, to-date not much is known about the role of the primary cilium in neurodevelopment and in the establishment of mature neural circuits. Mutations in the *CEP290* gene are involved in ciliopathies, i.e. severe multi-organ disorders that are related to dysfunctional primary cilia. Additionally, CEP290 has also been implicated in cancer as well as in intellectual disability syndromes and in individuals with autism. However, how CEP290 plays a role in regulating brain function is still

unclear.
Objectives:
In this study we set out to analyze the impacts of dysfunctions in the *CEP290* gene at a cellular and molecular level in order to dissect the pathways of disrupted neurodevelopment in an autism-related model system.
Methods: Using live cell imaging, immunocytochemistry and molecular techniques we assess the changes in morphological, proliferative and cell signaling mechanisms caused by alterations of CEP290. We employ shRNA techniques to target CEP290 expression and evaluate knockdown efficiencies by Western Blot. Monitoring of cells over 7 days using IncuCyte (Essen Biosciences) allows us to perform detailed analysis on changes in neurite formation and establishment, to make accurate calculations on proliferation rates, and in assessing cell viability and culture quality.
Results:
CEP290 is localized to the primary cilium in Neuro-2a cells. Overexpression as well as knockdown of *CEP290* leads to reduced retinoic acid-induced neurite outgrowth and diminished neurite arborization indicating that disruption in CEP290 expression might be involved in the regulation of proper neuronal differentiation and maturation. Moreover, cells overexpressing CEP290 displayed a higher rate of proliferation resulting in a disrupted balance between proliferation and differentiation within the cell population.
Conclusions: In summary, our present investigation into the cellular functions of CEP290 have the potential to provide novel insight into the role of primary cilium in neurodevelopmental conditions such as autism.

122 **109.122** Autism Patient-Derived Neural Stem Cells Display Neurite Extension and Migration Defects

S. Prem[1], *M. Williams*[1], *C. McDermott*[2], *X. Zhou*[3], *P. G. Matteson*[4], *P. Yeung*[5], *C. W. Lu*[5], *Z. Pang*[5], *L. M. Brzustowicz*[6], *J. H. Millonig*[3] *and E. DiCicco-Bloom*[7], *(1)Neuroscience, Graduate School of Biomedical Sciences, Piscataway, NJ, (2)Queens College, Queens, NY, (3)Rutgers Robert Wood Johnson Medical School, Piscataway, NJ, (4)Rutgers University, Piscataway, NJ, (5)Child Health Institute of New Jersey, Rutgers Robert Wood Johnson Medical School, New Brunswick, NJ, (6)Genetics, Rutgers University, Piscataway, NJ, (7)Rutgers University - Robert Wood Johnson Medical School, Piscataway, NJ*

Background:
Autism spectrum disorders (ASD) are neurodevelopmental disorders characterized by impaired social interaction and communication and the presence of repetitive restrictive behaviors. Invaluable studies in ASD mouse models have shown changes in neuronal connectivity and migration that replicate findings of human neuropathology and brain-MRI. However, mouse models cannot capture the complexity of human neurodevelopment. Thus, in order to understand a uniquely human disorder like ASD, we need techniques to model human neurodevelopment. Recently, induced pluripotent stem cell (iPSC) technology has allowed the generation of neural stem cells (NSCs) and neurons from individuals with neuropsychiatric disorders thereby allowing study of human neuropathology. Using iPSCs we have generated NSCs from 8 boys with severe idiopathic autism and their unaffected-brothers (Sib) as controls.
Objectives:
Our goals are to study neurite outgrowth and neurosphere migration in our patient-derived NSCs using developmentally relevant extracellular (EC) factors such as PACAP, serotonin (5HT) and nerve-growth-factor (NGF).
Methods:
Neurite Assay: Confluent NSCs were dissociated and plated at low density on fibronectin+ poly-d-lysine coated plates in control media, or media containing EC factors. At 48h, the proportion of cells with neurites >2 cell diameters were counted blind in 1 cm rows. 3 dishes were quantified per condition per experiment. At least 200 cells were counted per dish
Neurosphere Migration: Neurospheres were formed by plating NSCs in absence of substrate. After 48-96h, spheres were plated on Matrigel with control or EC factor media and fixed at 48h. Using phase-contrast images, areas of the inner-cell-mass and total sphere outgrowth were measured. 15-21 spheres were measured blind per condition per experiment. Migration*: total sphere area-inner cell mass area.*
Results:
We have extensively studied neurite outgrowth and migration in NSCs from one family. To ensure that the phenotypes observed were not a consequence of the viral-reprogramming involved in iPSC generation, we have assessed multiple NSCs derived from 2 iPSC clones for Sib and multiple NSCs derived from 3 iPSC clones for ASD.
Neurites:
In control media, Sib NSCs had a significantly higher percent of cells with neurites (15%) than ASD NSCs (8%, $p<0.0001$). Under stimulation of PACAP, there was a 51% increase in cells bearing neurites in the Sib NSCs ($p<0.0004$) but no change in ASD NSCs ($p>0.5$). Similarly, under stimulation of NGF, there was a 58% increase in neurites in Sib NSCs ($P<0.005$) but no change in ASD NSCs ($p>0.7$). Finally, Sib NSCs displayed a dose-dependent increase in neurites with 5HT stimulation while ASD NSCs only responded at the maximal tested dose of 5HT indicating a difference in sensitivity.
Migration:
In control media, Sib neurospheres migrated further than ASD NSCs ($p<0.05$). Under the stimulation of PACAP there was a 50% increase in migration of Sib neurospheres ($P<0.001$) but no change in migration in ASD neurospheres ($p>0.7$).
Conclusions: Our studies of patient-derived NSCs reveal neurobiological abnormalities that may provide insight into impaired brain development and function in ASD. Our studies also illustrate the value of using developmentally-relevant factors to uncover patient-specific abnormalities that may facilitate the development of personalized ASD therapies

123 **109.123** Autism and Immunity: Salivary Cytokines in Children with Autism Spectrum Disorder

L. C. Goodwin[1,2], *H. L. Green*[1] *and K. Froud*[3], *(1)Columbia University, New York, NY, (2)Center for Autism and the Developing Brain, White Plains, NY, (3)Biobehavioral Sciences, Columbia University Teaches College, New York, NY*

Background: Many individuals with ASD demonstrate skewed immune profiles, suggestive of a potential role for immune dysfunction (Noriega & Savelkoul, 2014). Elevated immune mediators such as cytokines have been found in the blood plasma, cerebral spinal fluid, gastrointestinal track, and post-mortem brain tissue of individuals with ASD (Ashwood et al., 2011; DeFelice et al., 2003; Molloy et al., 2006). Genetic studies have uncovered a host of potential immune regulatory related genes altered in ASD, while research on maternal immune activation during fetal development has also been implicated in immune dysregulation in ASD (Patterson, 2011). Other research suggests that volumetric differences, morphological differences, and abnormal neuroinflammation in ASD may be related to neuroimmune factors such as elevated cytokines (Wei, Alberts, & Li, 2013). The study of those with skewed immune panels is crucial for discerning the interaction between the immune system during neurodevelopment and its potential involvement in ASD.
Objectives: This study aims to assess if the inflammatory cytokines interleukin-6 (IL-6) and interleukin 1 beta (IL-1β) are elevated in the saliva of low functioning children with ASD as compared to typically developing control children. This study also aims to explore the relationship between elevated salivary cytokines in autism and the severity of autistic symptoms.
Methods: Twenty-five low-functioning children with ASD and twenty-eight typically developing control children from 6-18 years of age were enrolled in the current study. Salivary samples were collected using the SalivaBio Children's Swab (SCS) Method, which consists of placing a soft swab inside the mouth for 60 – 90 seconds. Salivary IL-6 and Salivary IL-1β levels were flow-rate controlled and measured via enzyme-linked imunnosorbent assays (ELISA) with a 450 nm plate reader. The Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) was administered to children with autism in order to determine severity of ASD.
Results: Salivary IL-6 was significantly elevated in children with ASD (μ= 7.3082 pg/mL) as compared to typically developing control children (μ= 2.691 pg/mL), (t= 2.3444; P=0.0283). There was no significant difference between children with autism (μ=235.28 pg/mL) and typically developing children's salivary IL-1β levels (μ=212.12 pg/mL), (t=.342; p=.735). There was a weak positive correlation between salivary IL-6 levels and ADOS-2 raw scores in ASD children with detectable levels of salivary IL-6 (R= 0.1495). There was also a weak positive correlation between salivary IL-1β levels and ADOS-2 raw scores in ASD children (R=0.1939).
Conclusions: Consistent with related studies, our findings are suggestive of a potential role for immune dysfunction in ASD. To our knowledge there are no published studies that have investigated salivary IL-6 or IL-1 β in individuals with ASD. Previous studies have found relationships between salivary IL-6 and psychosocial factors, immune functioning, stress, and sleep dysfunction (El-Sheikh et al., 2007; Groer et al., 2010; Ris et al., 2015 Sjögren et al., 2006) as well as relationships between salivary IL-1 β and inflammatory conditions (Hernández-Rodríguez et al., 2004; Southerland et al., 2006). Future studies should attempt to correlate blood plasma levels of cytokines to salivary levels of cytokines within same ASD population.

124 **109.124** Behavioral Phenotypes in Mouse Models of Angelman Syndrome

E. Weeber *and S. Ciarlone, University of South Florida, Tampa, FL*

Background: The mouse model for Angelman syndrome was developed over 15 years ago, but represents one of the most useful mouse models for a human cognitive disorder. The AS mouse shows strong phenotypes in the areas of motor coordination, learning and memory, seizure propensity and hippocampal synaptic function.
Objectives: To determine if the strongest phenotypes of the AS mouse model can be reversed in the adult mouse.
Methods: We used Ube3a maternal deficient mice on a background strain of C57BL/6 and 129Svev. The C57BL/6 strain was used for testing learning and memory. The 129Svev strain was used to for testing seizure propensity, duration and EEG abnormalities.
Results: We find that these specific phenotypes can be rescued with multiple strategies. Protein replacement with Adeno-Associated virus, dietary supplementation and

pharmacological intervention have all shown promise as potential therapeutic avenues.
Conclusions: There are multiple molecular sites for therapeutic intervention. It is likely that the AS phenotype can be overcome by multiple strategies due to the global effect of Ube3a deficiency and not a specific singular molecular problem. These associations have implications on future clinical trials and how the AS mouse may be used for further preclinical research.

125 **109.125** Behavioral and Electrophysiological Characterization of Children with 15q11.2-q13.3 Duplications

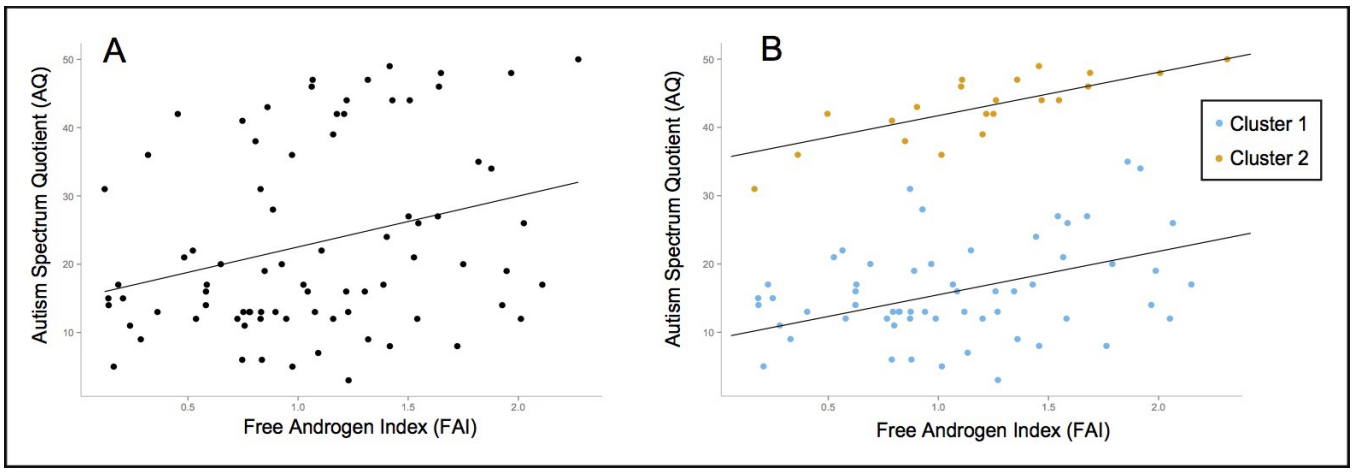
S. S. Jeste[1], *C. DiStefano*[2], *J. Frohlich*[1] *and P. Golshani*[3], *(1)Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA, (2)Psychiatry and Biobehavioral Sciences, University of California, Los Angeles, Los Angeles, CA, (3)Neurology, University of California, Los Angeles, Los Angeles, CA*

Background: The surge in genetic testing for chidlren with Autism Spectrum Disorder (ASD) has facilitated the identification of causative rare genetic variants and, with the ascertainment of subgroups of individuals with shared variants, the identification of clinically meaningful genetic syndromes (Jeste and Geschwind, 2014). Detailed developmental and behavioral characterization has lagged behind the genetic diagnoses, leaving considerable uncertainty regarding prognosis and recommended treatments. Duplication of 15q11.2-q13.3, or Dup15q syndrome, represents one of the most common copy number variants associated with ASD, and its clinical features, particularly in relation to ASD and intellectual disability, are being elucidated through collaborative efforts facilitated by a national Dup15q alliance.
Objectives: The first objective was to identify patterns of social communication, adaptive, and cognitive skills in children with Dup15q syndrome compared to those with nonsyndromic ASD. The second objective was to compare resting state EEG patterns in Dup15q syndrome with nonsyndromic ASD, as case reports have described excessive beta band power in clinical EEGs of these children.
Methods: The Dup15q Alliance has been collecting a registry of patients, with 425 patients in the registry and 212 with complete clinical records. From the registry, 142 children have isodicentric 15q duplications, 30 have interstitial duplications, 14 have mosaic isodicentric duplications, and 26 have “edge” duplications either at q11.2 or q13.3. We recruited 13 children from the UCLA Dup15q clinic and compared them to a 13 IQ and age matched cohort of children with ASD. Participants were assessed for verbal and non-verbal cognition, ASD characteristics [Autism Diagnostic Observation Schedule] and adaptive function [Vineland Adaptive Behavior Scales]. High density EEG was recorded while children watched an abstract video, with an additional TD comparison group also tested. Relative power in delta (1 – 4 Hz), theta (4 – 8 Hz), alpha (8 – 12 Hz), low beta (12 – 20 Hz), high beta (20 – 30 Hz), and gamma (30 – 48 Hz) was calculated. Group comparisons were performed between diagnostic groups: Dup15q and ASD, and within the Dup15q group based on duplication type and epilepsy status.
Results: All children with Dup15q syndrome met criteria for ASD, but severity scores were lower in children with Dup15q syndrome. Children with Dup15q syndrome demonstrated significantly more impairment in motor (Gross motor DQ: Dup15q M=35.38, ASD M=70.21; t=5.9, p<.001; Fine motor DQ: Dup15q M=30.03, ASD M=66.5; t=5.2, p<.001) and daily living skills (Dup15q M=53.18, ASD M=63.82; t=2.41, p=.03). Within the Dup15q group, children with epilpesy demonstrated significantly lower cognitive and adaptive function than those without epilepsy (p<0.01 for all measures). Relative beta power was significantly higher in Dup15q syndrome than in the TD ($p < 1.0 \cdot 10^{-4}$, FDR corrected) and ASD ($p < 1.0 \cdot 10^{-4}$, FDR corrected) groups.
Conclusions: We have identified behavioral and neurophysiological features that distinguish a genetically defined subgroup within the autism spectrum. Ongoing translational studies will link electrophysiological and behavioral phenotypes in mouse models to patients to facilitate the identification of the specific genetic mechanisms underlying the neurodevelopmental symptom profile in children with Dup15q syndrome.

126 **109.126** Bioavailable Testosterone Predicts Autistic Traits in Women with and without Autism

A. L. Pohl[1], *J. R. Lloyd*[2], *L. Ruta*[3], *B. Auyeung*[4] *and S. Baron-Cohen*[1], *(1)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (2)Computational and Biological Learning Lab, University of Cambridge, Cambridge, United Kingdom, (3)Institute of Clinical Physiology, National Research Council (CNR), Taormina, Italy, (4)University of Edinburgh, Edinburgh, United Kingdom*

Background: Individual differences in fetal testosterone levels predict individual differences in autistic traits, specific behaviors (such as eye-contact and language), and performance on specific cognitive tasks (such as those measuring theory of mind or attention to detail) related to autism. It is not yet known if testosterone levels in adults are related to autistic traits.
Objectives: To test whether bioavailable testosterone, estimated by the free androgen index (FAI), predicts autistic traits in adults, measured using the Autism Spectrum Quotient (AQ).
Methods:
We recruited two cohorts of adults with and without autism, and analyzed each cohort separately by sex. Cohort 1 comprised 164 individuals (28 females with an autism spectrum condition (autism), 55 control females, 32 males with autism, and 49 control males). Cohort 2 comprised 103 individuals (19 females with ASC, 26 control females, 44 males with autism, and 14 control males). We measured total testosterone and sex hormone binding globulin (SHBG) levels in serum, and calculated the ratio of total testosterone to SHBG to get the FAI. We tested whether FAI predicted total AQ scores using linear regression, finite mixture modeling, and Bayesian regression. We did not include diagnosis as a grouping variable, as the multifactorial inheritance of autism suggests no difference between diagnostic groups in response to a risk factor in the absence of gene-environment interaction. Instead, we used data-driven approaches to account for the bimodal distribution of AQ scores in our sample caused by including cases and controls.
Results: FAI predicted AQ only in females in a linear regression model (Cohort 1 females, $B_{FAI} = 7.445$, SE=2.780, $t = 2.68$, $p = 0.00903$) (Figure 1). However, we observed a multimodal distribution of error, as expected. To address this problem, we used finite mixture modeling, and found a significant relationship between FAI and AQ in Cohort 1 females, as well as two latent clusters that roughly, but not perfectly, correspond to the distribution of cases and controls in our sample ($B_{FAI} = 6.35$, SE = 1.43, $z = 5.90$, $p = 3.68 * 10^{-9}$) (Figure 1). To confirm this finding, we used probabilistic programming to encode a model that could account for possible latent clusters in our data without determining the number of clusters *a priori*. We performed Bayesian inference in our generative model using data from Cohorts 1 and 2. In females, data from Cohort 1 were consistent with frequentist results, and data from Cohort 2 confirmed a positive relationship between FAI and AQ, and the existence of latent structure not accurately accounted for by diagnostic labels in our data.
Conclusions:
Autistic traits in adults are predicted by bioavailable testosterone in females only. This result is consistent with the finding that testosterone administration lowers mind-reading ability in women (van Honk et al, 2011, *PNAS*). Furthermore, this study demonstrates the importance of choosing appropriate statistical models for regression when the data do not meet the assumption of being normally jointly distributed. This study further supports a role for testosterone in sex-differential autism risk.



127 **109.127** Compromised Neurite Morphology of Induced Pluripotent Stem Cell-Derived Neurons: Similar Patterns from Independent Non-Syndromic Autism Cases

V. Roman[1], *J. Kobolák*[2], *H. Avci*[2], *Z. Ábrahám*[3], *B. Hodoscsek*[3], *S. Berzsenyi*[3], *B. Koványi*[3], *P. Dezsõ*[3], *J. Nagy*[3], *A. Chandrasekaran*[2], *A. Ochalek*[4], *E. Varga*[2], *C. Nemes*[2], *I. Bock*[2], *K. Pentelényi*[5], *K. Németh*[6], *A. Balázs*[7], *J. Molnár*[5], *A. Dinnyés*[2], *G. Lévay*[8] *and B. Lendvai*[9], *(1)Neurodevelopmental Biology, Gedeon Richter Plc., Budapest, Hungary, (2)BioTalentum Ltd., Gödöllõ, Hungary, (3)Molecular Cell Biology, Gedeon Richter Plc., Budapest, Hungary, (4)Molecular Animal Biotechnology, Szent István University, Gödöllõ, Hungary, (5)Institute of Genomic Medicine and Rare Disorders, Semmelweis University, Budapest, Hungary, (6)Autism Foundation, Budapest, Hungary,*

(7)Outpatient Clinic, Autism Foundation, Budapest, Hungary, (8)Cognitive Pharmacology, Gedeon Richter Plc., Budapest, Hungary, (9)Division of Pharmacology and Drug Safety, Gedeon Richter Plc., Budapest, Hungary

Background: Autism spectrum disorder (ASD) is a highly prevalent neurodevelopmental condition, yet without approved pharmacological treatment options for the core symptoms. This significant need for effective treatments has resulted in great efforts to find reliable preclinical models of the disorder. Human behavioral aspects of ASD seem to be overwhelmingly difficult to recapitulate in in vivo models, therefore the want for in vitro disease models with high translational value is huge.
Objectives: The aim of the present study was to establish a human-derived in vitro disease model of ASD using the induced pluripotent stem cell (iPSC) technology.
Methods: Blood samples of three subjects on the autism spectrum and two controls were taken after ethical approval and obtaining written informed consent. The diagnosis of subjects was confirmed with the Autism Diagnostic Observation Schedule and Autism Diagnostic Interview Revised. To exclude syndromic ASD forms, next generation sequencing was performed with TruSight Autism Rapid Capture Kit (Illumina) to analyse 103 ASD associated gene variations. Mononuclear cells were isolated from the blood samples and a non-integrating delivery system was used to overexpress the genes of reprogramming factors in the cells. Two to three clones per subject were selected for further differentiation among the reprogrammed clones. The iPSCs showed embryonic stem cell morphology, normal karyotype, expressed pluripotency markers, and were able to spontaneously differentiate into cells of the three germ layers. Then, iPSCs were differentiated into neuronal precursor cells and neurons by a dual-SMAD inhibition protocol. Neuronal differentiation was demonstrated by neuron specific immunolabelling for MAP2, detection of tetrodotoxin-sensitive sodium currents and bicuculline-sensitive chloride currents by using patch clamp, as well as live cell calcium imaging.
Results: iPSC-derived neuronal cell cultures were investigated in order to detect substantial phenotypical differences between neurons originated from autistic and neurotypical subjects. As ASD is widely accepted as a neurodevelopmental connectivity disorder, first neurite morphology of the cells was explored. According to the morphological parameters (measured by using an Operetta® High Content Imaging System; PerkinElmer), neuronal maturation was found significantly less pronounced in autistic samples. Investigation of further cell biological parameters is in progress.
Conclusions: Our findings support the approach that iPSC-derived neuronal cultures may serve as relevant in vitro models that can shed light on the pathophysiology of autism, help to identify novel biomarkers and/or therapeutic targets for the treatment of ASD as well as provide a platform for screening novel drug candidates.

128 **109.128** Disrupted Short- and Long-Range Neural Connectivity in a Mouse Model of Autism

N. Cheng[1], *F. Alshammari*[1], *M. Khanbabaei*[1], *E. Hughes*[1], *R. Tobias*[1], *K. Murari*[2] *and J. M. Rho*[1], *(1)Alberta Children's Hospital Research Institute, University of Calgary, Calgary, AB, Canada, (2)Electrical and Computer Engineering, University of Calgary, Calgary, AB, Canada*

Background:
Autism spectrum disorder (ASD) is characterized by deficits in socio-emotional functions and language development, as well as repetitive and/or restrictive behaviours. The behavioural domains that define ASD together with the vast heterogeneity of the clinical symptoms suggest that these deficits likely involve widely distributed neural systems. Accordingly, it has been proposed that ASD may represent a condition of disrupted connectivity. Neuroimaging studies have shown diffuse impairment in brain networks of ASD patients, including both focal deficits in specific brain regions and aberrant long-range connections. However, their cellular substrates and molecular underpinnings remain poorly understood.
Objectives:
We investigated the development of neural circuitry in the BTBR mouse model of autism, which displays all of the three defining behavioural features of ASD. First, we examined eye-specific segregation in the lateral geniculate nucleus (LGN), which is a model system to study how precise patterning of synaptic connections form and refine during development. Second, we investigated the development of dendritic arbors and neuronal densities of hippocampal pyramidal neurons, which integrate spatial, contextual, and emotional information and transmit it to various regions throughout the brain.
Methods:
We labelled retinal afferents from both eyes with an anterograde tracer conjugated with different fluorophores, and compared eye-specific segregation in the LGN between the BTBR and B6 animals, a strain commonly used as a control for the BTBR mice in ASD studies. Next, we used Golgi staining to reveal dendritic structure, and Nissl staining to measure neuronal density of hippocampal CA1 pyramidal neurons. Western blots were used to quantify relative expression levels of proteins known to regulate dendritic structure.
Results:
We found that in neonatal animals, the total area of dorsal LGN occupied by retinal afferents was more rounded in shape, and significantly smaller in size in the BTBR compared to B6 mice. Notably, the degree of overlap between the ipsi- and contralateral afferents was significantly greater in the BTBR mice. Moreover, these abnormalities continued into adulthood in the BTBR animals, suggesting persistent deficits rather than delayed maturation of axonal refinement. Further, we found that both total length and branching of the dendritic arbor were significantly greater in neonatal BTBR compared to B6 animals, while no differences were found in the density of CA1 pyramidal neurons or the thickness of the neuronal layer. A significant difference in the protein levels of ERK pathway, but not BDNF or S6 kinase signaling, was found between the two strains, indicating that altered ERK signaling may be involved in the dendritic changes observed in the BTBR model.
Conclusions:
Circuit formation and refinement were disrupted in the BTBR model of ASD, including both precise patterning of synaptic connections by long-range axonal projections and the development of dendritic arbor. Together, these results indicate disrupted connectivity at both local and long-distance levels in the BTBR model of autism, suggesting that such abnormalities could contribute to the overall impaired connectivity observed in ASD, and may ultimately contribute to the behavioural symptoms.

129 **109.129** Elucidating the Antigenic Epitopes in Maternal Autoantibody Related Autism Spectrum Disorder (ASD)

E. Edmiston[1], *J. Van de Water*[2] *and K. L. Jones*[3], *(1)Internal Medicine, UC Davis, Sacramento, CA, (2)University of California at Davis MIND Institute, Davis, CA, (3)University of California at Davis, Sacramento, CA*

Background:
Numerous researchers have described the presence of maternal autoantibodies reactive to fetal brain proteins in a subset of mothers of children with autism spectrum disorder (ASD). Our laboratory recently determined the identity of the autoantigens targeted by autoantibodies in maternal autoantibody related (MAR) ASD; we identified seven autoantigens: lactate dehydrogenase A and B (LDH-A, LDH-B), stress-induced phosphoprotein 1 (STIP1), collapsin response mediator proteins 1 and 2 (CRMP1, CRMP2), cypin, and Y-box binding protein 1(YBX1). A detailed understanding of the targeted epitopes on each autoantigen will be critical in dissecting the pathology associated with maternal autoantibodies.
Objectives:
The specific objective of this study was to elucidate and verify the immunodominant epitope sequences targeted by maternal autoantibodies for each of the MAR ASD autoantigens.
Methods:
The amino acid sequences of the candidate autoantigens were obtained from the NCBI protein database. Working in conjunction with PEPperPRINT© microarray solutions, each protein was translated into a peptide array composed of duplicate, overlapping peptide sequences, which were 15 amino acids long with a 14 amino acid peptide-peptide overlap. Two microarray schemes were synthesized: one microarray containing LDH-A, STIP1, and CRMP1 sequences, and the other comprising LDH-B, CRMP2, Cypin, and YBX1 sequences. Each array was incubated with maternal plasma samples obtained from the Childhood Autism Risk from Genetics and Environment (CHARGE) Study at UC-Davis, which were predetermined via western blot and ELISA to be highly reactive to the target proteins. Immunodominant epitopes were consequently verified using microarrays, which contained peptide sequences identified in the previous arrays. We ran 24 plasma samples from mothers of children with severe ASD status, 12 plasma samples from mothers of children with mild ASD, and 12 samples from mothers of TD controls. Diagnosis of all enrolled children was confirmed at the UC Davis M.I.N.D. Institute.
Results:
We successfully determined that the MAR ASD autoantibodies recognized unique, discrete peptide sequences on each target autoantigen. We further determined that there are 3 epitopes for LDH-A, 3 epitopes for LDH-B, 3 epitopes for STIP1, 1 epitope for cypin, 3 epitopes of YBX1, 4 epitopes for CRMP1, and 9 epitopes for CRMP 2. Overall, we have determined that autoantibodies from mothers of children with ASD reacted to more autoantigens and more epitopes per autoantigen than autoantibodies from mothers of typically developing children.
Conclusions:
The results of this project will enable the development of robust biomarkers for ASD risk assessment and subphenotype stratification. Additionally, we have used these peptide epitopes to break tolerance in a mouse model, which will help us to better understand how the maternal autoantibodies are interacting with the candidate autoantigens, thus providing insight into the pathologic mechanisms through which these antibodies alter developmental trajectory, and the critical pathways that may serve as a template for therapeutic intervention. Future experiments using a larger sample population will be performed to determine if maternal autoantibody reactivity to individual or combinations of peptides correlate with increased aberrant behaviors and/or increased cognitive and social deficits.

130 **109.130** Hyperexcitability in Stem Cell-Derived Neurons from Dup15q Autism and Angelman Syndrome Patients

J. Fink[1], *T. Robinson*[1], *S. Chamberlain*[2] *and E. Levine*[1], *(1)Dept Neuroscience, University of Connecticut Health Center, Farmington, CT, (2)Genetics and Genome Sciences, University of Connecticut Health Center, Farmington, CT*

Background: Individuals with a duplication of the 15q11-q13 chromosomal region suffer from a neurodevelopmental disorder known as Dup15q syndrome, which represents the most common copy number variant associated with autism. In addition to the autistic-like symptoms such as intellectual disability and language delay, >50% of Dup15q patients suffer from some form of seizure disorder. Similarly, patients with maternal deletion of the same chromosomal region present with Angelman syndrome (AS), a related neurodevelopmental disorder in which a majority of the patients also develop seizures at some point in their life. Although the genetic cause of Angelman syndrome has been identified as the UBE3A gene, the specific gene or set of genes directly responsible for the Dup15q phenotype remains less clear, though UBE3A is thought to play an important role in Dup15q pathophysiology. Even less clear are the downstream UBE3A targets that might mediate these disease phenotypes, though several synaptic targets have been reported.
Objectives: Given the seizure phenotype associated Dup15q and AS, we examined the excitability of neurons derived from these patients using induced pluripotent stem cell (iPSC) lines. Hyperexcitability can result from a variety of network and cell-intrinsic properties. For this reason we investigated resting membrane potential (RMP), spontaneous excitatory and inhibitory synaptic currents, and action potential (AP) firing in these cells.
Methods: *Cell Culture Preparation*: Induced pluripotent stem cells (iPSCs) were derived from fibroblasts obtained from two AS subjects (1M/1F), 3 control subjects (2M/1F), and 2 Dup15q patients (2F) and differentiated into neurons and plated onto coverslips as previously described (Germain et al. 2014). *Electrophysiology:* Coverslips were individually transferred to a recording chamber and continuously perfused with carboxygenated artificial cerebrospinal fluid. Whole-cell patch recordings were obtained from morphologically-identified neurons. Cells were noted for RMP by injection with zero current, AP firing by holding at -40 mV or applying 10mV current injection steps from -70mV, and spontaneous synaptic activity via a holding potential of -70 mV. *Calcium Imaging*: Coverslips of neurons were incubated in Fluo-4 AM (10 µM) calcium dye for 45 minutes. Cells were then placed in a recording chamber and imaged for 40 minutes at a frequency of 10 Hz.
Results: We have observed disruptions in the electrophysiological maturation of neurons derived from AS and Dup15q patients. Specifically, these neurons show depolarized RMPs, immature AP firing, and a reduction in spontaneous synaptic activity. Additionally, neurons derived from Dup15q patients displayed significant increases in spontaneous AP firing at -40 mV as well as increased network synchrony.
Conclusions: Overall, data collected from both AS and Dup15q patients show significant differences compared to control subjects in a variety of electrophysiological properties throughout their development. These specific differences may contribute to hyperexcitability of these cells, a phenotype that could relate to the seizures associated with both AS and Dup15q syndrome. Therefore, these approaches may prove useful for identifying novel targets for drug discovery and for screening potential therapeutics aimed at reversing the seizures, movement disorders, and language and cognitive impairments in these patients.

131 **109.131** Identification of Serum Protein Biomarkers for Autism Spectrum Disorder

L. Hewitson[1], *S. Singh*[2], *U. Yazdani*[2], *B. Gadad*[2], *S. Zaman*[2], *N. Roatch*[1], *C. Schutte*[1], *L. S. Hynan*[3], *C. N. Marti*[4] *and D. C. German*[2], *(1)The Johnson Center for Child Health and Development, Austin, TX, (2)UT Southwestern Medical Center, Dallas, TX, (3)Clinical Sciences (Biostatistics) and Psychiatry, UT Southwestern Medical Center, Dallas, TX, (4)Abacist Analytics, Austin, TX*

Background: Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by deficits in social communication and social interaction, and restricted, repetitive patterns of behavior, interests or activities. Given the lack of specific pharmacological therapy for ASD and the clinical heterogeneity of the disease, current biomarker research efforts are geared mainly toward identification of markers for determining ASD risk or for assisting with earlier diagnosis. A wide range of putative biological markers for ASD are currently being investigated, including biomarkers pertaining to the genetic, epigenetic, transcriptomic, proteomic, and metabolomic levels. Proteomic analyses have indicated that the levels of many proteins in blood are altered in ASD suggesting that a panel of serum proteins may provide a possible biomarker for ASD.
Objectives: The aim of this study was to compare the levels of proteins in serum samples from 2-8 year old boys with and without ASD in order to identify possible early biological markers for ASD.
Methods: Subjects included 30 boys with ASD (mean age 5.47, SD 1.73 years) and 30 age-matched, typically developing (TD) controls (mean age 5.37, SD 1.75 years). ASD subjects underwent a diagnostic assessment using the ADOS and ADI-R. Clinical diagnosis was made based on these assessments and overall clinical impression using DSM-IV criteria. Only subjects with a diagnosis of Autistic Disorder were included. Controls were screened with the ABAS-II. To identify blood biomarkers of ASD we used the Myriad Rules Based Medicine (RBM) DiscoveryMAP to simultaneously measure a large number of proteins by multi-analyte profiling. Validation of two proteins identified from the Myriad RBM platform were subsequently performed on the MesoScales Discovery platform. Protein levels were subsequently regressed on each of the ADOS subdomain scores to determine whether they were related to a clinical measure of ASD.
Results: There were 11 proteins, 7 of which were significantly different between the two groups (p<0.05), which collectively predicted ASD vs. TD samples. Cross-validation of two proteins, thyroid stimulating hormone (TSH) and interleukin-8 (IL-8), was performed on 43 ASD boys (mean age 5.08, SD 1.77 years) and 37 TD boys (mean age 5.09, SD 1.86 years) for TSH, and 36 ASD boys (mean age 5.46, SD 1.61 years) and 35 TD boys (mean age 5.69, SD 1.94 years) for IL-8. TSH levels were 30% lower in ASD boys whereas IL-8 levels were 16% higher in ASD boys. When combining the levels of TSH and IL-8 to predict ASD, the predictive accuracy was 82%. Three ADOS subdomains exhibited a significant negative effect whereby higher scores in the subdomains (i.e. more ASD symptoms) were associated with lower levels of TSH: social interaction (z=-2.61, p=0.009), communication + social interaction (z =-2.12, p=0.034), and stereotyped behavior and restrictive interests (SBRI) (z=-2.28, p= 0.023). There was not a significant relationship between TSH and the ADOS communication subdomain, or IL-8 and any of the ADOS subdomain scores.
Conclusions: These data suggest that a panel of serum proteins can be useful as a blood biomarker for ASD in boys.

132 **109.132** Innate Versus Adaptive Immune Response Pathways in Peripheral Blood from ASD Children with Ileocolonic Inflammation

S. J. Walker[1] *and A. Krigsman*[2], *(1)Wake Forest Institute for Regenerative Medicine, Winston-Salem, NC, (2)Pediatric Gastroenterology Resources of New York and Texas, Far Rockaway, NY*

Background:
Gastrointestinal symptoms are a common co-occurring medical issue in ASD children. GI mucosal inflammatory infiltrates of both the small and large intestine have been noted in the setting of GI-symptomatic ASD and represent a potential etiology for many of the observed GI symptoms. Anecdotal and published reports of behavioral and cognitive improvement upon treatment of ASD-associated GI inflammatory disease supports the plausibility of a GI association for at least some of ASD behavioral and cognitive symptoms. We have previously described unique GI mucosal biomarkers specific for ASD-associated ileocolitis. It is not yet known whether these unique biomarkers are also present in the blood of these children. Identification of a validated blood-based biomarker of ASD-associated ileocolitis would allow for earlier identification of co-morbid GI disease and earlier GI intervention in affected patients. Moreover, it would provide insight into the relevant genes and biologic pathways in ASD-ileocolitis.
Objectives:
The goal of these studies is to evaluate blood-based gene expression In GI-symptomatic ASD children with demonstrated histologic ileocolitis to identify the genes and biological pathways most affected.
Methods:
The study cohort was comprised of whole blood from 22 ASD children undergoing clinically-indicated ileocolonoscopy for chronic GI symptoms, and 24 non-ASD (typically developing, TD) children undergoing ileocolonoscopy for a variety of GI symptoms. All ASD children had histologic inflammation of the ileum, colon, or both. The TD “controls” used for this study were selected based on absence of histologic inflammation anywhere in the GI tract and absence of a neurodevelopmental disorder. Differential gene expression in peripheral blood from ASD children (with ileocolitis) compared to TD children (without ileocolitis) was examined to identify differentially expressed transcripts that may serve as a proxy for GI inflammation.
Results:
We reported in an earlier study (Walker *et al*., PlosOne, 2013) that inflamed ileocolonic biopsy tissue from GI-symptomatic ASD children has a gene expression profile that overlaps with known inflammatory bowel disease. These earlier findings were apparent in inflamed ileocolonic mucosal tissue in this second cohort as well. In addition, we found that there is significant differential gene expression in peripheral blood of children with ASD and ileocolitis compared to TD children without GI inflammation. Two key immune-related pathways that were up-regulated in the blood of ASD cases are B cell receptor signaling and the Wnt signaling pathway, both important components of the *adaptive* immune response. In contrast, some of the key biological pathways that are coordinately down-regulated in the blood of the ASD (with inflammation) group are NOD-like receptor signaling, hematopoietic cell lineage, and Toll-like receptor signaling. Each of these pathways is important for pathogen recognition and for generating the host *innate* immune response.
Conclusions:
Gene expression in peripheral blood from ASD children with ileocolitis reveals a down-regulation of the host defense mechanism (innate immune response) together with an up-regulation of pathways that constitute the adaptive immune response, a pattern seen in other inflammatory bowel diseases. Studies are ongoing to validate these findings in additional samples.

133 **109.133** Non-Coding RNAs in Autism

ABSTRACT WITHDRAWN

Background: The human genome mostly consists of DNA that does not encode for protein. Although originally thought to represent evolutionary ‘junk,’ it has been shown

that much of the non-coding DNA in the human genome is actively transcribed to RNA in a highly regulated, tissue-specific manner.
Objectives: Following this insight, non-coding RNAs (ncRNAs) were demonstrated to be fundamental to many intracellular processes, such as targeting transcription factors to their binding sites, initiating chromatin remodeling, blocking transcription or translation of other genes both in cis and trans, and a variety of other functions that are still being uncovered. Perhaps not surprisingly, studies quickly followed showing that disruption of ncRNA biogenesis can lead to molecular and cellular defects.
Methods: Recently, ncRNAs have been demonstrated to be abnormal in the brains of patients with common neurodevelopmental disorders and their animal models, such as autism, schizophrenia, and bipolar disorder. These diseases were previously known to have a significant hereditary component, but their genomic etiology is complex and has remained poorly understood.
Results: Emerging research into underlying ncRNA problems in these disorders has the potential to reconcile their known heritability with their genomic and phenotypic heterogeneity, and hopefully unveil novel genomic pathologic mechanisms that can ultimately lead to new molecular therapeutics. In this presentation, we will present a broad overview of previous findings from our laboratory and others that have implicated long non-coding RNAs and short non-coding RNAs (such as microRNAs) in idiopathic autism.
Conclusions:
We will also present new work investigating non-coding RNAs expressed from the mitochondrial genome that appear altered in autistic brain.
Note: MNZ is an 'early career investigator' as defined by IMFAR

134 **109.134** Noncoding RNAs and Autism: The Impact of Employing Integrated Approaches

***Z. Talebizadeh**, Children's Mercy Hospital, Kansas City, MO*

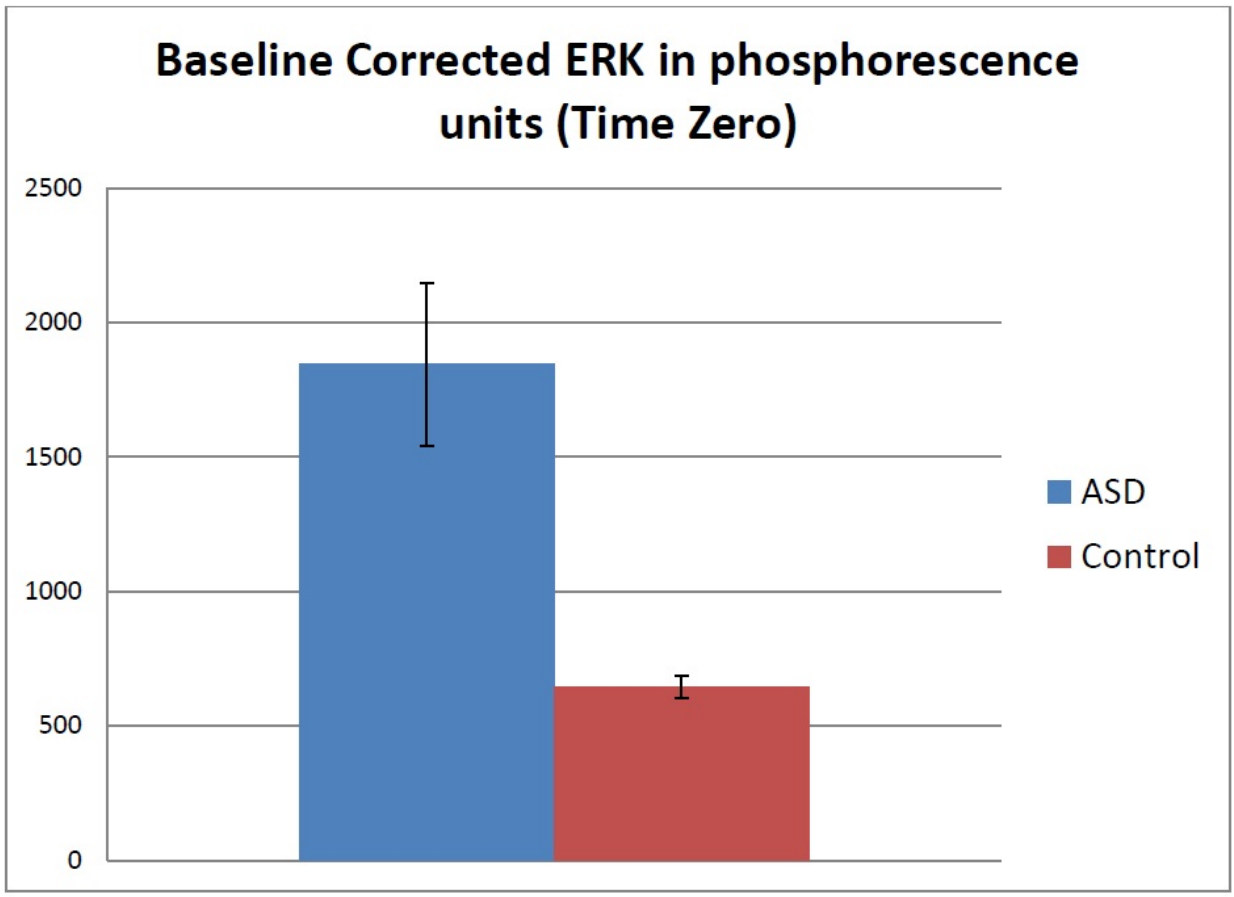
Background:
The field of noncoding RNAs (ncRNAs) is perhaps still in its infancy. However, because of the fascinating concept that they represent, regulation of gene expression, ncRNAs have become a topic of intense interest in understanding the underlying mechanism of human diseases. ncRNAs do not code for protein, but because of their influence on gene expression they may provide the key to uncover missing links in understanding the etiology of complex human diseases. Despite growing line of evidence indicating the essential role of ncRNAs in the brain function, they have been understudied in autism spectrum disorders (ASD).
Objectives: Among the main challenges in identifying causative genes for ASD are the extensive heterogeneity in the presentation of ASD and gene-environment interactions. Some of the undetected disease-causing mutations may alter gene regulation, whereas the candidate gene's genomic sequence remains intact. To address this critical gap, the existing and ongoing large-scale autism genetic sequencing and expression data need to be also analyzed with respect to assessing the gene regulatory factors.
Methods: Integrated approaches (i.e., utilizing two or more phenotypic and genetic/epigenetic factors as well as bioinformatics and data mining pipelines) would be beneficial in detecting biologically relevant and replicated findings that move the autism field forward.
Results: We highlight findings derived from a few integrative approaches, which had resulted in promising discoveries and provided practical examples of how uncovering genetic causes of autism may be accelerated.
Conclusions: The selected examples describe integrating different layers of genetic factors, including ncRNAs, thereby connecting the dots, which is expected to lead to the construction of autism-specific system biology networks (i.e., autism interactomes).

135 **109.135** Peripheral Lymphocytic Extracellular Signal Related Kinase Activation in Young Children with Autism Spectrum Disorder

***K. C. Dominick**[1], R. Shaffer[2], A. Duncan[1], C. L. Thomas[1], K. O'Brien[1], H. Meyer[1], L. K. Wink[3], E. Pedapati[4], C. R. Tessier[5] and C. Erickson[1], (1)Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (2)Cincinnati Children's Hospital Medical Center, Harrison, OH, (3)Child and Adolescent Psychiatry, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (4)INSAR Cincinnati Children's Hospital Medical Center, cincinnati, OH, (5)Indiana University School of Medicine - South Bend, South Bend, IN*

Background: Given the phenotypic variability within autism spectrum disorder (ASD), peripheral blood biomarker development offers the potential to objectively predict and measure treatment response. Additionally, peripheral biomarkers may aid early diagnosis and potentially predict disease severity. Biomarker development in ASD has been met with limited success to date. Recently, biomarker development has focused on looking at central points of cellular signaling and activity such as the extracellular signal-related kinase (ERK) signaling cascade. The ERK cascade plays critical roles in brain development, learning, and memory and has been linked with many neurogenetic disorders associated with ASD, including FXS, TS and neurofibromatosis.
Objectives: The purpose of this study was to examine ERK activation in peripheral lymphocytes in young children with ASD, aged 3 to 5 years old compared to age- and gender-matched neurotypical controls.
Methods: ASD diagnosis was based upon clinical interview with the Autism Diagnostic Observation Schedule completed by a research reliable examiner along with a score greater than or equal to 15 on the Social Communication Questionnaire (SCQ). Additional ASD subject characterization was done using the Aberrant Behavior Checklist (ABC), Social Responsiveness Scale (SRS) and Vineland Adaptive Behavior Scales. Participants with ASD had stable psychotropic drug dosing. Diagnosis of schizophrenia, another psychotic disorder, bipolar disorder, or alcohol or other substance abuse based on DSM-V criteria was exclusionary. Participants completed an extracellular signal-regulated kinase (ERK) activation assay administered at baseline and 8-12 weeks later to provide test-retest data. Neurotypical control subjects participated in baseline blood testing only to limit subject burden. ERK lymphocyte activation assays were completed by flow cytometry blind to participant diagnosis. Comparisons include baseline ERK activation (phosphorylation) and time to half maximum ERK phosphorylation following phorbol myristate acetate stimulation.
Results: There were 15 children in each group (4 female). Groups were matched for age with a mean ages of 4.5 and 4.2 in the ASD and control groups respectively ($p=0.26$). Groups were not matched on IQ with the children with ASD having a significantly lower IQ. Children with ASD had a significantly higher baseline ERK activation as compared to the control group ($p=0.037$). The time to half-maximum phosphorylation did not differ between groups (ASD M=5.67 minutes *s.d.*=0.84, Control M=5.87 *s.d.*=0.84 minutes, $p=0.662$).
Conclusions: ERK is a promising potential biomarker for ASD in young children. Further work is needed to fully understand how it may serve to aid in monitoring of treatment response or early identification.

Table 1: Group characteristics, ERK activation levels and time to half maximum ERK activation.			
	ASD	**Control**	**Paired t test**
Age	4.51 +/- 0.81 years	4.20 +/- 0.78 years	P=0.26
SCQ Score	21.53 +/- 5.94	4.64 +/- 4.43	P < 0.0001
IQ	58.88 +/- 23.48	102.09 +/- 9.19	P<0.0001
Corrected ERK in phosphorescence units at baseline (Time Zero)	**1844.87 +/- 1166.07**	**645.23 +/- 166.60**	**P=0.037**
Time to half maximum ERK activation following phorbol myristate acetate stimulation	5.67 +/- 1.23 minutes	5.87 +/- 0.84 minutes	P=0.662



136 **109.136** Reversing the Behavioral Phenotypes in fmr1 KO By the Reduction of Potassium Channel, Kv4.2

H. Y. Lee *and L. Jan, UCSF, SF, CA*

Background: Fragile X syndrome (FXS) is a common form of mental disability and one of the known causes of autism. The mutation responsible for FXS is a large expansion of the trinucleotide CGG repeats that leads to DNA methylation of the fragile X mental retardation gene 1 (FMR1) and transcriptional silencing, resulting in the absence of fragile X mental retardation protein (FMRP), an mRNA binding protein. Although it is widely known that FMRP is critical for metabotropic glutamate receptor (mGluR)-dependent long-term depression (LTD), which has provided a general theme for developing pharmacological drugs for FXS, specific downstream targets of FMRP may also be of therapeutic value. We reported dendritic localization of mRNA of Kv4.2 voltage- gated potassium channel, which regulates synaptic plasticity, and its local translational regulation by FMRP. FMRP suppression of Kv4.2 is revealed by elevation of Kv4.2 in neurons from fmr1 KO mice. Moreover, treating hippocampal slices from fmr1 KO mice with Kv4 channel blocker restores long-term potentiation (LTP) induced by moderate stimuli.
Objectives: We reported dendritic localization of mRNA of Kv4.2 voltage- gated potassium channel, which regulates synaptic plasticity, and its local translational regulation by FMRP. FMRP suppression of Kv4.2 is revealed by elevation of Kv4.2 in neurons from fmr1 KO mice. Moreover, treating hippocampal slices from fmr1 KO mice with Kv4 channel blocker restores long-term potentiation (LTP) induced by moderate stimuli.
Methods: To test the effect of Kv4.2 levels in FXS, we generated fmr1 mutant mice with a 50 % reduction in Kv4.2 expression and studied a range of phenotypes with relevance to the human disorders.
Results: We found that Kv4.2 reduction in fmr1 KO mice reverses the altered repetitive and perseverative phenotype of fmr1 KO mice. We also found Kv4.2 reduction rescues the deficit in social behaviors.
Conclusions: Our results demonstrate that Kv4.2 contributes significantly to the pathogenesis of the disease, a finding that has significant therapeutic implications for FXS.

137 **109.137** Sexual Dimorphism of Regulatory Small Non-Coding RNA in the Superior Temporal Gyrus Brain Region of Autism Spectrum Disorders: A Pilot Study

B. Stamova[1], *B. P. Ander*[2], *F. R. Sharp*[3] *and C. M. Schumann*[1], *(1)UC Davis MIND Institute, Sacramento, CA, (2)Department of Neurology, UC Davis MIND Institute, Sacramento, CA, (3)University of California at Davis, Sacramento, CA*

Background: Autism spectrum disorders (ASD) are more common in boys than girls. The bases for sex differences in ASD are poorly understood. It is theorized that higher etiologic load, including genetic and/or environmental load, is needed for females to develop ASD. Though sex differences in ASD neuropathology have been reported, sex differences in ASD brain transcriptomes remain largely unexplored. Male and female ASD subjects could have different molecular mechanisms for normal regional patterning in the brain which could contribute to sex differences in ASD. Thus, we investigated differential expression of small non-coding RNAs (sncRNA, including microRNA) in the superior temporal gyrus (STG) of male and female brains of ASD compared to typically developing (TD) controls. We investigated the superior temporal sulcus (STS) and primary auditory cortex (PAC) within the STG. STS is an association cortex involved in social perception, joint attention, face perception and speech perception and is implicated in ASD. PAC is a primary sensory cortex modulating auditory processing.
Objectives: To assess sncRNA expression in STS and PAC in postmortem male and female human brains of ASD compared to TD controls.
Methods: Affymetrix miRNA 3.0 arrays were run on 34 samples (5 ASD Female, 5 ASD Male, 2 TD Female, 6 TD Male; two brain regions – STS, PAC; 4-58 years of age; two of the 18 subjects had only one brain region available). ANOVA was used to identify sexually dimorphic differentially expressed sncRNA ($p<0.005$, $|\text{fold-change}|>1.2$). REML variance estimate suitable for unbalanced designs was used. To account for normal sexual dimorphism, we compared ASD female to TD female and ASD male to TD male, and overlapped the differentially expressed sncRNA to identify sexually dimorphic sncRNA expression specifically in ASD (Fig.1).
Results: We found sexually dimorphic sncRNA expression in the ASD postmortem brain, with a higher number of sncRNA being dysregulated in females compared to males (Fig.1). There were 27 sexually dimorphic sncRNA in ASD STS (7 in male and 20 in female), 9 in ASD PAC (2 in male, 7 in female), and 71 regionally dysregulated (between STS and PAC) (31 in male, 39 in female, and 2 common) (Fig. 2). The predicted mRNA targets of the mature miRNAs are over-represented in different pathways in male and female in STS and PAC. Axonal Guidance Signaling was the most over-represented canonical pathway in the regionally dysregulated (STS vs PAC) mature miRNAs both in male (FDR-corrected p=3.1E-12) and female (FDR-corrected p=2.4E-09). However, most of the predicted dysregulated target mRNAs were different in males compared to females. A number of predicted targets have been implicated in ASD, such as MET (in female), NTRK3 (in male), and SHANK2 (in both).
Conclusions: The sexually dimorphic sncRNAs in male and female ASD brains likely contribute to aberrant development and function of STS and PAC and likely contribute to some of the sexually dimorphic features of ASD. Future studies will need to confirm these findings.

138 **109.138** Syntaxin Binding Protein 5 Regulates Neurite Differentiation in an Autism-Related Model

W. Shen*, J. A. Frei and Y. C. Lin, Laboratory of Neuronal Connectivity, Hussman Institute for Autism, Baltimore, MD*

Background:
Autism is a neurological condition that features marked qualitative differences in communication and social interaction. It has been estimated that as many as 1/3 of individuals with autism spectrum condition also have epilepsy. Consistent with the extremely heterogeneous presentation of autism, genetic studies have implicated numerous genes that may contribute to the autism phenotype. Deletion and mutations of syntaxin binding protein 5 (*STXBP5*, also known as tomosyn) are identified in association with autism and epilepsy. *STXBP5* contains three distinct domains: C-terminal region containing an R-SNARE, synaptobrevin-like coiled-coil domain, and an N-terminal region enriched with WD40 repeats. *STXBP5* has a presynaptic role that negatively regulates neurotransmitter release by forming syntaxin-SNAP25-tomosyn complex. *STXBP5* is also detected in the postsynaptic domain in cerebellum. However, the postsynaptic role of *STXBP5* has not been well elucidated. Interestingly, WD40 as scaffolding domains, interact with diverse proteins, peptides or nucleic acids using multiple surfaces. It has been found that *STXBP5* is homologous to the L(2)gl, which is instrumental in establishing cell polarity. Therefore, we hypothesize that *STXBP5* may be involved in regulating cell growth and differentiation.
Objectives:
To knock down *STXBP5* and generate mutations of *STXBP5* in cell lines and primary mouse neurons to reveal the postsynaptic function of *STXBP5* and determine how mutations of *STXBP5* found in autism may contribute to the phenotype.
Methods:
Several shRNAs were created to knock down murine *STXBP5*. Knockdown efficiency is determined by Western blot analysis and the most efficient one is selected to knock down *STXBP5* in Neuro-2A cells. We use retinoic acid (RA) to induce Neuro-2A differentiation and determine whether *STXBP5* plays a role in this process. Neurite outgrowth is measured by live cell imaging with IncuCyte. We also use a mutagenesis method to generate several *STXBP5* mutations that are found in individuals with autism. Ongoing experiments are using primary neuron cultures as a model system to investigate the function of *STXBP5* for synapse and dendrite stability.
Results:
RA-induced Neuro-2A cells exhibit a characteristic bipolar-like shape, suggesting retinoic acid stimulates neurite outgrowth. shRNA of *STXBP5* shows 57% knockdown efficiency in Neuro-2A cells. Suppression of *STXBP5* by shRNA remarkably inhibits neurite outgrowth induced by retinoic acid.
Conclusions:
STXBP5 plays a role in regulating neurite outgrowth. Mutations of *STXBP5* found in individuals with autism may play a key role in altering neuronal differentiation including neurite outgrowth potentially disrupting normal developmental processes.

139 **109.139** Transcriptional Profiling of Human Neural Differentiation Implicates Noncoding RNA and ASD-Associated Genes

P. Hecht[1], *D. B. Campbell*[1], *N. A. Grepo*[2] *and J. A. Knowles*[1], *(1)University of Southern California, Los Angeles, CA, (2)USC, LOS ANGELES, CA*

Background: Increasing evidence suggests that noncoding RNAs hold diverse functions in various cellular processes and alterations in their expression may contribute to the etiology of several neuropsychiatric conditions, including autism spectrum disorder. Despite being abundantly expressed in the brain, the functional properties of these non-protein coding RNAs in human neuronal cells remains largely unknown. Exploring the complete transcriptional profile of human neurons may uncover gene networks underlying complex human disorders and may identify the noncoding RNAs possibly regulating these networks.
Objectives: The present study aimed to identify the transcriptional landscape of two human neural progenitor cell lines as they differentiate into human cortical projection neurons.
Methods: The human neural progenitor cell lines, SK-N-SH and ReNcell CX, were used to measure gene expression as they undergo differentiation. Cells were harvested at two stages of differentiation and RNA sequencing was performed to explore the transcriptional landscape of these cells. Differential expression analysis and weighted gene co-expression network analysis (WGCNA) was performed to identify genes showing altered expression and to infer the functional properties of noncoding RNAs through their co-expressed genes.
Results: Protein coding genes were found to account for 54.8% and 57.0% of expressed genes in SK-N-SH and ReNcell CX cells, respectively, and alignment of RNA sequencing reads revealed that only 25.5-28.1% mapped to exonic regions of the genome. Differential expression analysis in the two cell lines identified altered gene expression in both protein coding and noncoding RNAs as they undergo neural differentiation with 222 differentially expressed genes observed in SK-N-SH cells and 19 differentially expressed genes in ReNcell CX. Interestingly, genes showing differential expression in SK-N-SH cells are enriched in genes implicated in autism spectrum disorder, but not in gene sets related to cancer or Alzheimer's disease. Weighted gene co-expression network analysis (WGCNA) was used to detect modules of co-expressed protein coding and noncoding RNAs in SK-N-SH cells and found four modules to be associated with neural differentiation. These modules contain varying levels of noncoding RNAs ranging from 10.7% to 49.7% with gene ontology suggesting roles in numerous cellular processes important for differentiation.
Conclusions: These results indicate that noncoding RNAs are highly expressed in human neural progenitor cells and likely hold key regulatory roles in gene networks underlying neural differentiation and neurodevelopmental disorders, such as autism spectrum disorder.

140 **109.140** Urinary Metabolomics of Young Italian Autistic Children Supports Abnormal Tryptophan and Purine Metabolism

F. Gevi[1], ***S. Gabriele***[2], *L. Zolla*[1] *and A. M. M. Persico*[3,4], *(1)Department of Ecological and Biological Sciences, University of Tuscia, Viterbo, Italy, (2)Child & Adolescent Neuropsychiatry Unit, Lab of Molecular Psychiatry and Neurogenetics, University Campus Bio-Medico of Rome, Rome, Italy, (3)Mafalda Luce Center for Pervasive Developmental Disorders, Milan, Italy, (4)Child and Adolescent Neuropsychiatry Unit, Lab of Molecular Psychiatry and Neurogenics, University Campus Bio-Medico, Rome, Italy*

Background: Autism Spectrum Disorder (ASD) is still diagnosed through behavioral observation, due to a lack of biomarkers, which could instead greatly aid clinicians in providing earlier diagnoses, more timely referrals to behavioral intervention programs and evidence-based prognostic predictions. Metabolomic technologies offer a sensitive means to search human biofluids for metabolite profiles potentially usable as biomarkers for ASD. Initial metabolomic studies, analyzing urines and plasma of ASD and control individuals, suggested that autistic patients may share some metabolic abnormalities, despite several inconsistencies stemming from differences in technology, ethnicity, age range, and definition of "control" status.
Objectives: Our study aims to detect differences in urinary metabolic patterns between tightly matched young autistic and typically developing children previously shown to differ in urinary *p*-cresol levels (Altieri et al., 2011) by applying a highly sensitive, accurate and unbiased approach suitable to ensure broad metabolite detection coverage on human urine.
Methods: ASD-specific urinary metabolomic patterns were explored at an early age in 30 ASD children and 30 controls tightly matched by age, sex, Italian ancestry and city of origin within the country (age range 2-7, M:F=22:8) using hydrophilic interaction chromatography (HILIC)-UHPLC-MS. Metabolites were then subjected to multivariate statistical analysis (MetaboAnalyst 3.0 software) and grouped by metabolic pathway.

Results: Urinary metabolites displaying the largest differences between young ASD and control children belong to the tryptophan and purine metabolic pathways. Also vitamin B6, riboflavin, phenylalanine-tyrosine-tryptophan biosynthesis, pantothenate and CoA, and pyrimidine metabolism differ significantly. ASD children preferentially transform tryptophan into xanthurenic acid and quinolinic acid (two catabolites of the kynurenine pathway), at the expense of kynurenic acid and especially of melatonin. Also the gut microbiome contributes to altered tryptophan metabolism, yielding increased levels of indolyl 3-acetic acid and indolyl lactate.
Conclusions: The metabolic pathways most distinctive of young Italian autistic children largely overlap with those found in rodent models of ASD following maternal immune activation or genetic manipulations. These results are consistent with the proposal of a purine-driven Cell Danger Response, accompanied by overproduction of epileptogenic and excitotoxic quinolinic acid, large reductions in melatonin synthesis, and gut dysbiosis. These metabolic abnormalities could conceivably underlie some comorbidities frequently associated with ASD, such as seizures, sleep disorders, and gastrointestinal symptoms, and could contribute to autism severity. Their diagnostic sensitivity, disease-specificity and interethnic variability merit further investigation.

141 **109.141** Using iPSCs to Study Pathobiology and Drug Targets for Phelan-Mcdermid Syndrome

A. Browne[1], *E. Drapeau*[2] *and J. D. Buxbaum*[3], *(1)Icahn School of Medicine at Mount Sinai, New York, NY, (2)Icahn School of Medicine at Mount Sinai, Long Island City, NY, (3)Psychiatry, Seaver Autism Center at Mount Sinai, New York, NY*

Background:
Autism spectrum disorder (ASD) has high heritability and a prevalence of ca. 1% worldwide, but heterogeneity has made identifying the underlying pathobiology difficult. By focusing on genetic disorders with high penetrance for causing ASD, common pathobiological pathways might be identified. Phelan-McDermid syndrome (PMS) is one such genetic ASD-associated syndrome, where the neurobehavioral changes are caused by haploinsufficiency of the gene *SHANK3*, which encodes for a scaffolding protein of the post-synaptic density of glutamatergic synapses. While animal models provide great insight into the pathways involved in PMS, some features of the disease may not be captured because of neuronal variation across species. One approach to deal with this shortcoming is to generate induced pluripotent stem cells (iPSCs) from patients that can then be differentiated into neural progenitor cells (NPCs) and neurons.
Objectives:
Results from a recent study indicate that iPSC-derived neurons from PMS patients show excitatory synaptic deficits similar to those seen in animal models. This provides further support for our hypothesis that expression analysis from such cells can provide valuable insight into the underlying pathobiology and can be mapped to the expression profiles of FDA-approved drugs to identify candidates for repositioning as novel PMS therapeutics. Therefore, we aim to 1) generate high-quality iPSC clones from PMS patients and siblings; 2) differentiate them into neurons that capture the neurobiological phenotype of PMS in patients; 3) identify PMS-associated differential gene expression in iPSC-derived neurons by RNA sequencing; and, 4) identify candidate drugs by comparing gene expression patterns for FDA-approved drugs with PMS-associated expression.
Methods:
Blood samples from patients with PMS and unaffected siblings have been collected for 14 patient/sibling pairs and are being reprogrammed using a non-integrating virus to express reprogramming factors. Three clones are selected for each patient after quality control (QC). Clones are then transfected with lentiviruses carrying vectors to induce expression of NGN2 under the control of doxycycline, followed by puromycin selection. Astrocytes are added at day 2 to support synapse formation, and after 3 weeks, cells are harvested and processed for RNA isolation, followed by RNA sequencing. The PMS-associated changes in gene expression are then analyzed to understand the underlying neurobiology, and compared to known gene expression profiles of FDA-approved drugs and used to identify candidate PMS therapeutics based on anti-correlation between disease and drug gene expression.
Results:
Ten patient/sibling pairs have been reprogrammed and high quality clones have been obtained after QC, while the remaining 4 patient/sibling pairs are currently being reprogrammed. NPC generation and neuronal induction has been performed on clones as they finish QC testing. Studies making use of Axion high-throughput Microelectrode arrays are being piloted as a means of high throughput electrophysiological analyses.
Conclusions:
iPSCs from PMS patients offer a powerful tool for disease characterization, drug identification, and screening. Generating an expression profile for these patient-derived neurons will provide a unique perspective on the transcriptional signature of PMS that can be used to understand neurobiology and, in conjunction with other models of the disease and known drug expression profiles, to identify new therapeutics.Background: Autism spectrum disorder (ASD) has high heritability and a prevalence of ca. 1% worldwide, but heterogeneity has made identifying the underlying pathobiology difficult. By focusing on genetic disorders with high penetrance for causing ASD, common pathobiological pathways might be identified. Phelan-McDermid syndrome (PMS) is one such genetic ASD-associated syndrome, where the neurobehavioral changes are caused by haploinsufficiency of the gene *SHANK3*, which encodes for a scaffolding protein of the post-synaptic density of glutamatergic synapses. While animal models provide great insight into the pathways involved in PMS, some features of the disease may not be captured because of neuronal variation across species. One approach to deal with this shortcoming is to generate induced pluripotent stem cells (iPSCs) from patients that can then be differentiated into neural progenitor cells (NPCs) and neurons.
Objectives: Results from a recent study indicate that iPSC-derived neurons from PMS patients show excitatory synaptic deficits similar to those seen in animal models. This provides further support for our hypothesis that expression analysis from such cells can provide valuable insight into the underlying pathobiology and can be mapped to the expression profiles of FDA-approved drugs to identify candidates for repositioning as novel PMS therapeutics. Therefore, we aim to 1) generate high-quality iPSC clones from PMS patients and siblings; 2) differentiate them into neurons that capture the neurobiological phenotype of PMS in patients; 3) identify PMS-associated differential gene expression in iPSC-derived neurons by RNA sequencing; and, 4) identify candidate drugs by comparing gene expression patterns for FDA-approved drugs with PMS-associated expression.
Methods: Blood samples from patients with PMS and unaffected siblings have been collected for 14 patient/sibling pairs and are being reprogrammed using a non-integrating virus to express reprogramming factors. Three clones are selected for each patient after quality control (QC). Clones are then transfected with lentiviruses carrying vectors to induce expression of NGN2 under the control of doxycycline, followed by puromycin selection. Astrocytes are added at day 2 to support synapse formation, and after 3 weeks, cells are harvested and processed for RNA isolation, followed by RNA sequencing. The PMS-associated changes in gene expression are then analyzed to understand underlying neurobiology, and compared to known gene expression profiles of FDA-approved drugs and used to identify candidate PMS therapeutics based on anti-correlation between disease and drug gene expression.
Results: Ten patient/sibling pairs have been reprogrammed and high quality clones have been obtained after QC, while the remaining 4 patient/sibling pairs are currently being reprogrammed. NPC generation and neuronal induction has been performed on clones as they finish QC testing. Studies making use of Axion high-throughput Microelectrode array are being piloted as a means of high throughput electrophysiological analyses.
Conclusions: iPSCs from PMS patients offer a powerful tool for disease characterization, drug identification, and screening. Generating an expression profile for these patient-derived neurons will provide a unique perspective on the transcriptional signature of PMS that can be used to understand neurobiology and, in conjunction with other models of the disease and known drug expression profiles, to identify new therapeutics.

Poster Session
110 - Social Cognition and Social Behavior
11:30 AM - 1:30 PM - Hall A

142 **110.142** A Dynamic Systems Approach to Emotion Coregulation in Families of Children with Autism Spectrum Disorders and Families of Typically Developing Children

Y. Guo[1], *W. A. Goldberg*[1], *D. R. Garfin*[1] *and A. R. Ly*[2], *(1)University of California Irvine, Irvine, CA, (2)University of Delaware, Newark, DE*

Background: Parent-child coregulation lays the foundation for the development of adaptive skills and future self-regulation in child. Emotional dysregulation is one of core symptoms in children with autism. Previous research on Autism Spectrum Disorders (ASD) has focused primarily on children's ability to recognize and describe emotional experiences. Little is known about role of the dynamic interplay between parents and their young children with ASD in emotion regulation. Impaired emotional regulation may hallmark behavioral rigidity in ASD. However, there is no study examining dyadic flexibility which indicates dyad's ability to shift emotional states.
Objectives: To compare moment-to-moment processes of emotion coregulation between dyads of mother-child with ASD and dyads of mother-typically developing (TD) child in terms of dyadic flexibility and emotional content using a dynamic systems method.
Methods: Seventy-four dyads of mothers and children (47 ASD dyads and 27 TD dyads) participated in a 10-minute Three Boxes procedure at home. An original coding scheme was developed to evaluate positive engagement, negative engagement, and disengagement in dyadic mother-child interaction every five-second intervals using Mangold International's INTERACT 9.47 software. Inter-coder reliability for child and mother engagement was 91.07% (k = .82) and 91.76% (k = .81). The observation data were imported into the State Space Grid (SSG) software to operationalize dyadic *flexibility* indicated by *dispersion* (higher values indicating more flexibility or wider range of dyadic engagement states), *transition* (higher values indicating more flexibility or frequent changes in dyadic engagement states) and *average mean duration* (AMD: lower values indicating more flexibility or spending short times in a particular dyadic engagement state), and *emotional content of coregulation* indicated by five regions marked in the SSG: (1) *mutual positive* (both mother and child showed positive engagement), (2) *mutual negative* (both mother and child showed negative engagement), (3) *child negative/mother positive*, (4) *child positive/mother negative*, and (5) *child object*(child engaged only with toy/objects). T-tests and OLS regressions controlling for maternal

education and child age were used to analyze the data.
Results: As expected, in comparison to TD dyads, ASD mother-child dyads had more frequent engagements that were mutually negative, child negative/mother positive and child object-focused; also, ASD child negative/mother positive engagements were of longer duration. Mutual positive engagements were shorter in duration, but more frequent. Surprisingly, ASD dyads exhibited greater flexibility compared to TD dyads, indicating by higher dispersion and higher transition and lower AMD (see Table 1).
Conclusions: To our knowledge, this study is the first to examine emotion coregulation process in mothers and children with ASD using the State Space Grid method. The findings suggest that flexibility and emotional content of coregulation are congruent. Constant change between positive and negative dyadic engagement support the idea that unstable structures of dyadic interactions may be observed in ASD dyads. The dynamic systems approach to assessing emotional coregulation in families with a child with ASD has both research and therapeutic implications.

A Dynamic Systems Approach to Emotion Coregulation in Families of Children with Autism Spectrum and Families of Typically Developing Children

Table 1
Comparisons of Autism Spectrum Disorder (ASD) and Typically Developing (TD) Children on Key Space State Grid and Region-level Variables

	Diagnostic Groups N=74[a]				
	ASD *n*=47		TD *n*=27		Test of differences between groups (ASD vs. TD)
	M	*SD*	*M*	*SD*	
Grid-level variables					
Dispersion	0.79	0.11	0.69	0.14	$t(72)=-3.39^{**}$
Transition	74.85	17.73	57.33	14.11	$t(72)=-4.39^{***}$
AMD[a]	9.04	2.56	11.50	3.00	$t(72)=3.99^{***}$
Region-level variables					
Visits					
Mutual positive	14.96	5.01	11.26	5.17	$t(72)=-3.02^{**}$
Child-object	10.75	6.24	7.26	4.24	$t(72)=-2.58^{*}$
Child positive/mother negative	8.27	6.01	5.70	5.80	$t(72)=-1.79$†
Child negative/mother positive	2.65	3.15	0.78	1.85	$t(72)=-2.83^{**}$
Mutual negative	13.96	5.01	10.26	5.17	$t(72)=-3.02^{**}$
Duration					
Mutual positive	35.42	33.63	60.31	56.10	$t(72)=2.39^{*}$
Child-object	112.30	89.91	77.56	64.62	$t(72)=-1.76$†
Child positive/mother negative	80.76	77.37	68.81	77.97	$t(72)=-0.64$
Child negative/mother positive	16.81	20.70	4.11	10.20	$t(72)=-2.98^{**}$
Mutual negative	35.04	51.15	9.44	26.36	$t(72)=2.42^{*}$

†<.10; *p<.05; **p<.01; ***p<.001 [a]AMD=Mean duration per visit
Note: Analyses were conducted using the standardized values for region-level variables; the pattern of results was identical. For ease of interpretation, unstandardized estimates with the raw data are presented. Ordinary Least Squares Regression analyses were used to confirm bivariate models: significance remained in three grid-level variables (dispersion, transition and AMD), four region-visits variables (mutual positive, child object, child negative/mother positive, and mutual negative), and three region-duration variables (mutual positive, child object, child negative/mother positive).

110.143 A Longitudinal Study of the Social-Cognitive Phenotype of ASD and Reading Comprehension Development

N. S. McIntyre[1], *P. C. Mundy*[2], *M. Solomon*[3], *T. Oswald*[4], *L. E. Swain-Lerro*[1], *M. C. Zajic*[1], *J. B. McCauley*[4] *and H. K. Schiltz*[5], *(1)University of California at Davis MIND Institute, Davis, CA, (2)Education and Psychiatry, University of California at Davis, Sacramento, CA, (3)MIND Institute, Sacramento, CA, (4)University of California at Davis MIND Institute, Sacramento, CA, (5)Human Development, University of California at Davis, Davis, CA*

Background:
Observations suggest that reading comprehension (RC) impairment is part of the social communication phenotype of higher-functioning school-aged children with ASD (HFASD), showing significant negative associations between ASD symptom intensity, oral language skills, text reading fluency, and RC (e.g. McIntyre et al., 2015; Norbury & Nation, 2011). This includes observations that social cognition, as operationalized by Theory of Mind (ToM) tasks, was a unique predictor of RC even after controlling for oral language and word reading for adolescents with ASD (Ricketts et al., 2013).
Objectives:
1) To compare changes in RC over a 15-month development period across children with HFASD, ADHD, or Typical Development. 2) To test the hypothesis that social cognition is a specific predictor of RC development among children with HFASD.
Methods:
Participants included 8- to 17-year-old children with HFASD (N=70), ADHD (N=30), and typical development (TD, N=40). The groups were matched on age but varied on FIQ (99, 100, 115, respectively). Analyses control for FIQ where appropriate. ASD symptoms were confirmed with the ADOS-2 and presence of ADHD symptoms were confirmed with Conners-3 parent reports. Reading fluency and comprehension were measured with the Gray Oral Reading Test-5 (GORT-5), and a latent ToM score was comprised of scores from the Strange Stories (Happe, 1994) and the Silent Films (Devine & Hughes, 2012) tasks.
Results:
A repeated measures ANCOVA revealed little change in RC for any of the diagnostic groups in GORT-5 across 15 months, $\lambda = .99$, $F(2,139)=0.28$, $p=.76$ $\eta^2_p = .004$. The HFASD group, however, was significantly lower than both the ADHD and TD groups at Time Points 1 & 2, $F(2,143)=7.10,6.10$, $p's<.01$, $\eta^2_p=.09$ & .08, respectively. MANCOVA results indicated the HFASD group performed significantly lower than both the ADHD and TD groups on both ToM measures, $\lambda = .88$, $F(2,139)=0.28$, $p=.76$ $\eta^2_p = .06$. A regression predicting Time Point 2 RC with Diagnostic Group, Time Point 1 RC, FIQ, language measures, the latent ToM Score, and the Diagnostic Group by latent ToM score interaction term revealed that the latter was significant after considering all other variables in the equation, change in $R^2=.07$, $F(1,62)=6.21$, $p<.02$. Follow-up regressions within each of the three diagnostic groups indicated that latent ToM measure explained unique significant portion of the variance in TP2 RC for HFASD Group, but not for ADHD or TD groups (Table 1). Separate regressions revealed the association between the ToM and TP 2 RC in HFASD was significant when both the more verbal (Strange Stories) or less verbal (Silent Films) measures were used the analyses.
Conclusions:
Results indicated that while children with HFASD did not lose reading comprehension skills, neither did they make any progress toward closing the previously-reported gap, placing them at risk for falling further behind as reading materials become increasingly more complex and integral to academic achievement. Furthermore, mental state understanding (ToM) in the HFASD group was impaired relative to the other diagnostic groups and explained unique variance in TP2 RC providing evidence that the social cognitive phenotype of ASD is important to consider when designing reading interventions for children with ASD.

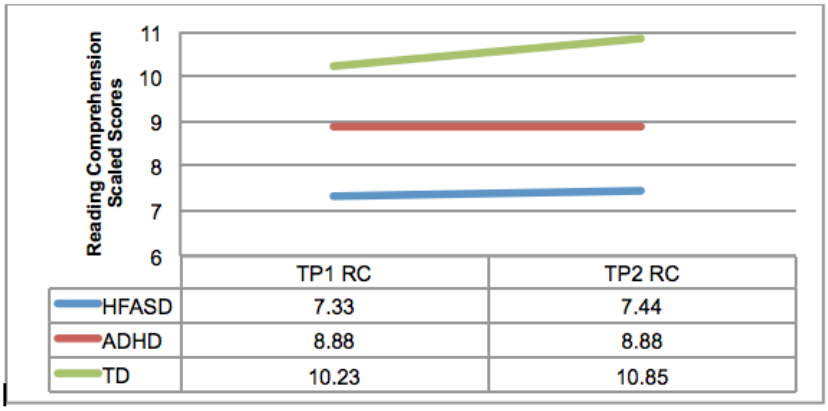


Figure 1. Time Point 1 and 2 Gray Oral Reading Test-5 reading comprehension scaled scores by diagnostic group.

Table 1

Regression Analyses Predicting Time Point 2 Reading Comprehension by Group

Dx Gp	Step	Variable	R^2 change	*F* change	*p*	*β*	*p*
HFASD	1	TP1 RC	.66	119.83	<.001	.38	<.001
	2	FIQ	.08	18.51	<.001	.10	.25
	3	Text Fluency	.03	8.55	<.01	.22	<.01
	4	Strc.Language	.02	2.63	.08	.16	.08
		Inference				.07	.45
	5	ToM	.02	5.81	.02	.18	.02
ADHD	1	TP1 RC	.70	64.27	<.001	.30	.13
	2	FIQ	.02	2.36	.14	.34	.04
	3	Text Fluency	.06	7.20	.01	.28	.05
	4	Strc.Language	.01	.48	.63	.12	.41
		Inference				-.04	.69
	5	ToM	.01	1.10	.31	.12	.31
TD	1	TP1 RC	.63	61.09	<.001	.75	<.001
	2	FIQ	<.01	.41	.53	.20	.14
	3	Text Fluency	.01	.58	.45	.11	.29
	4	Strc.Language	.08	4.60	.02	-.25	.03
		Inference				.24	.03
	5	ToM	.02	2.00	.17	-.16	.17

Note: HFASD = High-Functioning Autism Spectrum Disorder; ADHD = Attention-Deficit Hyperactivity Disorder; TD = Typically Developing; TP1 RC = Gray Oral Reading Test-5, text comprehension scaled score.; FIQ = Full-Scale IQ, WASI; Text Fluency = Gray Oral Reading Test-5, text reading fluency scaled score; Strc.Language = CELF-4 Recalling Sentences scaled score; Inference = Test of Auditory Processing, Auditory Reasoning scaled score; ToM = Strange Stories and Silent Films raw score average.

144 **110.144** A Meta-Analysis of Friendships in School-Age Youth with ASD

J. Mendelson[1], *J. A. Gates*[2] *and M. D. Lerner*[3], *(1)Marcus Autism Center, Children's Healthcare of Atlanta and Emory University School of Medicine, Greensboro, NC, (2)Stony Brook University, Smithtown, NY, (3)Stony Brook University, Stony Brook, NY*

Background: As a result of the core social deficits of autism spectrum disorder (ASD), some have questioned whether meaningful social relationships, including friendship, are even possible in this population (e.g., Hobson, 1993; Calder, Hill, & Pellicano, 2013; Mitchell & Locke, 2014). Friendship serves a range of crucial functions across the lifespan (Baumeister & Leary, 1995), with friendlessness yielding serious, negative implications for children (Bagwell, 2004; Berndt & Keefe, 1995). [JG1] Crucially, recent studies indicate that at least some youth with ASD *do* make friends according to their parents, peers, and themselves (e.g., Kasari et al., 2011; Bauminger et al., 2008), and that these friendships may vary as a function of age and cognitive ability (Mendelson & Lerner, 2014). However, to date no systematic meta-analysis of friendship presence and patterns in youth with ASD has been conducted.

Objectives: We aimed to meta-analyze the empirical literature on friendships of children with ASD.

Methods: We conducted a systematic review of the literature (via PsycINFO and PubMed) on friendships (sociometric, self-report, parent-report) among school-age youth with ASD. 659 candidate articles were identified, and a pair of blinded coders examined them according to these inclusion criteria: a) empirical studies presenting quantitative data not previously published; b) published in peer-reviewed journals; c) claimed to include individuals with ASD; d) included some confirmation of ASD diagnostic status; e) included at least one participant in the 8-12 age range; f) not intervention studies; g) presented quantitative data on friendship. This yielded 18 articles. All 18 articles were double-coded by two blinded raters on demographic variables and all component scales. Coders achieved excellent agreement (ICC(1,2) > .97). Three articles were excluded due to overlapping participant samples and 14 were included in the final analysis. Meta-analyses were run for sociometric, self-report, and parent-report measures of friendship. If significant variation was found across the studies, fixed effects moderator analyses were conducted for age and IQ.

Results: Results from 1,768 participants with ASD were analyzed $M_{\%male}$ =85.46, M_{age}=114.92; M_{IQ}=91.85). We found that youth with ASD *do* make friends according to peers and parents (Figure 1; Hedges's g > 2.84). However, self-reported friendship quality (Hedges's g = -1.09) and parent- and peer-reported quantity (Hedges's g < -0.63)

were poorer than TD peers (Figure 2). For sociometric and self-report quality of friendship measures, the differences between ASD and TD peers were smaller with both age and higher IQ Older youth with ASD made more friends than younger youth according to sociometrics. Parents reported youth with higher IQ to have fewer/less active friendships.
Conclusions: Despite the widespread assumption that youth with ASD do not make friends, this meta-analysis reveals that they do so, and that they are of reasonable quality. Indeed, the difference from zero friendships was *larger* than the differences between youth with ASD and TD. Nonetheless, these friendships were lower in number and quality than those of their TD peers. These friendship patterns appear dynamic across time and IQ. This meta-analysis provides a foundation for future friendship studies in ASD.

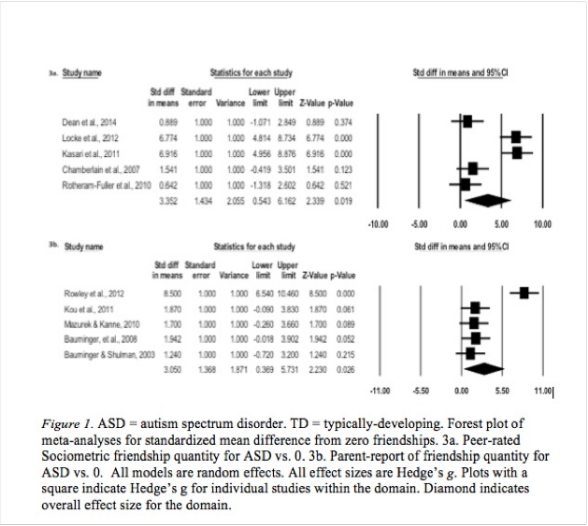


Figure 1. ASD = autism spectrum disorder. TD = typically-developing. Forest plot of meta-analyses for standardized mean difference from zero friendships. 3a. Peer-rated Sociometric friendship quantity for ASD vs. 0. 3b. Parent-report of friendship quantity for ASD vs. 0. All models are random effects. All effect sizes are Hedge's *g*. Plots with a square indicate Hedge's g for individual studies within the domain. Diamond indicates overall effect size for the domain.

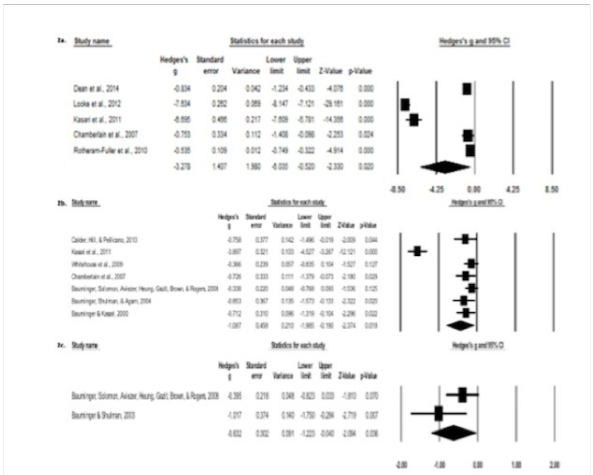


Figure 2. ASD = autism spectrum disorder. TD = typically-developing. Forest plot of meta-analyses for mean difference between ASD and TD friendships. 2a. Peer-rated Sociometric friendship quantity ASD vs. TD. 2b. Self-report friendship quality for ASD vs. TD. 2c. Parent-report friendship quantity for ASD vs. TD. All models are random effects. All effect sizes are Hedge's *g*. Plots with a square indicate Hedge's *g* for individual studies within the domain. Diamond plots indicate overall effect size for the domain.

145 **110.145** Abnormal Joint Attention Network in Children and Adolescents with Autism: An Interactive Eye-Tracking Paradigm

E. Oberwelland[1,2], *L. Schilbach*[3,4], *I. Barisic*[3,5], *S. C. Krall*[2,6], *K. Vogeley*[2], *G. R. Fink*[2,7], *B. Herpertz-Dahlmann*[1], *K. Konrad*[1,2] *and M. Schulte-Rüther*[1,2], *(1)Department of Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy, University Hospital RWTH Aachen, Aachen, Germany, (2)Cognitive Neuroscience, Institute of Neuroscience and Medicine (INM-3), Jülich Research Center, Jülich, Germany, (3)Department of Psychiatry, University Hospital Cologne, Cologne, Germany, (4)Max Planck Institute of Psychiatry, Munich, Germany, (5)Department of Humanities, Social and Political Science, ETH Zurich, Zurich, Switzerland, (6)Department of Child and Adolescent Psychiatry, Psychosomatics, and Psychotherapy, University Hospital RWTH Aachen, Aachen, Germany, (7)Department of Neurology, University Hospital Cologne, Cologne, Germany*

Background: Social interactions form a substantial part of human daily living and develop from fundamental processes during infancy, such as joint attention (JA), to highly sophisticated processes in adolescence and adulthood. In the case of autism spectrum disorder (ASD), social interactions are typically affected with deficits in JA as one of the earliest sign to be at risk for ASD. Numerous behavioral studies have consistently demonstrated the compelling link between JA and ASD. However, to fully understand the deficits in JA and the link to ASD, it is crucial to examine the underlying neural processes during development, which are until now poorly understood.
Objectives: We compared the neural correlates of JA and its modulation by a familiar and unfamiliar interaction partner and by self- and other-initiation in children and adolescents with and without ASD.
Methods: We used an interactive eye-tracking setup (Wilms et al., 2010), in which participants were looking at a face surrounded by three targets (left, right and top). In the *Self-Initiated* conditions, participants shifted their gaze towards a target. The interaction partner followed the participant's gaze (*JA-Self)* or the interaction partner shifted her gaze downwards (*Control_Self*). In the *JA-Other* condition, participants were followed the interaction partner's gaze. In the *Control-Other* condition, participants shifted the gaze towards the target that changed color while the interaction partner shifted her gaze downwards. Importantly, the gaze-contingent setup allowed for comparison of neurofunctional differences for successfully established JA irrespective of behavioral differences. We analyzed 14 participants with ASD (8-18 years) and 14 age-, gender-, and IQ-matched TD participants. Brain imaging data were analyzed with SPM8, using a flexible factorial ANOVA model (random effects analysis, threshold: $p<0.05$ cluster-level FWE corrected, voxel level $p<0.001$).
Results: TD participants elicited greater activation in the right STS during JA than control conditions compared to participants with ASD who even showed deactivation during JA. Similarly, TD participants elicited left TPJ and left inferior parietal lobe activation specifically for JA, whereas participants with ASD elicited the left TPJ over all conditions with no differentiation between JA and control conditions. TD participants also deactivated the right temporal pole during control conditions and showed nearly no activation during JA. Participants with ASD though, deactivated the same region during JA. Furthermore, we found an overall effect of familiarity in the ASD group, i.e. increased activation when interacting with their mother in bilateral fusiform gyrus, left precuneus, left STS, ventral striatum and amygdala.
Conclusions: The STS, TPJ and temporal pole have all been discussed as critical brain regions for social processing with documented abnormalities in ASD (Allison, Puce, & McCarthy, 2000; Olson, Plotzker, & Ezzyat, 2007; Zilbovicius et al., 2006). Specific neurofunctional differences even during successfully established JA in children and adolescents with ASD suggest persistent developmental differences in JA capabilities, contributing to social processing difficulties. Thus, for basic processes such as JA abnormalities in neural functioning appear to persist despite seemingly successful behavioral maturation. Additionally, our data supports previous studies demonstrating

enhanced activation in participants with ASD when processing familiar faces.

146 **110.146** Adolescents' Ability to Differentiate Interest Levels of Their Conversational Partners on the Contextual Assessment of Social Skills (CASS)

C. O. Leonczyk, *S. Mrug, R. Murray, L. N. Perry, J. W. Blackston and S. E. O'Kelley, Psychology, University of Alabama at Birmingham, Birmingham, AL*

Background:
The Contextual Assessment of Social Skills (CASS) is a new observational measure that uses semi-structured role-plays to assess conversational abilities, ability to perceive conversational partners' interest, and ability to adapt to changes in social context (Ratto, Turner-Brown, Rupp, Mesibov, & Penn, 2011). The initial validation study compared adolescents with high-functioning ASD to college-aged healthy controls. Compared to college-aged healthy controls, individuals with ASD perceived less of a difference in bored and interested conversational partners. Studies have not compared the CASS in adolescents with ASD and adolescents with other developmental or social difficulties.
Objectives:
To compare adolescents with ASD and adolescents with other developmental or social difficulties' ability to differentiate the interest level of their conversational partners on the CASS.
Methods:
We administered the CASS to 23 high school students referred for a school-based social skills intervention. All students were referred because they displayed difficulty making friends and some level of social difficulty. Some students had diagnoses of ASD (n = 7) and the remainder (n = 16) had other developmental disabilities or social difficulties (e.g., language disorders, learning disorders, shyness, social anxiety). Each student participated in two consecutive semi-structured role-play conversations. During the first role-play, the confederate acted interested in the conversation. During the second role-play, a different confederate acted bored in the conversation. After each role-play the participant filled out the Conversation Rating Scale (CRS), which consists of 5 items rating the confederate's perceived interested on a Likert-scale. We calculated a CRS Difference Score (CRS Interested condition score – Bored condition score), which reflects the adolescent's ability to distinguish between the two conditions. Higher difference scores indicate better ability to perceive differences in the confederate's interest level. We compared CRS Difference Scores between students with and without ASD using an independent samples t-test. We also examined the correlation between students' CRS Difference Scores and autism symptoms, as measured by the SRS-2 teacher report.
Results:
We found a significant difference in CRS Difference Score between students with and without ASD, $t(21) = -.61$, $p < .05$. Students with ASD had lower CRS Difference Scores (M = 5.83, SD = 12.12) than their peers without ASD (M = 8.18, SD = 6.27), indicating less ability to perceive the change in partner's interest level. Interestingly, three students with ASD and two students without ASD perceived no difference between the two conditions (i.e., had CRS Difference scores of 0 or negative CRS Difference Scores). Higher autism symptoms on the SRS-2 were associated with lower CRS Difference scores, $r(19) = -.48$, $p < .05$, indicating less ability to perceive differences in conversational partner's interest level.
Conclusions:
Compared to peers with other developmental disorders or social difficulties, students with ASD were less able to perceive a difference in their conversational partners' interest level. More than 1/5 of students (including some without ASD) did not perceive any difference in their conversational partners' interest levels, which is a critical social skill. Future studies should evaluate the CASS' potential as a treatment outcome measure for social skills interventions.

147 **110.147** Affective Flexibility during the Self-Referenced Memory Task: A Novel Analytic Approach

C. A. Burrows[1], *S. Sun*[2], *L. V. Usher*[1], *J. C. Britton*[2] *and H. A. Henderson*[3], *(1)University of Miami, Coral Gables, FL, (2)Psychology, University of Miami, Coral Gables, FL, (3)University of Waterloo, Waterloo, ON, Canada*

Background: Individuals with high-functioning autism (HFA) demonstrate difficulties in several domains, including cognitive flexibility, emotion understanding and self-referenced processing, which have been linked to maladaptive outcomes. However, little research has examined affective flexibility, or the ability to switch between information of emotional content, in HFA. The valence of information (positive versus negative) and processing condition (thinking about oneself or another person) are two factors that may influence affective flexibility in individuals with HFA.
Objectives: The goals of this study were to examine the effect of switching between adjective valence and condition on behavioral measures of affective flexibility in children and adolescents with HFA and a matched comparison sample (COM) on a self-referenced memory task.
Methods: Children and adolescents with HFA (N=76, 65 males, Mage=12.51, SD=2.58) and a comparison sample (N=72, 52 males, Mage=13.28, SD=2.15) completed a self-referenced memory paradigm, where they judged both positive and negative traits with reference to themselves or a familiar other person (e.g., Harry Potter). Switch cost was computed as the reaction time (ms) difference between switch-trials (trials that differed in valence from previous trials) and non-switch trials (trials that had the same valence as previous trials). The difference score was computed for positive-negative (P-N) and negative-positive (N-P) switches in the self and other conditions.
Results: Mean switch cost values for each group and condition are presented in Table 1. A Group (HFA, TD) x Condition (Self, Other) x Switch type (P-N, N-P) repeated-measures ANCOVA was conducted on the switch cost data, controlling for verbal IQ and gender. Overall, there was a main effect of switch, $F(1,146)=8.55$, $p=.004$, with a greater slowing in reaction times in the positive-negative switches than in negative-positive switches. A three-way interaction also emerged, $F(1,146)=4.01$, $p=.047$, indicating that the differential switch-cost by condition and type differed by group. Follow-up analyses revealed that the group effect was specific to the difference between self and other P-N switches, $F(1,147)=4.46$, $p=.036$. Reaction times of participants with HFA were particularly affected by switching from positive- to negatively-valenced adjectives in self relative to other condition.
Conclusions: This study is the first to examine elements of affective flexibility using a self-referenced processing task. All participants found it easier to process positive information. However, the reaction time cost was accentuated when children with HFA were required to think of switch between positive and negative self-referenced information, relative to thinking of another person. It may be more effortful for them to evaluate negative self-referential information, indexing affective inflexibility. These impairments could account for different patterns of comorbidity in children with HFA.

Table 1. Switch cost (difference in reaction times between switch trials and non-switch trials) values for each group in milliseconds. Estimated marginal means and standard errors are presented, controlling for verbal intelligence and gender. Positive values indicate greater slowing between switch and non-switch trials. Note: HFA = high-functioning autism; COM = comparison, *=group difference.

	HFA Group			COM Group		
	Self	Other	Self-Other Difference	Self	Other	Self-Other Difference
Positive to Negative Switch Cost	127 (42)	4 (46)	126 (61)*	66 (43)	112 (48)	-65 (63)*
Negative to Positive Switch Cost	-179 (47)	-130 (42)	-49 (60)	-80 (49)	-117 (44)	37 (63)

148 **110.148** Alexithymia, Executive Function and Mind-Reading in Children with and without Autism Spectrum Disorders

B. Auyeung[1,2], *C. Griffin*[3] *and M. V. Lombardo*[4], *(1)Department of Psychology, School of Philosophy, Psychology and Language Sciences, University of Edinburgh, Edinburgh, United Kingdom, (2)Department of Psychiatry, Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (3)Psychology, University of Edinburgh, Edinburgh, United Kingdom, (4)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom*

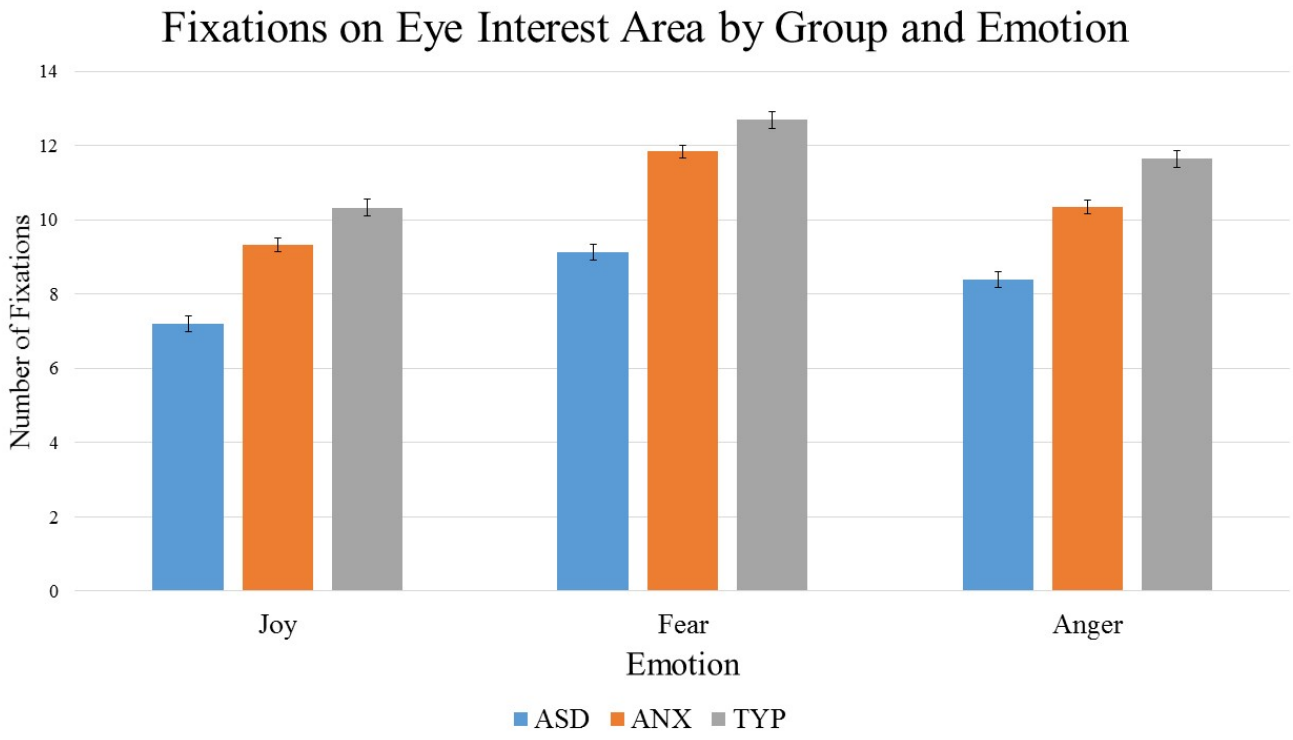
Background: Alexithymia refers to a pronounced difficulty in identifying and describing one's own emotions, and is associated with an externally oriented focus of thinking. Alexithymia is known to be much more common in adults with autism spectrum disorders (ASD) compared to the typically-developing adult population. However, we know very little about alexithymia in young children with ASD and advancing our understanding of this topic may be of critical clinical and translation importance.
Objectives: To investigate alexithymia and it's relationship with autistic traits, executive functioning (EF) and mind-reading in children with and without ASD.
Methods: The sample consisted of 57 school- aged children (7-12 years) both with (n= 25) and without (n=32) Autism Spectrum disorder (ASD). Both self and parent- report questionnaires were chosen to assess alexithymia. Autistic traits and communication difficulties were measured using parent-report measures. EF was measured using the Delis- Kaplan Executive Function System and mind-reading was measured using the children's Reading the Mind in the Eyes test.

Results: We found that alexithymia is substantially elevated in ASD on both self- (ASD mean=21.667, SD=5.87; TD mean=16.5, SD=5.38; t=2.40, p=0.009, Cohen's d=0.94) and parent-report (ASD mean=19.70, SD=10.20; TD mean=5.71, SD=6.24; t=4.74, p<0.0001, Cohen's d=1.74) measures. Despite both measures being sensitive to on-average group differentiation, we found no evidence of correlation between such measures, indicating that children and their parents may be using different sources of information. Parent-rated alexithymia was also associated with increasing levels of autistic traits when corrected for multiple comparisons (i.e. p<0.0025). A discrepancy between self and other alexithymia ratings were also associated with autistic traits, but only in ASD (SRS r=-0.54, p=0.01; AQ r=-0.42, p=0.06). Mind-reading significantly predicted higher scores on both self (F (3,43) = 6.16, p < .001) and parent-report alexithymia measures (F (4,44) = 16.19 p < .001). No relationship between EF and alexithymia were observed.
Conclusions: These results suggest that assessing alexithymia in ASD at younger ages may be important in identifying subgroups that have particular difficulties in the domain of emotion processing. This may aid our ability to deconstruct some of the heterogeneity in ASD and may be useful in developing tailored interventions for children with ASD.

149 **110.149** Alexithymia, Not Autism or Anxiety Symptoms, Predicts Reduced Eye Fixation in a Transdiagnostic Adult Sample

K. G. Stephenson[1], *N. Top*[1], *S. Luke*[1], *T. Shuman*[1], *L. Peacock*[1], *A. Ward*[1] *and M. South*[1,2], *(1)Brigham Young University, Provo, UT, (2)Psychology and Neuroscience, Brigham Young University, Provo, UT*

Background: Beyond the core clinical symptoms of autism spectrum disorder (ASD) are common comorbid symptoms such as anxiety and alexithymia (i.e., difficulty identifying, expressing, and feeling emotional states). These associated features are related to increased distress and avoidance in ASD and may also underlie social deficits. There is considerable research suggesting reduced eye fixation in ASD, even from an early age. One study has found that comorbid alexithymia, more than autism symptoms, predicts reduced eye fixation in ASD.
Objectives: The goal of this study was to add to existing literature by assessing the role of alexithymia, compared to symptoms of autism and anxiety, in both reduced eye fixation and emotional labeling accuracy, in ASD, anxious, and neurotypical control groups.
Methods: Participants were 25 adults diagnosed with ASD as well as 27 anxious controls (ANX) recruited from a university counseling center, and 25 neurotypical university students (TYP). All participants completed a battery of questionnaires including the Toronto Alexithymia Scale (TAS-20), the Autism Spectrum Quotient (AQ), and the Penn State Worry Questionnaire (PSWQ). Participants viewed filmed emotional expressions selected from the Amsterdam Dynamic Facial Expression Set (ADFES) and indicated whether they portrayed *joy*, *fear*, or *anger* while we tracked their eye movements.
Results: Overall emotion identification accuracy was high (~98%) and did not differ significantly between groups. Repeated-measures ANOVA indicated a significant main effect for group [$F(2, 61) = 5.05$, $p < .001$, $\eta^2 = .13$] in the number of fixations on the eyes during while watching the emotional expressions (ASD < ANX < TYP). Average eye fixation across all emotions was significantly correlated with alexithymia levels (TAS-20, $r = .26$) and autism symptoms (AQ, $r = .18$), but not with trait worry (PSWQ, $r = .01$). Hierarchical regression indicated that only TAS-20 was a significant predictor of eye fixation ($\beta = -.28$).
Conclusions: Our results replicate and extend previous findings of the role of alexithymia in reduced eye fixation in ASD. A similar pattern in an anxious control group provides added evidence of the transdiagnostic importance of alexithymia in processing emotional faces. While additional research is needed to better understand the directionality of these effects, these preliminary findings suggest that treating alexithymia may be a promising therapeutic intervention for social difficulties in clinical populations.



150 **110.150** An Examination of Prosocial Behaviors in Children with and without Autism Spectrum Disorders

H. Van Etten *and L. J. J. Carver, University of California San Diego, La Jolla, CA*

Background: Past research has provided insight into the development of prosocial behaviors in typically developing children, but surprisingly little research has been done examining this behavior in children with ASD. To engage in prosocial acts, one must be aware of subtle social cues that indicate prosocial behaviors are warranted, as well as be motivated and have the necessary means to accomplish these behaviors (Dunfield, Kuhlmeir, O'Connell, & Kelley 2011). As children with ASD display social communication deficits – specifically impairments in social motivation and difficulty interpreting social cues – engaging in prosocial behavior may prove difficult. Surprisingly little research has been done examining this social behavior, though a few studies have found decreased levels of helping and sharing in children with ASD measured in experimental tasks (Travis, Sigman, & Ruskin, 2001; Dunfield, O'Connel, Kuhlmeier, & Kelley, 2012), and caregiver report (Iizuka et al. 2010; Jones and Fredrickson, 2010; Russel et al. 2012). Previous differences in prosociality between typically developing children and those with ASD may be attributed to differences in the ability to recognize and interpret social cues.
Objectives: The aim of this study is to examine how and if children with ASD respond to social cues indicting an opportunity to engage in prosocial behaviors, and whether this response differs from typically developing children. Additionally, as no previous studies combined parent-report measures of prosocial behaviors with experimental data, this study is the first of its kind to do so.
Methods: Caregivers filled out questionnaires to assess for Autism symptomology (AQ) and difficulties in prosocial behaviors (SDQ). Typically developing children and children with ASD, aged four-and-a-half to six-years old, engaged in a variety of naturalistic tasks that were designed to elicit prosocial behaviors, specifically helping and sharing. In each task, children were exposed to progressively explicit cues (ranging from eye gaze shifts to verbal prompts) indicating that prosocial behaviors were warranted. Additionally, children engaged in a structured sticker-sharing task to further examine sharing behaviors.
Results: 75% of children helped the experimenter and 38% shared with the experimenter during naturalistic prosocial tasks. During the sticker-sharing task, typically developing children shared on average 49% of their stickers with another child. Results of the caregiver questionnaire indicated that all children displayed typical levels of prosocial behaviors and no children were reported as displaying significant Autistic traits. We predict that the children with ASD will show lower levels of helping and sharing behavior in the prosocial scenarios, will require more explicit cues, and will be less likely to engage in sharing on the sticker task.
Conclusions: Understanding if the inability to respond appropriately to social cues impacts children with ASD can have important implications for future prosocial therapies.

Therapies may be able to target prosocial skills through slowly decreasing the reliance on explicit cues. Additionally, as engaging in these behaviors are an important aspect of peer relationships, improving prosocial behaviors in children with ASD can help in the formation of these relationships.

151 **110.151** Are “Strange Stories” Strange to a Non-Clinical Population? Relationships Between AQ and Physical and Mental State Reasoning

*T. Loucas[1], P. Beaman[1], **M. Younas**[2] and L. E. Martin[2], (1)Psychology and Clinical Language Sciences, University of Reading, Reading, United Kingdom, (2)University of Reading, Reading, United Kingdom*

Background: Performance associated with autism spectrum disorders has been demonstrated in individuals with high levels of autistic traits but without a diagnosis of ASD. These include lexical effects (Stewart & Ota, 2008) and compensation for co-articulation (Yu, 2010) in speech perception; cognitive flexibility in set-shifting (Goken et al., 2014); and social cognition (Goken et al., 2014; Sasson et al., 2012). One of many lines of evidence indicating that individuals with ASD have a specific deficit in reasoning about the mental states of others comes from the “strange stories” test (Happé, 1994) which reveal that children and adolescents with ASD diagnoses score particularly poorly on stories that require reference to mental states compared with stories which require causal reasoning about physical states only. It is not known whether this pattern of results extends to those members of the general population who score highly on autistic traits as measured by instruments such as the Autism Spectrum Quotient (AQ; Baron-Cohen et al., 2001).
Objectives: We hypothesized that participants without an ASD diagnosis who nevertheless scored highly on the AQ would perform less well on the mental-state stories than participants with low AQ scores, and that there would little or no relationship between AQ and performance on the mental state stories.
Methods: The AQ was completed online by a sample of 177 adult participants, all of whom reported no previous or current ASD diagnosis. Participants also completed both physical and mental-state strange stories), in which individuals with ASD typically perform poorly on the mental-state stories.
Results: Pearson’s correlation coefficients revealed that AQ was negatively associated to a significant extent with performance on both mental and physical state stories. A stepwise multiple regression analysis showed that – once educational level and verbal ability were accounted for – ability to answer mental-state stories accounted for significant variance in AQ scores once variance associated with ability to answer physical state stories was accounted for, but the converse was not the case: Once variation associated with ability to answer mental-state stories was accounted for, performance on physical state stories no longer accounted for significant variance in AQ scores.
Conclusions: These results show the utility of running behavioral studies in a general population with the advantages this gives of easy access to large numbers of participants, and with AQ scores as a proxy for ASD-like traits. The results also indicate that – contrary to initial suppositions – ASD-like traits in a general, non-clinical, population (as measured by the AQ) are associated not only with difficulties in reasoning about mental states but also with difficulties in reasoning about physical states when these are presented in a verbal, “strange story” format. Mental-state story scores did, however, account for a unique proportion of the variance in AQ suggesting that individuals who score highly both have a general difficulty with verbally-presented reasoning tasks and a specific difficulty with such tasks when they require explicit reference to the mental states of others.

152 **110.152** Assessing and Training Emotion Recognition: A Comprehensive Facial Expression Training Program for Children with ASD

S. Matsuda[1,2] *and J. Yamamoto[3], (1)University of Tsukuba, Ibaraki, Japan, (2)Japan Society for the Promotion of Science, Tokyo, Japan, (3)Dept. of Psychology, Keio University, Tokyo, Japan*

Background: Deficits in emotion recognition have been well documented in children with autism spectrum disorders (ASD); therefore, previous studies have focused on improving emotion recognition in intervention programs (e.g., Bölte et al., 2002; Golan & Baron-Cohen, 2006; Silver & Oakes, 2001). However, these programs have been developed only in Western countries even though there are cultural differences in emotion recognition (Elfenbein & Ambady, 2002). We have developed the comprehensive facial expression training program called Face-Expression Expert Program (FEEP) over a period of several years in Japan, which is based on the Sidman’s stimulus equivalence analysis (Sidman, 1994). The program consisted of 10 stimulus-response relations. In the current series of studies, we assessed and trained emotion recognition in the children with ASD using FEEP.
Objectives: This presentation review preliminary outcomes from the studies of the comparison between children with and without ASD, as well as effects of training.
Methods: The current FEEP assessment consisted of five stimulus-response relations; (1) “facial expressions – facial expressions (identical),” (2) “facial expressions – facial expressions (categorical),” (3) “words – facial expressions,” (4) “affective prosodies – facial expressions,” (5) “descriptive images – facial expressions.” 13 children with ASD and 43 typically developing (TD) children, aged 3 to 10 years, participated in the series of group comparison studies. 7 children with ASD also participated in the series of intervention studies used single-subject designs on (3) “words – facial expressions,” (4) “affective prosodies – facial expressions,” and (5) “descriptive images – facial expressions.”
Results: Preliminary findings from assessments suggest there were no difference between children with ASD and TD in four stimulus-response relations (1) “facial expressions – facial expressions (identical),” (2) “facial expressions– facial expressions (categorical),” (3) “words – facial expressions,” (5) “descriptive images – facial expressions.” On the other hand, there was a difference between two groups in (4) “affective prosodies – facial expressions.” Results of the interventions showed that trained stimulus-response relations were established. The results of intervention for (3) “words – facial expressions” indicated symmetrical relation “facial expressions – words” emerged. The results of intervention for (4) “affective prosodies – facial expressions,” and (5) “descriptive images – facial expressions showed generalizability to untrained stimuli.
Conclusions: The current series of studies indicated the utility of the training program, FEEP, for both assessments and training emotion recognition in children with ASD. Although data collection is still ongoing, these findings extend past work by showing that children with ASD in Japan can be taught emotion recognition. Updates will be provided from the results of the ongoing iPad software use and a multi-site study.

153 **110.153** Associations Between Emotional Problems and Cognition in Autism Spectrum Disorders

*C. Cantio[1] and **N. Bilenberg**[2], (1)Child and Adolescent Psychiatry, Odense C, Denmark, (2)Research Unit, Child and Adolescent Psychiatry, Odense, Odense C, Denmark*

Background:
Depression and anxiety disorders are seen far more in individuals with autism spectrum disorders (ASD) than in the background population, and the estimated prevalence of these co-morbid diagnoses in ASD sums up to 80%. It is unknown why individuals with ASD have a higher prevalence of these disorders, but both depression and anxiety have been associated with ASD symptomatology, and it is possible that this increased risk derive from underlying causes, such as cognitive dysfunctions.
Objectives:
We aimed to study these co-morbid problems in a prospective design, where we examined the associations between depression and anxiety, and the three most prominent cognitive theories of ASD; Theory of Mind (ToM), Executive Functions (EF) and a Local processing Bias (LB). Additionally, we investigated the correlations to ASD symptomatology.
Methods:
We examined these objectives in a group of high-functioning children (IQ>70) with ASD (N=22) and a matched group with neurotypical development (NTD, N=30) at baseline and three years later. At both time points, a comprehensive battery of cognitive tasks were applied and co-morbid problems as well as ASD symptomatology were assessed with questionnaires. Additionally, the ASD group was examined with ADOS and ADI at baseline.
Results:
We found strong correlations between the parent-rated co-morbidity and the parent-rated ASD symptomatology although very few of these correlations held in the groups individually. Clinically observed symptoms (ADOS) and parental interviews (ADI) of ASD symptomatology was barely correlated to depressive or anxious symptoms.
A general relationship between Theory of Mind (ToM) and symptoms of depression and anxiety was found at Time 1 and across time, but not at Time 2. Interestingly those individuals in the ASD group who showed persistently high levels of anxiety had a different trajectory of ToM performance; their ToM performance decreased, while the individuals with persistent low levels of anxiety improved their ToM performance.
Conclusions:
The results suggest that the level of anxiety is important in the development of ToM.

154 **110.154** Attention Orienting to Direct Gaze in Young Children with Autism Spectrum Disorder - a Heart Rate Study

T. M. Helminen[1], *J. K. Hietanen[1], J. M. Leppänen[2], K. Eriksson[2] and A. Kylliainen[1], (1)School of Social Sciences and Humanities / Psychology, University of Tampere, Tampere, Finland, (2)School of Medicine, University of Tampere, Tampere, Finland*

Background:
Reduced use of eye contact is a prominent characteristic of individuals with autism spectrum disorder (ASD). It has been disputed whether this reflects 1) *active avoidance* due to negatively valenced heightened arousal to eye contact or 2) *passive avoidance* due to diminished attention towards eyes.
Objectives:
The objective was to investigate whether young children with ASD show a normative physiological index of attentional orienting to direct vs. averted gaze. To this end, we measured heart rate deceleration (orientation) responses. It was hypothesized that the direct gaze would elicit stronger orientation response than averted gaze in children without ASD, whereas this would not be observed in children with ASD.
Methods:

20 children with ASD (2.5 – 5.3 years, developmental age 1.2 – 4.2 years), 20 typically developing control children matched by chronological age, and 18 children with developmental delay matched with developmental age were presented pictures of faces with direct and averted gaze directions. During the stimulus presentation, their heart rate and eye movements were recorded and evaluated. The experiment was repeated after 4-5 months with the same participants, to see whether the results of the initial experiment could be replicated.
Results:
The results of the initial experiment showed that, in the control children (both typically developing and with developmental delay), the heart rate deceleration response was more prominent to direct than to averted gaze. No heart rate deceleration was observed in children with ASD in either gaze condition. Based on eye tracker data, the lack of heart rate deceleration was not explained by reduced looking at the eye region. In the follow-up visit, the control children responded to both gaze directions with more prominent heart rate deceleration than the ASD children. Again, no heart rate deceleration was observer in children with ASD.
Conclusions:
The results indicated that, in contrast to children without ASD, children with ASD do not show heart rate deceleration to direct or averted gaze. These findings support the assumption that direct gaze, or perhaps faces in overall, do not attract the attention of the children with ASD and this leads to reduced initiation of eye contact.

155 **110.155** Autism Subgroups Defined By Heterogeneity in Performance on an Advanced Mentalizing Test

M. V. Lombardo[1], *M. C. Lai*[2], *B. Auyeung*[3], *R. Holt*[4], *C. Allison*[4], *P. Smith*[4], *B. Chakrabarti*[5], *A. N. Ruigrok*[4], *C. MRC AIMS*[6], *C. Ecker*[7], *M. Craig*[7], *D. G. Murphy*[7] *and S. Baron-Cohen*[4], *(1)University of Cyprus, Nicosia, Cyprus, (2)Centre for Addiction and Mental Health, The Hospital for Sick Children, and Department of Psychiatry, University of Toronto, Toronto, ON, Canada, (3)University of Edinburgh, Edinburgh, United Kingdom, (4)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (5)School of Psychology & Clinical Language Sciences, University of Reading, Reading, United Kingdom, (6)Autism Research Centre, University of Cambridge; the Institute of Psychiatry (IoP) at King's College, London; Autism Research Group, University of Oxford, Cambridge, United Kingdom, (7)Sackler Institute for Translational Neurodevelopment, Department of Forensic and Neurodevelopmental Sciences,, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom*

Background: Difficulty in the domain of mentalizing is a key cognitive explanation behind the social-communication difficulties that are hallmarks of autism. However, heterogeneity is also present, and individuals differ in their degree of competency in mentalizing, particularly in adulthood. Understanding how such heterogeneity manifests may be clinically important, particularly with regards to personalizing intervention and may also present opportunities for stratification that may help increase sensitivity for detecting underlying neurobiological mechanisms of importance in autism.
Objectives: Here we use unsupervised hierarchical clustering to stratify adults on the autism spectrum into discrete subgroups, based on their performance on an advanced mentalizing test.
Methods: Two datasets (discovery and replication) were used to test whether discrete autism mentalizing subgroups emerge in a replicable fashion. The discovery dataset consisted of 190 adults with autism (96 males, 94 females) and 251 typically-developing controls (TD; 130 males, 121 females) who completed the Reading the Mind in the Eyes test (RMET) online as part of the Cambridge Autism Research Database (CARD). The replication dataset consisted of participants from the MRC AIMS Consortium dataset (n=123 autism; 85 male, 38 female; n=128 TD; 87 male, 41 female). For both datasets, we used unsupervised two-way hierarchical clustering to cluster the data along both dimensions of RMET items and autism subjects. We tested the hypothesis that similar discrete subgroups would emerge across both discovery and replication datasets. We then compared autism subgroups to TD using RMET total scores and estimate replication Bayes Factors (repBF) to quantify evidence for replicability (repBF ~ 1 indicates no evidence supporting replication; repBF>100 indicates extremely strong evidence supporting replication).
Results: Across both discovery and replication datasets there was evidence for 2 discrete autism subgroups that can generally be characterized as 'Impaired' or 'Good'. The 'Good' subgroup showed no consistent difference in RMET total scores compared to the TD group (Discovery: t = 1.82, p = 0.06, Cohen's d = 0.21; Replication: t = -3.72, p = 0.0002, Cohen's d = 0.52; repBF = 0.22). However, the 'Impaired' subgroup had RMET total scores that were massively reduced in a replicable manner compared to the TD group (Discovery: t = -16.96, p = 4.10e-47, Cohen's d = 2.10; Replication: t = -13.04, p = 3.13e-27, Cohen's d = 2.36; repBF = 1.63e+25).
Conclusions: The RMET can be a valuable tool for parsing heterogeneity in mentalizing in adults with autism. After stratification, there is a useful distinction between autism individuals with intact versus impaired mentalizing ability. Stratification by these mentalizing subgroups may be useful in future work with clinical and translation aims. For example, in direct extensions of this work, we will directly test these subgroups for differentiation within mentalizing circuitry with existing task and resting state fMRI data from the MRC AIMS dataset.

156 **110.156** Autism Symptom Severity and Social-Emotional Cognition Among Children with High Functioning Autism Spectrum Disorder

C. S. Albaum[1], ***P. Burnham Riosa***[2] *and J. A. Weiss*[2], *(1)Psychology, York University, Toronto, ON, Canada, (2)York University, Toronto, ON, Canada*

Background: Autism spectrum disorder (ASD) is characterized in part by social communication difficulties, such as deficits in recognizing and understanding body language and facial expression during social interaction (American Psychological Association, 2013). A large body of research in this area has focused on how emotion recognition differs between children with ASD and typically developing peers (Harms, Martin, & Wallace, 2010), but relatively few studies have focused on how symptom severity in particular relates to difficulties with social cognition. Understanding the relation between ASD severity and social cognition challenges may be useful in informing interventions focusing on social-emotional cognition targets.
Objectives: To identify the relation between autism symptom severity and social-emotional cognition in school-aged children with high functioning ASD.
Methods: Data were collected from 47 children with high functioning ASD (87.2% male) and their parents as part of a larger trial to improve child emotion regulation. Children were 8 to 12 years of age (*M* = 9.74, *SD* = 1.36) with at least average IQ (*M* = 103.40, *SD* = 13.87, Range: 79-140). Measures of interest were collected at baseline, before children received the intervention. We collected parent-reported autism symptom severity ratings using the *Social Responsiveness Scale, Second Edition* (*SRS-2*; Constantino & Gruber, 2012) and data on social-emotion cognition performance using the following two child administered tasks: 1) *Reading the Mind in Films* (RTMF; Golan, Baron-Cohen, & Golan, 2008), in which children watched a scene from a film and identified how a character was feeling; and 2) *CogState-Research Tasks Social Emotional Cognition* task (SEC; Collie et al., 2003), in which children identified the character whose emotional expression was different from the other three characters.
Results: When controlling for age and IQ, total ASD symptom severity scores were not significantly correlated with performance on the social-emotional cognition tasks ($p > .05$). Upon further examination of SRS-2 subscales, we found that when controlling for age and IQ, there was a significant partial correlation between parent-reported social cognition and SEC task performance ($r(42) = -.36$, $p = .015$). No other SRS-2 subscale scores were correlated with social-emotion cognition task performance nor was ASD severity correlated with performance on the RTMF task ($p > .05$).
Conclusions: Contrary to expected, overall ASD severity scores did not correlate with social-emotion cognition task performance when controlling for age and IQ; however, greater parent-reported social cognition difficulties was correlated with poorer performance on an emotion discrimination task. Global ASD symptomatology was not related to social cognition task performance in our sample. The implications of these findings will be discussed.

157 **110.157** Automated Measurement of Head Movement in Children with and without ASD

K. B. Martin[1], *Z. Hammal*[2], *J. Cohn*[3], *J. Cassell*[4] *and D. S. Messinger*[1], *(1)Psychology, University of Miami, Coral Gables, FL, (2)The Robotics Institute, Carnegie Mellon University, Pittsburgh, PA, (3)Psychology, University of Pittsburgh, Pittsburgh, PA, (4)School of Computer Science, Carnegie Mellon University, Pittsburgh, PA*

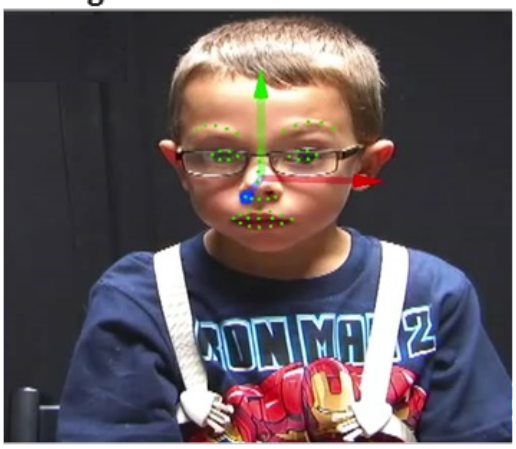
Background:
Motor and social deficits are associated in children with Autism Spectrum Disorders (ASD). Successful social interactions require typical coordination and motor movement initiations (Piek & Dyck, 2004). Motor abnormalities, such as head motion atypicalities, in development may contribute to the perceptual and social impairments that characterize individuals with ASD. To date, deficits in motor movement in children with ASD have been characterized descriptively by human observers. In lieu of laborious human coding, automated measurement provides objective, continuous measurement to quantify head position and head movement.
Objectives:
To objectively quantify differences in head movement in children with and without ASD.
Methods:
Participants were 48-to-68- month old children with a diagnosis of ASD (*n*=20) or no evidence of ASD (n=20). A diagnosis of ASD or no ASD was confirmed for all children with the Autism Diagnostic Observation Schedule (Lord et al., 2000), which yielded severity scores for social affect and restricted, repetitive behaviors (Hus, Gotham, & Lord, 2014). Children were video recorded while watching a 16 minute video of six stimuli blocks, 3 social and 3 nonsocial stimuli. Three degrees of rigid head movement—pitch (nodding), yaw (head turns), and roll (lateral head inclinations) were tracked from the video recordings using an automatic person-independent tracker (Zface; Jeni, Cohn, & Kanade, 2015) (**Figure 1**). To measure the dynamics of head movement, head angles were converted into angular displacement and angular velocity. The root mean square was then used to measure the magnitude of variation of the angular displacement and the angular velocity for yaw, pitch, and roll for each stimulus block and for each infant separately.
Results:
Repeated measures ANOVA revealed differences in yaw angular displacement and roll angular velocity by stimulus block, *p*s<.05. There were no interaction effects of stimulus block and ASD status in angular displacement or velocity of yaw, pitch, and roll. Children with ASD exhibited larger angular displacement of yaw and roll than children without ASD, $F(1, 36)=5.29$, $p=.027$, *partial* $\eta_p^2=.13$ and $F(1, 36)=4.10$, $p=.05$, $\eta_p^2=.10$, respectively, indicating greater variability in head position. They also

exhibited greater angular velocity of yaw, $F(1, 36)=4.09$, $p=.050$, $\eta_p^2=.10$, and roll, $F(1, 36)=7.69$, $p<.01$, $\eta_p^2=.18$, than children without ASD (**Figure 2**), indicating greater variability in head motion. There were no ASD status effects in angular displacement or velocity of pitch, $ps>.10$. Over both groups, children with greater angular displacement in yaw showed higher levels of repetitive behaviors ($r=.37$, $p<.01$) and social affect deficits ($r=.30$, $p=.036$).

Conclusions:

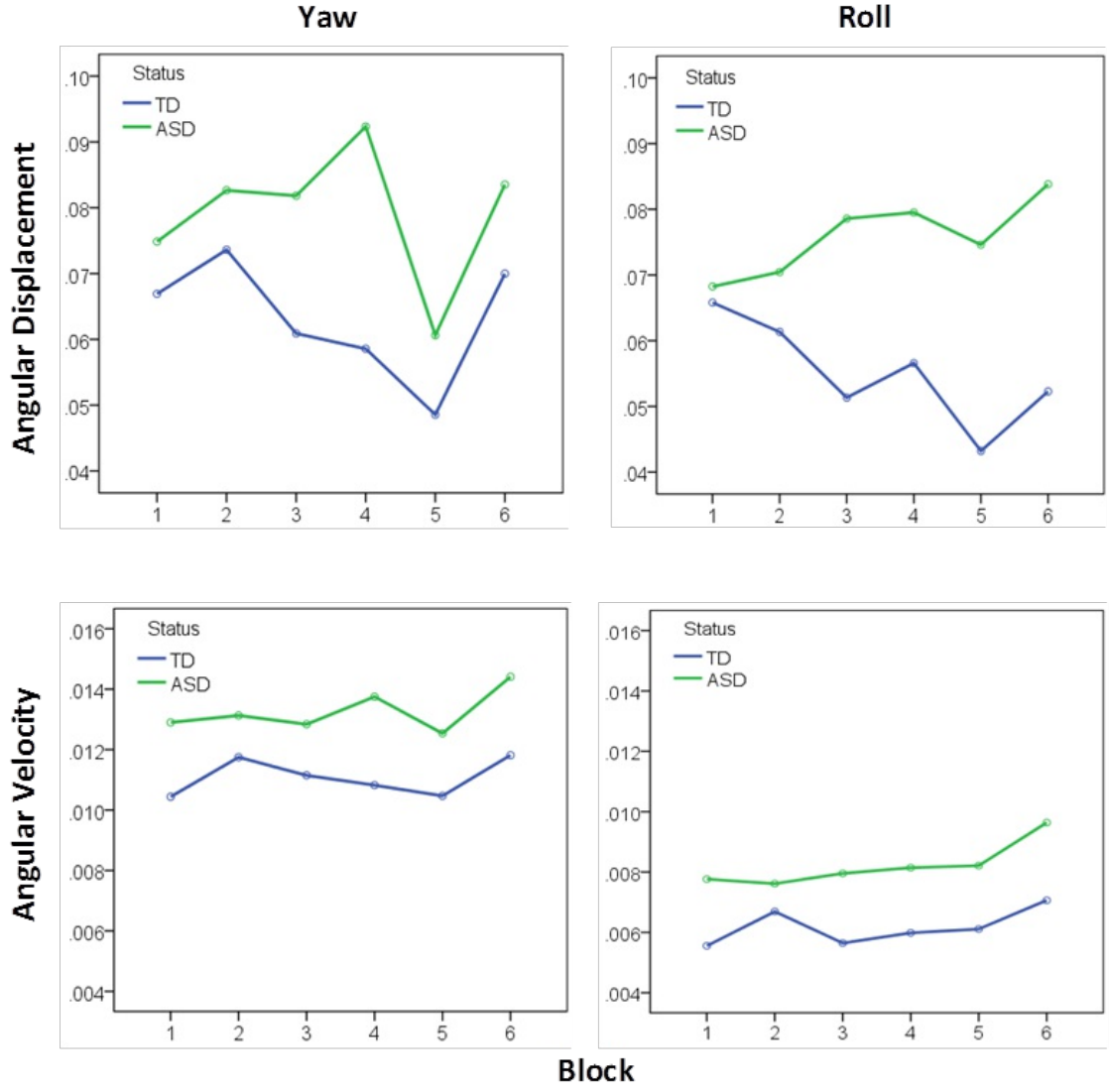
To our knowledge, this is the first study to use objective measurements to quantify head movement differences in children with and without ASD. The findings suggest that children with ASD nod (pitch) and turn their heads (yaw) with greater variability than children without ASD. Moreover, greater variability in head turns (yaw displacement) was associated with higher ASD symptomatology in both the social affect and repetitive behavior domains. These head movement differences may create sensory experiences for children with ASD that involve greater accommodation to changes in head position and movement than those experienced by children without ASD.

Figure 1. Head Orientation



Pitch (green), yaw(blue), roll (red)

Figure 2. Head Movement Differences in Children with and without ASD



158 **110.158** Biological Motion Preference and Autism Symptomatology in Adolescents with Fragile X Syndrome

K. E. Caravella[1], *F. Shic*[2], *Q. Wang*[2] *and J. E. Roberts*[3], *(1)University of South Carolina, Columbia, SC, (2)Yale Child Study Center, Yale University School of Medicine, New Haven, CT, (3)Psychology, University of South Carolina, Columbia, SC*

Background: Fragile X syndrome (FXS) has the highest known penetrance of autism spectrum disorder (ASD) of any single gene disorder, with up to 60% of individuals

meeting criteria for ASD, and up to 90% showing at least 1 symptom of the disorder. While symptomatology overlaps significantly between the two disorders, controversy continues to exist over a shared underlying mechanism driving the similar behavioral presentation.
Objectives: This study aims to examine preliminary data on a biological motion eye-tracking paradigm collected on individuals with FXS. Preference for biological motion is a foundational social cognitive skill known to be present in typically developing infants from the first days of life, and has been shown to be deficient in individuals with idiopathic autism (Annaz, Campbell, Coleman, Milne & Swettenham, 2011). It is unknown whether this preference for biological motion is intact in individuals with FXS, and whether the presence or absence of a co-morbid diagnosis of ASD is related to this particular social cognitive skill.
Methods: Participants included 14 adolescent males with FXS who are part of a larger study on language development (5 FXS, 9 FXS+ASD). Data were collected on an SR Eyelink 1000 plus eye tracker. Stimuli consisted of a split screen video of biological motion point light displays horizontally juxtaposed to random point light displays with the same motion, presented at16° visual angle, for 30 trials, 4-5seconds each. A central fixation point was displayed before each trial that triggered the start of the next trial after a 250ms fixation. Percentage of looking time at biological motion was the time spent looking at biological motion divided by the total looking time at either region of interest (biological motion or random motion control), aggregated across all trials to create a single outcome measure of each participant. Trials with total looking times in both interest areas (i.e. biological motion and random motion) less than 1000ms were removed from the analysis. Participants also completed the ADOS-2. Severity scores from the ADOS-2 were used in the analysis as a measure of autism symptomatology. Analysis included Pearson-product moment correlations and a one-way ANOVA.
Results: No significant correlations were observed between percentage of time looking at biological motion and severity scores on the ADOS-2 (r = -.12, p = .7). An ANOVA to compare mean looking times between the individuals with FXS with and without autism indicated no differences in mean looking time to biological motion, FXS (M = 52.2%, SD =3.56) and FXS+ASD (M = 52.11%, SD=6.38).
Conclusions: Findings suggest that severity of autism symptomatology is not related to preferential attention to biological motion in individuals with FXS, and preferential attention to biological motion does not differ between individuals with FXS and FXS+ASD. Given variability in the data, we will examine these data with a larger sample, add a group with idiopathic (non-FXS) autism and examine the effect of other variables (e.g., genetics) to document preferential looking to biological motion in FXS.

159 **110.159** Cardiac Vagal Tone Predicts Eye Gaze Fixation in the Broad Autism Phenotype

J. Klusek[1], *J. Schmidt*[2], *A. Porter*[1] *and J. E. Roberts*[1], *(1)Psychology, University of South Carolina, Columbia, SC, (2)University of Central Florida, Orlando, FL*

Background: Diminished gaze fixation is a primary feature of autism spectrum disorder (ASD) that is associated with abnormal neural activation patterns (Dalton et al., 2005; Senju et al., 2005). Diminished gaze fixation has also been documented as part of the broad autism phenotype (BAP), both in infant siblings of children with ASD (Dalton et al., 2005), as well as among parents of children with ASD (Adolphs et al., 2008). The expression of the BAP among unaffected relatives is believed to reflect genetic liability for ASD, and studies aimed at defining mechanisms underlying these features may hold important clues into causal pathways in ASD. Autonomic nervous system dysfunction is present among some individuals with ASD and is thought to underlie aberrant social behavior (Klusek et al., 2015). The present study examined cardiac vagal tone, an index of the parasympathetic “rest and restore” response, as a potential mechanism for diminished gaze fixation in the broad autism phenotype.
Objectives: To investigate the relationship between cardiac vagal tone and gaze fixation patterns in response to direct and averted eye gaze among mothers of children with ASD and control mothers of children with typical development.
Methods: Eye movements of 16 mothers of children with ASD (mean age=48.39 years) and 21 control mothers of children with typical development (mean age=43.15) were recorded while watching an animated female face displaying either direct or averted gaze for 6.3 seconds (stimuli from Weiser et al., 2009). Trials began with participants fixating within the eye region and the percent of time dwelling within the eye region was quantified. Prior to completing the eyetracking paradigm, baseline cardiac activity was measured during a 3 minute baseline where participants viewed a calming ocean scene. CardioEdit/Batch software (Brain-Body Center, University of Illinois) was used to extract mean estimates for respiratory sinus arrhythmia, an index of vagal tone. Higher vagal tone reflects increased parasympathetic control and thus improved autonomic flexibility.
Results: Repeated measures ANOVA tested the effect of vagal tone, group, their interaction, and condition (averted vs. direct gaze) on the percent of time spent dwelling within the eye region of the face. A significant group-by-vagal tone interaction was detected, where higher vagal tone was associated with a greater percent of time dwelling within the eye region among the mothers of children with ASD, whereas these variables were unrelated in the control mothers (F[1,33] = 4.70, p = .038). The effect of condition was not significant (p = .449).
Conclusions: Poorer autonomic nervous system flexibility among mothers of children with ASD, indexed by dampened parasympathetic vagal tone, was associated with decreased gaze fixation. This finding highlights autonomic nervous system dysfunction as a potential mechanism that may underlie atypical gaze fixation patterns seen in ASD and its broader phenotypes.

160 **110.160** Children with Autism Are Hypo-Responsive to Human Eyes Presented without Sound, but Hyper-Responsive to Eyes Presented after Social Sounds

J. L. Kleberg[1], *E. Thorup*[2] *and T. Falck-Ytter*[3], *(1)Box 1225, Uppsala University, Uppsala, Sweden, (2)Uppsala universitet, Hägersten, Sweden, (3)Uppsala University, Uppsala, Sweden*

Background: Children with this autism spectrum disorder (ASD) often fail to make use of human gaze to learn about the social world. A subcortical network involving the superior colliculus, amygdala and putamen underlies rapid orientation to human faces. Influential theories have suggested that altered functioning of this network is an important part of the ASD phenotype. Recent studies have questioned these theories by demonstrating intact orienting to face-like configurations in people with ASD.
Objectives: We hypothesized that children with ASD would be slower than typically developing (TD) children to orient to isolated eyes. Our study was based on the prediction that visual orienting to human eyes rather than to faces as a whole is reduced in ASD. This prediction was based on single-cell recordings in monkeys and electrophysiological data from humans demonstrating that the neural mechanisms underlying responses to eyes and whole faces are partly dissociable. In addition, we examined the effect of spatially nonpredictive social and nonsocial sounds on visual orienting in children with and without ASD.
Methods: Seventeen children with ASD (mean age: 6.5 years) participated in the experiment along with a typically developing (TD) control group matched for age and nonverbal IQ. We presented images of human eyes with direct gaze along with three nonsocial objects. Trials could be preceded by a social sound (a single phoneme spoken by a human voice), by a common nonsocial sound or by no sound. The eye regions of fearful faces were used as stimuli. We used eyes displaying fear to maximize the likelihood of quick orienting of attention (based on previous research). The latency of the saccades was measured with corneal reflection eye tracker at a sample rate of 60 hz.
Results: We found a strong interaction effect between group and sound type (p <.001), indicating that the presence of sound had a different impact on saccadic latency in the two groups. As expected, the ASD group was slower to orient to the eyes than the TD group on silent trials (p = .01). In contrast, children with ASD were faster to orient to the eyes than the TD group after social sound (p <.001). No group difference was found after nonsocial sounds. Higher degrees of ASD symptoms as measured with the ADOS-2 predicted faster orienting to the eyes after social sounds (r = .61; p <.05).
Conclusions: Our results provide clear evidence of reduced social orienting in ASD, but suggest that brain mechanism underlying responses to eyes rather than to whole faces are the source of this effect. The strong modulation by non-visual information provides support for the view that ASD is characterized by network-wide atypicalities in information integration. Our results show that the multisensory environment is highly important for early social attention in children with ASD. These results have implications for our understanding of early attentional impairments in ASD.

161 **110.161** Common Genetic Variation in Neuropeptide Receptors and Social Processing Across Neurodevelopmental Disorders

D. A. Baribeau[1], *A. Dupuis*[2], *T. A. Paton*[3], *S. W. Scherer*[4], *R. Schachar*[5], *P. D. Arnold*[6], *P. Szatmari*[7], *R. Nicolson*[8], *S. Georgiades*[9], *N. Soreni*[9], *J. Crosbie*[2], *J. A. Brian*[10], *A. Iaboni*[11] *and E. Anagnostou*[1], *(1)University of Toronto, Toronto, ON, Canada, (2)The Hospital for Sick Children, Toronto, ON, Canada, (3)the Centre for Applied Genomics at the Hospital for Sick Children, Toronto, ON, Canada, (4)Centre for Applied Genomics (TCAG), Hospital for Sick Children, Toronto, ON, Canada, (5)Psychiatry, The Hospital for Sick Children, Toronto, ON, Canada, (6)University of Calgary, Calgary, AB, Canada, (7)Centre for Addiction and Mental Health, Toronto, ON, Canada, (8)University of Western Ontario, London, ON, Canada, (9)McMaster University, Hamilton, ON, Canada, (10)Bloorview Research Institute, Toronto, ON, Canada, (11)Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada*

Background: Common genetic variation in the oxytocin receptor (OXTR) and vasopressin receptor (AVPR1a) genes has been associated with differences in social abilities in typically developing individuals and in those with autism spectrum disorder (ASD). Whether common genetic variation in OXTR or AVPR1a also affects social abilities to the same degree in other neurodevelopmental disorders is unknown.
Objectives: To examine the effects of common genetic variation in the oxytocin receptor (OXTR) and vasopressin receptor (AVPR1a) genes, on social communication and perception abilities across different childhood onset neurodevelopmental disorders.
Methods: Children with autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), or obsessive-compulsive disorder (OCD) (n=253), completed a standardized social perception task (Reading the Mind in the Eyes Test-RMET) and their parents/caregivers completed the Social Communication Questionnaire (SCQ). DNA from blood/saliva was analyzed to determine individual genotypes for 5 OXTR single nucleotide polymorphisms (SNPs) and AVPR1a RS3 microsatellite length. Social communication, as measured by the SCQ, and social perception abilities, as measured by the RMET, were compared by genotype using regression models, while controlling for differences in age, sex, ancestry and IQ. Significant findings were examined for interactions with diagnosis.
Results: Social communication abilities varied significantly by genotype for one OXTR SNP (OXTR rs53576) and showed a trend towards an association for another (OXTR rs237887) (p = 0.007, and p = 0.05 respectively). For OXTR rs237887, secondary pairwise comparisons of RMET scores by genotype revealed a pattern congruent with SCQ scores. Length of AVPR1a RS3 did not impact social communication or perception abilities. For analyses involving OXTR rs53576, genotype effects on SCQ scores were

highly significant in the group with ASD only ($p \leq 0.0001$), with no significant effects detected in the other diagnostic groups. Specific allele pairs in combination [OXTR rs53576 (GG) and OXTR rs237887 (AA)] were associated with greater social communication deficits.
Conclusions: Common genetic variation in OXTR, but not AVPR1a, was associated with variable social communication abilities across neurodevelopmental disorders in this sample, suggesting that common variation may play a role in modifying severity of social impairment. Children with ASD may be more sensitive to this effect.

162 **110.162** Developing an Eye-Tracking Biomarker to Measure Social Motivation in Minimally Verbal Children with ASD

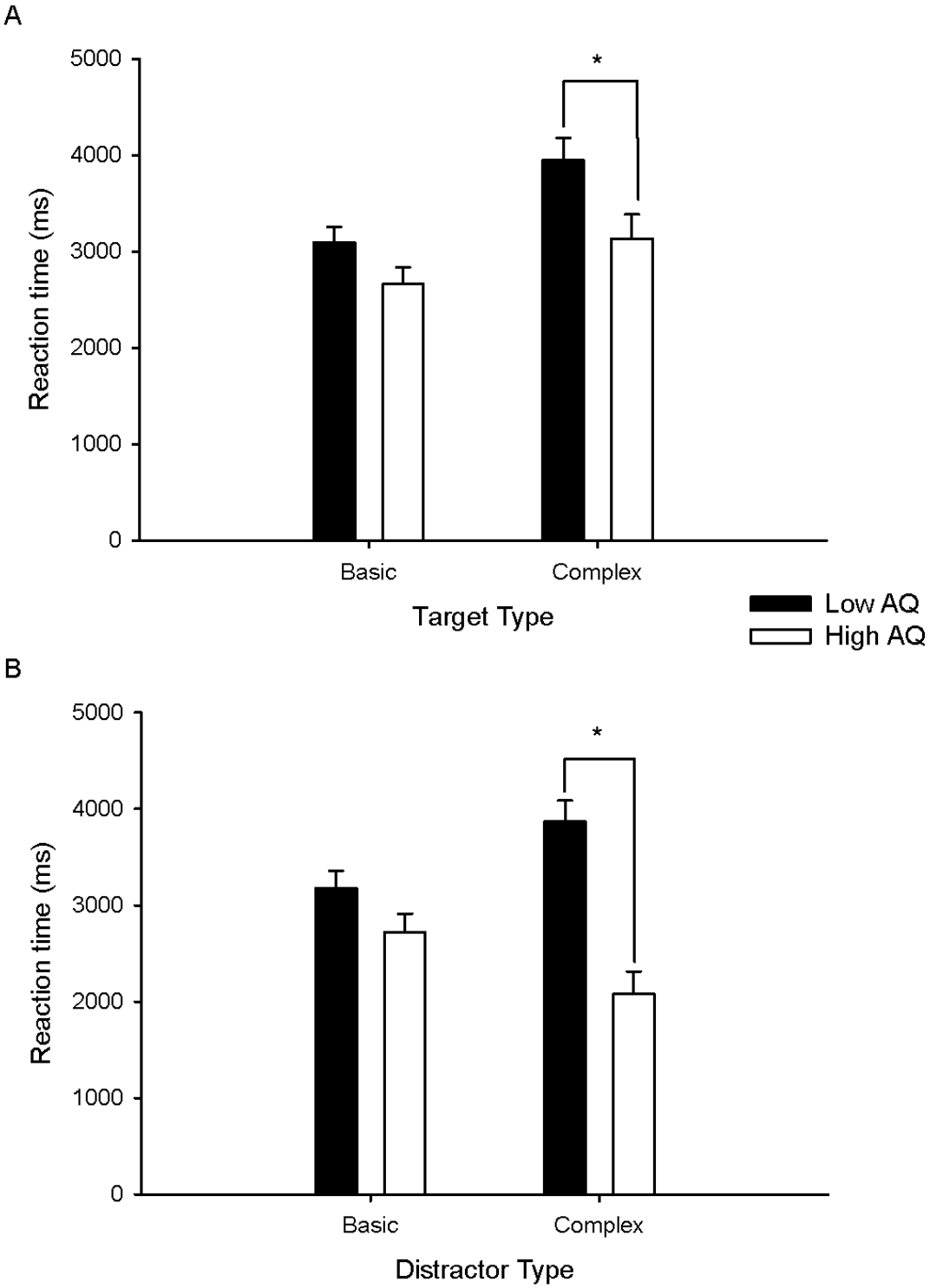
K. Unruh[1,2], *J. W. Bodfish*[1,2,3] *and E. Morrow*[1,3], *(1)Vanderbilt University, Nashville, TN, (2)Vanderbilt Brain Institute, Nashville, TN, (3)Vanderbilt Bill Wilkerson Center, Nashville, TN*

Background: Approximately 30% of persons with autism have minimal verbal ability (MVA). This subgroup of cases often experiences significantly greater morbidity and poorer outcomes relative to their ASD peers with average verbal ability (AVA). This subgroup is frequently excluded from research studies, as most ASD-related measures are not applicable to persons with cognitive / language deficits. Eye-tracking technology can be used to quantify ASD-relevant features such as social attention and motivation, can be configured to require minimal task demands of the participant. For these reasons, this method is a reasonable platform for the development of measures applicable to cases with cognitive / language deficits.
Objectives: To compare subgroups of minimal verbal ability (MVA) and average verbal ability (AVA) children with ASD on gaze measures from a passive social versus nonsocial image paired preference task.
Methods: Our preferential viewing (eye-tracking) task measures patterns of visual attention to social and nonsocial content. Social images (SOC) are paired with one of two types of objects: images of high interest to children with ASD (HAI images; e.g. trains, electronics) and images of low interest to children with ASD (LAI images; e.g. clothing, furniture). Stimuli were presented in a passive manner (no instructions) for 5 seconds each, with a variable 2-6 second interstimulus interval. Participants with ASD were classified as either MVA (Verbal IQ < 70; N = 15; mean age = 11.9 years) or AVA (Verbal IQ > 90; N = 48; mean age = 13.9 years); our sample also included typically developing peers (TYP; N = 31, mean age = 13.8 years).
Results: Task completion rate was similar across ASD groups (67% of MVA, 69% of AVA). Both MVA and AVA subgroups were slower than the TYP group to orient to faces (latency), only when paired with HAI images ($F(2,71) = 6.59$, $p = .002$) but not LAI images ($F(2, 71) = .457$, $p = .635$). Latency to face did not differ between ASD subgroups for either array type ($t = -1.6$, $p = .22$). MVA participants made more fixations to faces than both TYP and AVA participants ($F(2,59) = 11.2$, $p < .001$); however, these fixations were shorter in their average duration ($F(2,59) = 17.18$, $p < .001$).
Conclusions: Here we demonstrate that minimally verbal children with ASD can successfully complete a passive eye-tracking task at rates that are comparable to those of verbal ASD peers. Both MVA and AVA children were significantly slower to look to faces when paired with an HAI image, relative to TYP, providing evidence that social motivation deficits may manifest similarly in both ASD subgroups. Domain general attentional parameters (e.g., fixation duration) were similar in AVA and TYP but altered in MVA suggesting that MVA children may have a unique attentional impairment relative to their verbal peers with ASD.

163 **110.163** Differences in Reaction Time to Detect Emotion Faces Varies Based on Autistic Social Skills and Communication Abilities in Young Adults

J. Burk[1], *C. Dickter*[1], *J. Zeman*[2] *and K. M. Fleckenstein*[3], *(1)College of William & Mary, Williamsburg, VA, (2)Psychology, College of William and Mary, Williamsburg, VA, (3)College of William and Mary, Williamsburg, VA*

Background: Individuals with autism spectrum disorders (ASD) show challenges with tasks that involve rule switching or ignoring distracting stimuli, but better performance in visual search tasks that require identification of specific features in the target stimulus.
Objectives: The goal of the present study was twofold. We wanted to test a group of participants who were along the broader autism phenotype (BAP) in a visual search task. We modified the task to include emotion faces to test whether advantages in visual search performance would be stronger with these stimuli, rather than neutral stimuli.
Methods: Participants were 136 non-ASD undergraduate students (44.4% men; M_{age} =19.1 years; 76.3% Caucasian). Participants completed the Autism Quotient (AQ, Baron-Cohen et al., 2001).), a measure that assesses self-report of autistic-like behaviors. The AQ has five sub-scales assessing autistic behaviors including social skills, attention switching, communication, imagination, and attention to detail. Participants completed a modified visual search task, a procedure that typically measures attention by assessing response speed whenthere is a discrepant stimulus among other stimuli displaying the same properties (Plaisted et al., 2010). The visual search task was modified by using faces that displayed either basic emotions (i.e., happiness,anger) or complex emotions (i.e., surprise, fear). Participants indicated whether a group of 8 or 16 faces on the screen depicted the same emotion or different emotion by pressing a certain key on a keyboard.
Results: For the total AQ and each subscale, the top and bottom third of participants were compared. Reaction time data were analyzed using a 2 (Target: basic, complex) x 2 (Distractor: basic, complex) x 2 (Number of Stimuli: 8, 16) x 2 (AQ scale: bottom third [low AQ], top third [high AQ]) mixed model ANOVA. Only significant effects involving AQ are reported below. For total AQ, there was a between-subjects main effect, with low AQ participants responding more slowly ($M = 3905.99$, $SE = 263.01$) than high AQ participants ($M = 3105.19$, $SE = 241.93$), $F(1, 70) = 5.02$, $p = .03$. For the Social Skills subscale, there was a Target x AQ interaction, $F(1, 81) = 5.04$, $p = .03$. For complex targets, low AQ participants were significantly slower than high AQ participants, $F(1, 82) = 5.69$, $p = .02$ (Figure 1A). There was also a Distractor x AQ interaction, $F(1, 81) = 4.19$, $p = .04$. For complex distractors, low AQ participants were significantly slower than high AQ participants, $F(1, 82) = 6.20$, $p = .02$ (Figure 1B). For the Communication subscale, there was a Distractor x AQ interaction, $F(1, 70) = 4.71$, $p = .03$. For basic emotions, $F(1, 70) = 5.63$, $p = .02$ and complex emotion, $F(1, 70) = 8.39$, $p = .01$, distractors, low AQ participants were slower than high AQ participants.
Conclusions: Individuals who scored high on the total AQ and the socioemotional AQ subscales, and may be along the BAP, show faster identification on a visual search task compared to those who score low on these measures, even when the target stimuli are emotion faces.



164 **110.164** Dissociating Social Functioning in ASD and Schizophrenia Using Clinical Assessment and Neural Response to Gaze Cues

J. H. Foss-Feig[1], *A. Naples*[2], *K. Deckert*[3], *E. J. Levy*[3], *K. K. Stavropoulos*[2], *M. Rolison*[2], *N. Santamauro*[4], *U. Kosir*[5], *C. Schleifer*[5], *V. Srihari*[4], *A. Anticevic*[4] *and J. McPartland*[2], *(1)Yale School of Medicine, New Haven, CT, (2)Child Study Center, Yale School of Medicine, New Haven, CT, (3)Yale Child Study Center, New Haven, CT, (4)Yale University School of Medicine, New Haven, CT, (5)Yale University, New Haven, CT*

Background:
Social difficulties, including deficits in maintaining and interpreting social gaze and in face and emotion processing, are hallmark features of autism spectrum disorder (ASD). Atypical social functioning and gaze processing are not, however, unique to ASD. Both are also impaired in schizophrenia (SCZ), a disorder with genetic, neurobiological, and phenotypic commonalities with ASD. This study utilized novel methods, integrating eye-tracking and electrophysiology (EEG), to study social behavior and brain function during simulated face-to-face interactions in individuals with ASD and SCZ. Specifically, we evaluated P100 and N170 response to direct and averted gaze in adults with ASD, SCZ, and typical development to determine between-group differences in neural processes associated with face decoding. In parallel, we evaluated social functioning on a battery of diagnostic, clinical, and neurocognitive assessments. In this way, we evaluate whether specific abnormalities in gaze processing differ by diagnostic category or are general indicators of social dysfunction across neurodevelopmental disorders.
Objectives:

To evaluate neural markers of gaze processing during simulated face-to-face interactions in individuals with ASD, in comparison to those with SCZ and controls.
Methods:
Participants included 13 adults with ASD, 14 with SCZ, and 15 controls. EEG data was recorded using a 128-channel sensor net, and eye-tracking data was collected using an Eyelink-1000 remote camera system. Participants were presented with 80 distinct photorealistic, animated faces matched for low-level visual features. Contingent upon participants' fixating on the face, stimuli responded by shifting eye gaze (either from direct to averted or averted to direct). EEG data was preprocessed off-line, and the P100 and N170 was extracted from electrodes over right occipitotemporal scalp. Participants completed the Social Responsiveness Scale, the Benton Face Recognition task, and the Reading the Mind in the Eyes Test. All were administered gold-standard diagnostic measures of both ASD and SCZ (Autism Diagnostic Observation Schedule; Positive and Negative Symptom Scale). Between-group differences were examined with repeated measures ANOVAs; transdiagnostic associations between neural response to gaze shift and clinical assessment scores were explored with bivariate correlations.
Results:
Between-group analyses revealed amplified P1 response in SCZ, but not ASD, and altered N170 response in ASD, but not SCZ (Fig.1). In contrast to ERP markers, self-report measures of ASD and SCZ symptomatology did not differentiate between diagnostic categories. Across groups, greater P1 response was associated with more positive symptoms of SCZ and with fewer social communication deficits associated with ASD (Fig.2).
Conclusions:
Results revealed that neural efficiency of visual processing and face-decoding during simulated face-to-face interactions differentiates ASD from SCZ. In contrast, signal strength relates to symptom severity transdiagnostically, rather than varying by diagnostic category. These findings support a dimensional approach to understanding gaze processing differences in ASD and related disorders.

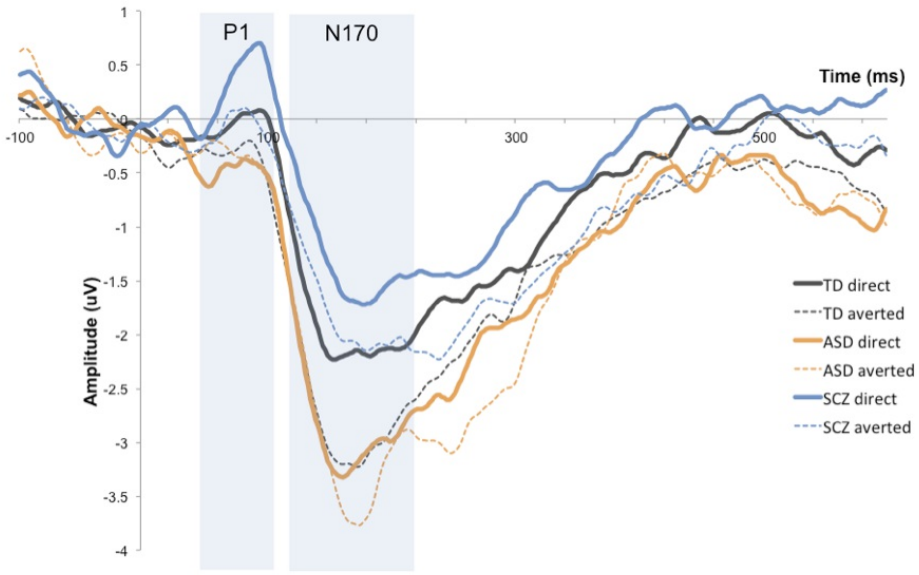


Fig.1. Grand averaged waveforms elicited by direct and averted gaze

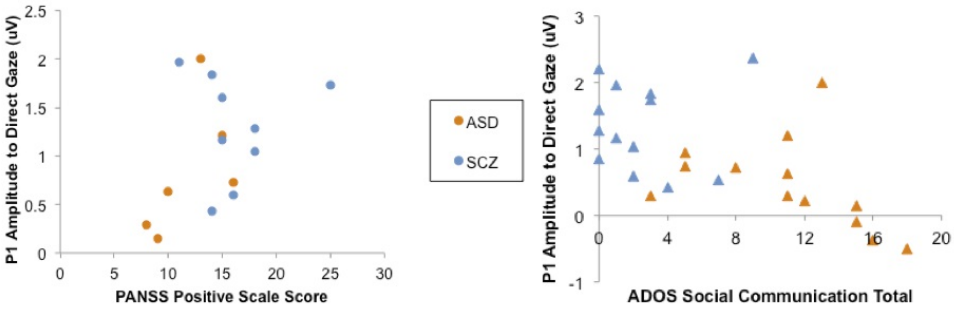


Fig.2. Neural response to gaze associate with symptoms of SCZ and ASD transdiagnostically

165 **110.165** Distinctive Abnormalities in Imitative Response to Socially Engaging Versus Neutral Partners Are Specific to ASD and Predict Treatment Outcomes

G. Vivanti, *Olga Tennison Autism Research Centre, Melbourne, Australia*

Background: While imitation difficulties are often documented in preschoolers with ASD, it is not yet clear whether such abnormalities reflect differences of a social, attentional, cognitive and/or motor nature. As early educational intervention programs often require children to imitate actions and behaviors that are demonstrated to them during social routines, it is plausible that differences in imitation will impact on response to educational programs in this population. Therefore, a fine-grained understanding of the social, attentional, motor and cognitive processes underlying imitation abnormalities in ASD has the potential to advance knowledge on both the mechanisms of impairment and the mechanisms of treatment response in this population.

Objectives: We investigated multiple processes underlying imitation in 35 preschoolers with ASD and 20 peers with Williams syndrome (WS), matched for age, cognitive, verbal and motor functioning, with the aim to identify whether putative imitation differences between the groups were (1) specifically linked to differences in sociability observed in these two disorders, or associated with motor and cognitive difficulties shared by ASD and WS, and (2) linked to learning outcomes in response to early intervention in ASD.

Methods: We tested participants' spontaneous propensity to imitate others and the accuracy of imitation performance in response to a series of novel eye-tracking-based imitation tasks, in which the following factors were manipulated 1) motor demands, 2) social engagement of the model demonstrating the action, 3) presence/absence of clear mean-goals structure, and 4) attentional demands. In the ASD group, we also examined the extent to which individual differences in imitative learning were correlated to intensive early intervention gains occurring in the 12 months following the test.

Results: We found that children with WS increased their attention to the model and their propensity to imitate the demonstrated action in response to a socially engaging versus a neutral partner. In contrast, preschoolers with ASD showed a similarly reduced propensity to look at the model and to imitate her actions regardless to whether the model was socially engaging or neutral (Group by Condition Interaction F (2, 52)=5.5; p<0.05, η2= 0.95). We also found that children with WS imitated actions that were not relevant to the actions' outcomes (overimitation) while this was not the case in children with ASD (Mann Whitney U = 290, p<.05). In contrast, the two groups showed similar strengths in the instrumental aspects of imitation (e.g. understanding of the mean-goals articulation of the demonstrated actions) and a similar decrease in imitation accuracy as the motor complexity of the demonstrated actions increased. Imitative response to a socially engaging but not to a neutral model in ASD was a robust predictor to early intervention outcomes (r=.7, p<.005).
Conclusions: Social motivational factors underlying imitation appear to be distinctively impaired in young children with ASD and to be linked to early intervention outcomes.

166 **110.166** Does Early Response to Joint Attention Predict Executive Functioning Among Infant Siblings at School-Age?

M. del Rosario[1], *K. Gillespie-Lynch*[2], *N. Pham*[3], *T. A. De los Santos*[3] *and T. Hutman*[4], *(1)Medicine, University of California, Los Angeles, Los Angeles, CA, (2)City University of New York, College of Staten Island, Staten Island, NY, (3)University of California, Los Angeles, Los Angeles, CA, (4)University of California Los Angeles, Los Angeles, CA*

Background: Response to joint attention (RJA) (Mundy et al., 1986) and executive functioning (EF) (Dawson et al., 1998) are impaired in children with ASD. Difficulty regulating attention may contribute to JA and EF challenges in ASD (Dawson et al., 2002; Van Hecke et al., 2011). RJA deficits among children with ASD are evident by 12 months (Osterling and Dawson, 1994) while impairments in EF are not apparent until approximately school age (Dawson et al., 1998; 2002). Concurrent relations between RJA and EF have been found in young children with ASD (Dawson et al., 2002). Among typically-developing children, early RJA has been associated with EF at preschool age (Van Hecke et al., 2011; Morales et al., 2005). Longitudinal relations between RJA in toddlerhood and later EF have not been evaluated in ASD.
Objectives: The current study examines associations between RJA at 18 months and EF at school age among children with and without ASD.
Methods: Participants were at high- (n=48) and low-risk (n=17) for ASD. High-risk participants had an older sibling diagnosed with ASD. Diagnostic assessments at or after 36 months yielded three "outcome" groups: ASD (n=11), non-ASD developmental concerns (Concerns; n=10), and typically developing (TD; n=44). RJA, evaluated at 18 months using the Early Social and Communication Scales (Seibert et al., 1982), was calculated as the percentage of trials on which participants followed the examiner's points to pictures in a book (RJA proximal) and posters on the wall (RJA distal). Parents completed the Behavior Rating Inventory of Executive Functioning (BRIEF; Gioia et al., 2000) when participants reached school age (5-9 years old). Higher BRIEF scores correspond to poorer EF.
Results: MANOVAs indicated no differences in EF subscales between risk groups, but ASD > TD and Concerns groups on inhibitory control, attention shifting, working memory, planning, and the ability to monitor effect on others; ASD > TD only on emotional control, p's < .05. Kendall's tau correlation analyses with the full sample indicated negative associations between RJA proximal and inhibitory control, attention shifting, working memory, and planning, and associations between RJA distal and inhibitory control (tau's ranged -.25 to -.32, p's ≤ .05). When correlations were tested separately in ASD and non-ASD groups, associations between RJA and EF were specific to the ASD group: inhibitory control was associated with both RJA proximal (tau = -.741, p=.014) and RJA distal (tau = -.684, p=.042).
Conclusions: Findings extend upon prior research demonstrating that RJA is a core difficulty in ASD (e.g., Sigman & Ruskin, 1999) by documenting longitudinal associations between RJA and EF in ASD. Early difficulties regulating shared attention (RJA) may contribute to later difficulties inhibiting ineffective behaviors. Although associations between RJA and EF were not observed in the non-ASD group, both RJA proximal and RJA distal were negatively correlated with inhibitory control in the ASD group. Inhibitory control is positively associated with math and literacy skills (Blair & Razza, 2007). Thus, early intervention targeting RJA among infants at risk for ASD may support the development of self-regulation and academic achievement.

167 **110.167** Effects of Reciprocal Imitation Training on Brain and Behaviour: A Pilot Randomized Controlled Trial

S. Malik[1], *C. Oliver*[1], *J. Moss*[2], *B. Ingersoll*[3], *C. Stefanidou*[4], *A. Wainer*[5], *L. Kossyvaki*[6] *and J. McCleery*[7], *(1)School of Psychology, University of Birmingham, Birmingham, United Kingdom, (2)University of Birmingham, Birmingham, England, United Kingdom of Great Britain and Northern Ireland, (3)Michigan State University, East Lansing, MI, (4)University of Birmingham, Birmingham, United Kingdom, (5)Autism Assessment, Research, Treatment and Services Center, Rush University Medical Center, Chicago, IL, (6)School of Education, University of Birmingham, Birmingham, United Kingdom, (7)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA*

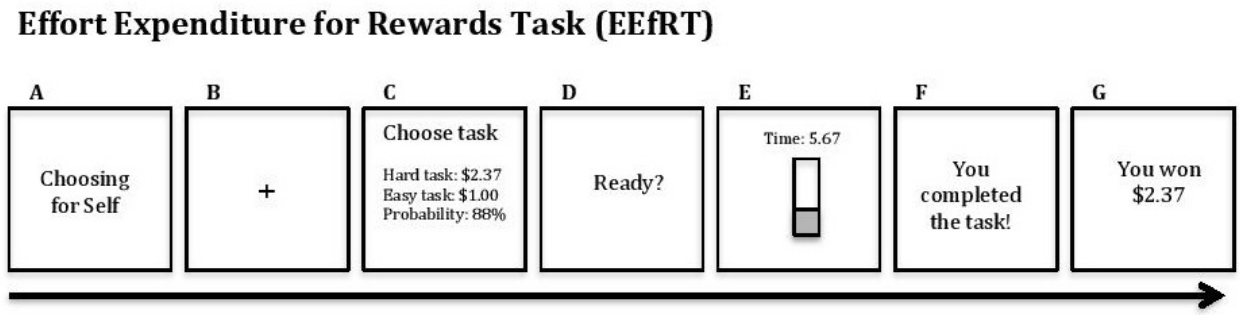
Background:
Reciprocal Imitation Training (RIT) is a play-based developmental-behavioural intervention focused on increasing imitation skills and gesture use, developed to address social imitation deficits in individuals with autism. Previous research has demonstrated RIT to be effective for increasing spontaneous object and gesture-based imitation.
Objectives:
The current study is an examination of electroencephalographic (EEG) measures of brain activity as potential biomarkers for these intervention effects, in the context of an external-laboratory replication trial.
Methods:
Participants in this completed Randomized Controlled Trial were 24 children with autism aged 2- to 6-years. An intervention group received 20 sessions of RIT over a period of 12 weeks, relative to a Wait-List control group. Stratified randomization was conducted utilizing pre-defined chronological age and verbal ability criteria at intake. Pre- and post-intervention assessments included the verbal portion of the Mullen Scales of Early Learning, the Autism Diagnostic Observation Schedule, and two experimental-behavioural change measures: Unstructured Imitation Assessment (UIA) and Structured Imitation Assessment (SIA), administered by experimenters who were blinded to intervention status. Event-related potentials were recorded at post-training utilizing a Rapid Auditory Mismatch paradigm for Human versus Non-Human Action Sound Processing previously utilized in our laboratory to study children with and without Autism Spectrum Disorder.
Results:
Behavioral effects of RIT were evaluated using a repeated-measures ANOVA, with post-hoc t-tests further comparing baseline scores with scores after 12 weeks. Children in the intervention group (N = 12; M = 11.08, S.D. = 10.4) made significantly more gains in spontaneous imitation measured via the UIA as compared to children in the wait-list group (N = 12; M = 6.3, S.D. = 9.3), F (1,22) = 8.09, p < .01, η_p^2 = .27. Follow-up t-tests on the intervention group data further supported this finding, exhibiting a significant difference between pre-intervention and post-intervention imitation scores, t (11) = -3.1, p = .01. Repeated measures ANOVAs conducted on event-related potentials data recorded over medial central and medial parietal cortex produced interactions of Participant Group (Intervention, Wait-List) by Stimulus (Human, Non-Human) by Congruency (Match, Mismatch) which indicated that children in the Intervention group (N = 8) exhibited larger amplitude responses for human stimuli which were preceded by a non-human stimulus (mismatch) whereas Wait-List participants (N = 7) exhibited larger amplitude responses for human stimuli which were preceded by a human stimulus (match), F (1,13) = 11.45, p < .01, η_p^2 = .47 and F(1,13) = 5.59, p=0.02, η_p^2= 0.3 for central and parietal components respectively.
Conclusions:
The current findings produced an external-laboratory replication of previous behavioural intervention effects driven by RIT, providing further experimental evidence for the effectiveness of RIT for improving socially interactive imitation during unstructured play. The results of the event-related potentials assessment provide further experimental evidence to suggest that these behavioural effects are associated with increased attentional orienting responses to social stimuli, reflected in increased central and parietal brain activity in response to human sounds which are not predicted from the preceding context.

168 **110.168** Effort-Based Decision-Making in Adolescents with Autism Spectrum Disorders

M. G. Mosner[1], *J. Kinard*[2], *S. McWeeny*[3], *C. R. Damiano*[4], *M. R. Burchinal*[5], *H. J. V. Rutherford*[6], *M. T. Treadway*[7] *and G. S. Dichter*[8], *(1)University of North Carolina, Carrboro, NC, (2)Carolina Institute for Developmental Disabilities, University of North Carolina School of Medicine, Chapel Hill, NC, (3)Psychology, University of Chapel Hill, Carrboro, NC, (4)University of North Carolina, Durham, NC, (5)Data Management and Analysis Core, Frank Porter Graham Child Development Institute, University of North Carolina, Chapel Hill, NC, (6)Yale Child Study Center, Yale University, New Haven, CT, (7)Department of Psychology, Emory University, Atlanta, GA, (8)University of North Carolina, Chapel Hill, NC*

Background: The purpose of this investigation is to examine effort-based decision-making in adolescents with autism spectrum disorder (ASD). It is well established that ASD is characterized by deficits in social cognition, social perception, and social communication. However, there has been recent emphasis on addressing motivational aspects of social deficits in ASD (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012). Although current conceptualizations of reward processing deficits in ASD have focused specifically on processing of social rewards, evidence suggests that processing of non-social rewards is impaired in ASD as well (Dichter & Adolphs, 2012). Recently, our research group reported that adults with ASD are characterized by impaired effort-based decision-making in the context of monetary rewards (Damiano, Aloi, Treadway, Bodfish, & Dichter, 2012).
Objectives: The present study is a downward extension of our previous findings and explores effort-based decision-making in adolescents with ASD. Additionally, effort-based decision-making in the context of rewards for self versus others will be investigated.
Methods: To date, we have collected data from 15 typically developing controls (TDCs; age *M*= 14.79, IQ *M* =109) and 24 high-functioning adolescents with ASD (age *M*=14.96, IQ *M* =97). ASD diagnoses were confirmed with the ADOS-2 and groups were matched on age and gender distribution (*p*'s>.05). By the date of the IMFAR conference, we anticipate that we will have collected data from an additional 10 TDCs and 10 participants with ASD. A modified version of the Effort Expenditure for Rewards Task (EEfRT) was used as a behavioral measure of effort-based decision-making. In this task, participants were provided with the probability of receiving monetary rewards on a given trial and asked to choose between an "easy task" for a small, stable reward or a "hard task" for a variable but consistently larger reward (Damiano et al., 2012; Treadway, Buckholtz, Schwartzman, Lambert, & Zald, 2009). In addition, participants were told they were either playing to win money for themselves ("self" condition) or for a

hypothetical person on a particular trial ("other" condition).
Results: Analyses examined the proportion of hard task choices in the "self" and "other" conditions. Results revealed a main effect of group such that the ASD group made fewer hard task choices across both self (p=.014) and other (p=.057) conditions compared to the TDC group. There was no main effect of condition (self vs. other) nor was there a significant group x self vs. other interaction.
Conclusions: Findings suggest that adolescents with ASD are biased towards less effort expenditure for rewards for themselves and for others. These results stand in contrast to our previous findings, in which we found that adults with ASD were biased towards more effort expenditure for rewards. Adolescence in particular may be a period during which reward-based decision-making differs compared to adults (Blakemore, 2008; Rilling & Sanfey, 2011), and these results further highlight that ASD research should be framed in the context of longitudinal change (Karmiloff-Smith, 1998). Future research in this area will consider younger children with ASD as well as effort expenditure for more personally relevant rewards in ASD.



Vicarious version: Schematic diagram of a single trial of the Effort Expenditure for Rewards Task ('EEfRT'). A) Subjects begin by seeing a 1s fixation cue. B) Subjects are told whether they are "Choosing for Self" or "Choosing for Other." C) Unlimited choice period in which subjects are presented with information regarding the reward magnitude of the hard task for that trial, and the probability of receiving any reward for that trial. D) One-second "ready" screen. E) Subjects make rapid button presses to complete the chosen task for 7s (easy task) or 21s (hard task). F) Subjects receive feedback on whether they have completed the task. G) Subjects receive reward feedback as to whether they received any money for that trial.

169 **110.169** Elementary School Impact of Early ABA Intervention

E. Rotheram-Fuller[1], *K. S. Turner*[1], *H. Park*[1], *D. Martinez*[1], *N. L. Matthews*[2] *and C. J. Smith*[2], *(1)Arizona State University, Tempe, AZ, (2)Southwest Autism Research & Resource Center, Phoenix, AZ*

Background: Applied Behavior Analysis has been shown to be the most effective intervention methodology for children with ASD (Wong et al., 2015). Although there are some initial studies that support the long-term effects of early intervention using ABA for this population (Virués-Ortega, 2010), there remain some questions about all of the ways that intensive early intervention can support children with ASD later in school.
Objectives: This pilot study specifically compared elementary teacher reports of students with ASD who had received early intensive ABA services, relative to students with ASD who did not receive early intervention.
Methods: This study included 14 students with ASD at various functional levels, who completed diagnostic (ADOS-2), intelligence (KBIT-2), and adaptive skills measures (Vineland-II), as well as parent report of previous educational supports and interventions. Nine (64.3%) of these children had previously received intensive early intervention ABA services. Participants were predominantly Caucasian (57.1%), with 28.6% who identified as Latino, 7.1% African American, and 7.1% Asian. The group had IQ scores that ranged from 40 to 87, with a mean score of 63.11 (SD=19.70). All children attended one diagnostic visit at a clinical site, and then the teachers of each child were asked to complete a rating scale on students social and classroom behavior.
Results: There were no significant differences in parent age or education, although this was likely due to sample size. Parents of children receiving ABA services had an average education level of a Bachelors degree, while parents of children not receiving ABA services had an average level of a high school diploma. Of the nine students who received early intervention services, 7 (77.8%) were in inclusive regular education classrooms, while all (n=5) students who did not receive early ABA intervention were in Special Education classrooms. Teacher ratings of students' social behavior did not differ significantly by group, however, their ratings of children's classroom behavior was significantly worse for children who had not received ABA services (M=26.20, SD=3.96), relative to those who had (M=19.88, SD=4.02; t(12)=-2.78, p=0.018).
Conclusions: These preliminary results show that while later social behavior may not be as impacted by early ABA services, classroom behavior is significantly improved for those with early behavioral intervention. Behavior functioning in classrooms is a key to educational success, and may be an essential factor to allow students to remain in less restrictive settings.

170 **110.170** Emotion Recognition Patterns from Facial Expressions in Children with ASD: Results from a Cross-Modal Matching Paradigm

O. Golan[1], *I. Gordon*[1,2], *K. Fichman*[3] *and G. Keinan*[3], *(1)Department of Psychology, Bar-Ilan University, Ramat-Gan, Israel, (2)Yale Child Study Center, Yale University, New-Haven, CT, (3)School of Psychological Sciences, Tel-Aviv University, Tel-Aviv, Israel*

Background:
Emotion Recognition (ER) deficits are considered a core characteristic in Autism Spectrum Disorder (ASD). These deficits have been described in specific modalities (e.g., facial expressions, voices) as well as in cross modal settings. Although the clinical definitions and experimental evidence point to a global ER deficit in ASD, several studies also argue for emotion-specific deficits. These conflicting findings raise the question of the specificity of ER deficits in ASD and point to the need for further comparisons of distinct emotions. In addition, inconsistent findings regarding ER in ASD could be related to paradigm requirements as well as to sample characteristics, such as age or levels of functioning.
Objectives:
The current study aimed to (1) Assess ER patterns of four distinct emotions: *happy, angry, sad* and *surprised* in children with ASD, compared to typically-developing (TD) children; and (2) to examine the relative contribution of cues from several perceptual modalities to ER by utilizing a matching paradigm in which cues from 3 different modalities (verbal, vocal or facial) were presented alongside three options of facial expressions.
Methods:
Twenty nine children with medium to high functioning level ASD (5 girls), aged 8-12, were matched on verbal mental age (PPVT) and gender to a group of 34 TD children (7 girls), aged 3-6. In the ER assessment, participants were presented with stimuli in three modalities: facial expressions (NimStim database), non-verbal emotional vocal cues (Montreal Affective Voices), or emotional verbal labels. Each target was presented alongside 3 photos of different facial emotional expressions. Participants were asked to select the facial expression that matches the emotion presented as target. Each of the four emotions tested was represented by four items, comprising three 16 item conditions: face-face, voice-face, and word-face.
Results:
Compared to the TD group, the ASD group had lower scores across all modalities, but group differences were most pronounced in the face-face condition, followed by the word-face and voice-face conditions.
For each of the 4 emotions tested, the ASD group had lower scores than the TD group. Within group comparisons revealed that, whereas in the TD group recognition of *surprise* was significantly lower compared to recognition of all other emotions, that were not different from each other, in the ASD group recognition of *anger* and *surprise* was significantly poorer than recognition of *sadness* and *happiness*.

Verbal mental age had an effect on ER, but had no significant interaction with group.
Conclusions:
Our findings demonstrate a developmental delay in the acquisition of ER skills in children with ASD. Deficits were found not only in emotions requiring mentalization, such as surprise, but also in more basic, situational emotions, such as anger. Our findings regarding the role of modalities in ER, namely that the ASD group seemed to have succeeded the most in the cross-modal (voice-face) condition, and struggled the most in the within modality (face-face) condition, challenge previous findings on cross-modal integration difficulties in ASD, and on visual compensatory mechanisms characteristic of ASD.

171 **110.171** Emotional Effects of Ostracism in ASD: A Physiological Approach

E. Trimmer[1], *S. McDonald*[2], *D. Mathersul*[3] *and J. A. Rushby*[4], *(1)University of New South Wales, Potts Point, NSW, Australia, (2)Psychology, University of New South Wales, Sydney, Australia, (3)University of Pennsylvania, Philadelphia, PA, (4)University of New South Wales, UNSW, Sydney, NSW, Australia*

Background: Social exclusion or ostracism is experienced by most people at some point in their lives. This is even greater for individuals with Autism Spectrum Disorder (ASD). Individuals with ASD experience difficulties making and maintaining friendships as well as difficulties with social communication, often leading to feelings of isolation and social exclusion. Very little research has examined the perceptions and emotional experience of individuals with ASD when they are being ostracized.
Objectives: This study aims to explore the emotional and psychophysiological responses to ostracism in individuals with ASD.
Methods: Twenty-five individuals aged 16 or older (21 males; mean age 27 years) with a diagnosis of ASD and twenty-six matched controls (21 males, mean age 26) participated in an online game of ball tossing, Cyberball. Each participant played two games, both against fictional players: one game in which they were excluded from the game and another in which they were included and the ball was shared equally between players. Whilst playing, participants' arousal level was monitored via skin conductance. Participants were also required to complete a self-report questionnaire about their experience and mood after both games.
Results: Individuals with ASD showed increased arousal compared with controls when playing the game ($p < .001$), both when excluded and included. Furthermore, individuals with ASD demonstrated higher levels of arousal when excluded from the game compared with when they were included. Individuals with ASD did not demonstrate habituation of arousal over the course of the game, as controls did. Psychological responses indicated that individuals with ASD showed similar patterns of responses to controls and shared the same social needs and mood.
Conclusions: The present findings suggest that, when excluded, individuals with ASD exhibited greater emotional response to the game compared to controls. This would suggest that they are more sensitive to ostracism and these effects do not dissipate as quickly as controls. However, these elevated physiological effects of ostracism are not recognised and interpreted as emotionally salient by individuals with ASD.

172 **110.172** Evaluating the Role of Social Approach Behaviors in Language Development

J. Weber[1], *A. Gutierrez*[2] *and M. Alessandri*[2], *(1)Els for Autism Foundation, Jupiter, FL, (2)University of Miami, Coral Gables, FL*

Background:
According to social motivation and social orienting models of autism, decreased social interest leads to less social input and fewer social learning opportunities (Chevallier et al., 2012; Mundy & Neal, 2001). These models suggest that the ability to initiate and participate in social interactions are important factors in language development. Research in this area has focused on the role of joint attention in language development however; the current study takes a broad view of social interest and posits that not only joint attention, but all socially mediated behaviors are important in language development
Objectives:
To evaluate a novel behavioral-coding scheme of social approach behaviors and determine the relationship between social approach behaviors and language development.
Methods:
Thirty-nine children, 3-5 years of age, with ASD who particpated in a completed multisite study comparing pre-school programs were included in the study. The current study utilized ADOS, PLS4 and MSEL assessments, administered at both the beginning and end of the academic year.
A social approach (SA) coding scheme was devised that used frequency counts of seven social behaviors (gaze to a person, smiling, showing, pointing, giving, vocalizations and laughing) emitted during an ADOS. These behaviors were coded as being either initiated by the child or occurring in response to the parent or examiner. No distinction was made on the basis of the function of the behavior. Composite scores of social initiations and responses were used to evaluate the role of these behaviors in both concurrent language abilities as well as language development over the course of an academic year
Results:
SA rates were correlated with existing measures of social motivation suggesting that SA coding is capturing a similar construct as those of existing measures.

Multiple regression was used to determine the relative contribution of ADOS social affect scores, social initiation rates and social response rates. The model significantly predicted concurrent receptive language abilities, however, only social responses significantly contributed to this relationship (Table 1). Hierarchical regression was used to evaluate the role of social initiations and social responses in receptive language development. Both social initiations ($\Delta R^2 = .054$) and social responses ($\Delta R^2 = .076$) were found to significantly contribute to receptive language development.
Equivalent analyses were run for expressive language. Again, only social responses significantly contributed to concurrent expressive language using the multiple regression model (Table 2). Similarly both social initiations ($\Delta R^2 = .043; .05$) and social responses (($\Delta R^2 = .034; .053$) were found to contribute to expressive language development as assessed by the PLS4 and MSEL, respectively.
Conclusions:
The SA coding scheme provides an alternative way to quantify behaviors on the ADOS that may be used in treatment development and assessment. Given the relationship between SA rates and language development, using this coding scheme may provide a way to determine those individual behaviors that lead children to differentially respond to various interventions. Continuing with this line of research will help parents/professionals determine which types of intervention are most beneficial to children based on various pretreatment behavioral profiles.

Table 1

Regression Coefficients and Standard Error for Concurrent Receptive Language Multiple Regression (PLS4)

Predictor	B	SE_B	β
Constant	19.707	6.062	
ADOS Social Affect	-0.356	0.34	-0.148
Social Initiations	0.95	2.711	0.058
Social Responses	3.582	0.966	0.631*

*$p < .001$

Table 2

Regression Coefficients and Standard Error for Concurrent Expressive Language Multiple Regression

PLS4	B	SE_B	β
Constant	19.707	6.062	
ADOS Social Affect	-0.356	0.34	-0.148
Social Initiations	0.95	2.711	0.058
Social Responses	3.582	0.966	0.631*
MSEL			
Constant	-.624	10.212	
Chronological Age	.155	.145	.109
ADOS Social Affect	.150	.388	.049
Social Initiations	-.155	3.155	-.008
Social Responses	5.981	1.1.35	.833*

*$p < .001$

173 **110.173** Event-Related Potential and Induced Gamma Study of Facial Expression Processing Deficits in Autism

*E. M. Sokhadze[1], **Y. WANG**[2], A. S. El-Baz[3], G. E. Sokhadze[4] and M. F. Casanova[5], (1)Outpatient Clinic, University of South Carolina School of Medicine, Greenville, SC, (2)State Key Laboratory of Cognitive Neuroscience and Learning,BeiJing Normal University, Beijng, China, (3)University of Louisville, Louisville, KY, (4)Anatomical Sciences & Neurobiology, University of Louisville, Louisville, KY, (5)Pediatrics and Biomedical Sciences, University of South Carolina School of Medicine, Greenville, SC*

Background:
Autism spectrum disorder (ASD) is one of neurodevelopment disorders, which presents with impairments in communication and social skills, and stereotyped, repetitive patterns of behavior. Disturbances of affective reactivity and innate inability to perceive and respond to the social cues including facial emotional expressions in a typical and appropriate manner are the hallmark deficits of ASD. There are several theories describing the neurobiology of underlying deficits. The study used event-related potentials (ERP) and single-trial induced EEG gamma oscillations recording in a modification of a "Theory-of-mind" (ToM) test using facial emotional expression recognition to test emotional responsiveness in children with autism and typical age-matched children.
Objectives:
Autism is featured by difficulty in decoding affective facial cues. The goal of the study was to find the differences between ASD group (N=19, mean age 16.3, SD= 4.9 yrs) and typically developing children (CNT group, N=21,14.9 yrs, SD= 4.5 yrs) in behavioral (reaction time and accuracy), induced gamma and ERP correlates of processing emotional information from facial expressions. Children with ADHD (N=14, 14.4 yrs, SD=3.9 yrs) served as a contrast group in induced gamma analysis.

Methods:
Task had 4 different conditions: either to identify the gender or the emotion of the face. Dense-array EEG was recorded using 128 channel EGI system. The ERP components analyzed in the study were parieto-occipital N170, frontal P3a, and parietal P3b, while induced gamma oscillations were recorded at 8 frontal and parietal sites.
Results:
ERP measures yielded following group differences: N170 showed a more negative amplitude in the ASD group than controls when identifying emotional faces (F= 5.66, p=0.023). The latency of N170 was prolonged in the ASD group (F= 7.54, p=0.01). The ASD group had a larger frontal P3a amplitude as compared to controls when differentiating emotions (F= 5.15, p=0.03). In the emotion recognition conditions, P3b had larger amplitude in autism (F= 4.17, p=0.049). Induced gamma (35-45 Hz) oscillations in ASD showed significant differences from controls at all 8 sites of recording in facial emotion discrimination condition (p<0.05).
Conclusions:
The results of the study indicate that more effort is required for an individual with autism to recognize emotion rather than gender from viewing a face. Abnormal processing of emotional stimuli may provide an explanation for some of the social and communicative deficits observed in autism. The results of the study contributes to better understanding of possible neurobiological mechanisms resulting in abnormal processing of facial information resulting in deficient social communication and mentalizing abnormalities in autism spectrum disorders. Analysis revealed larger difference waves in ASD subjects in the N170 component from the occipital cortex and in the P3a component from the frontal cortex. The parietal P3b measurements also showed a larger amplitude and shorter latency when viewing emotion in autism, representing more evaluation of one's performance after a task. The measurement of single trial induced gamma oscillations with advanced alignment technique provides confirmation that differences exist between how children with autism, and those with typical development process emotional stimuli.

174 **110.174** Examining Ecological Validity in the Use of Eye-Tracking for Toddlers with Autism Spectrum Disorders

A. Navab[1], *T. Vernon*[1], *J. Bradshaw*[2], *E. J. Horowitz*[1], *A. Barrett*[3], *J. Ko*[3], *S. Offman*[1], *J. Gong*[1], *A. C. Voos*[1], *T. German*[1] *and R. L. Koegel*[1], *(1)University of California, Santa Barbara, Santa Barbara, CA, (2)Marcus Autism Center, Emory University, Atlanta, GA, (3)Koegel Autism Center, University of California Santa Barbara, Santa Barbara, CA*

Background:
A growing body of eye-tracking literature demonstrates that when compared to TD controls, toddlers with ASD exhibit decreased attention towards socially salient stimuli and increased fixation on non-social stimuli (Pierce et al., 2015; Shic et al., 2011). The degree of deviation away from a typical gaze pattern appears to be a reliable measure of autism severity and holds promise as a potential diagnostic tool (Jones et al, 2008; Rice et al, 2012). However, there is currently little known regarding how eye-tracking task performance relates to preferential gaze during naturalistic interactions with caregivers. Such lines of inquiry may elucidate the ecological validity of eye-tracking data as a social engagement predictor in the real world—especially within the context of crucial interactions with caregivers that may serve as fundamental agents of change during early intervention efforts.
Objectives:
The current study presents data from an intervention study using eye-tracking as an indicator of social motivation prior to treatment onset among toddlers with ASD. Baseline levels of preferential looking were compared to TD toddler performance. Eye-tracking preferential looking was also compared to behavioral performance on measures of autism symptomology (ADOS) and gaze during parent-child interactions in a structured laboratory observation (SLO).
Methods:
Participants included toddlers with ASD (18-54 months) and TD controls. Children viewed a social versus non-social preference paradigm modeled after the social preference task adapted from Pierce et al. (2011). Six 5s videos depicted clips of social interactions presented side-by-side with clips of non-social geometric patterns. Differential looking scores (DLS) for preference across videos were calculated and compared within and between groups. Analyses included associations between DLS and ADOS social affective scores and gaze toward caregiver during the SLO.
Results:
An independent samples t-test revealed that ASD toddlers preferentially gazed at non-social stimuli significantly more than TD controls (T=2.6, p<0.05). This lower mean social preference ratio found in the ASD group was moderately associated with ADOS severity of social impairment. No relationships were found between non-social preferential eye-tracking looking behavior and gaze to caregiver during the SLO.
Conclusions:
The data suggest that compared to TD controls, toddlers with ASD displayed a preference for non-social eye-tracking stimuli that predicted severity of social affect symptoms. Findings also revealed that participants' preference for non-social eye-tracking stimuli did not predict decreased gazing to caregivers during the SLO. Different eye-tracking paradigms may be better suited for unique functions. The task used in this study appears to be a strong indicator of symptom severity, but alternative paradigms may be better suited as a metric of real world social performance. In the future, naturalistic social paradigms may need to be explored as a method for predicting ecologically valid social behaviors in the real world (e.g. looking behaviors, joint attention). Social looking behaviors appear to be influenced by motivational interactions with a caregiver and may be a responsive target to early intervention efforts. Additional post-intervention data may enhance these findings and reveal how social motivation may be a prognostic indicator for treatment outcome for toddlers with ASD.

175 **110.175** Examining the Relationship Between Social Engagement, Self-Esteem, and Self-Perceived Popularity in Adolescents with Autism Spectrum Disorder

E. Kutasevich[1], *J. W. Yang*[2], *E. Veytsman*[3] *and E. A. Laugeson*[3], *(1)Psychiatry, UCLA Semel Institute for Neuroscience and Human Behavior, Los Angeles, CA, (2)The Help Group-UCLA Autism Research Alliance, Sherman Oaks, CA, (3)Psychiatry and Biobehavioral Sciences, UCLA Semel Institute for Neuroscience and Human Behavior, Los Angeles, CA*

Background:
Popularity is often thought to be an important assessment of self-esteem, as well as social standing for adolescents (Boutot 2007). Social acceptance seems to be a predictor of future social functioning throughout adolescence, and later into adulthood (McElhany, Antonishak, Allen 2008). Perhaps due to lack of social skills, adolescents with autism spectrum disorder (ASD) are rarely perceived as popular by their peers (Boutot 2007). Research suggests that adolescents with ASD experience greater peer rejection and poorer friendship quality (Reichow & Volkmar 2010), resulting in less social engagement, which is a key necessity for adolescents with ASD (Conn 2014). With increased expectations to include youth with ASD into mainstream classrooms, there has been an increased need for social inclusion (Owen-DeSchryver et al. 2008); however, research suggests that youth with ASD integrated into general education settings often demonstrate poor quality of social interactions with peers (Owen-DeSchryver et al. 2008). Studies also suggest that when integrated into general education settings, adolescents with ASD are at an increased risk for peer rejection as well as social isolation (White, Koenig, & Scahill 2006). Although poor self-esteem and social standing might easily influence social interactions with others, the relationship between self-perceived popularity, and self-esteem more broadly, has yet to be examined in relation to social engagement in adolescents on the autism spectrum.
Objectives: The purpose of this study was to investigate the relationship between self-esteem, self-perceived popularity, and social engagement among adolescents with ASD without intellectual disabilities.
Methods: Participants included 322 males and 87 females ranging from 11-18 years of age (*M*=13.75, S*D*=1.86) who presented for social skills treatment through the UCLA PEERS® Clinic. To understand the relationship between self-esteem, popularity, and social engagement, teens completed the Piers-Harris Self-Concept Scale-Second Edition (PHS-2; Piers, & Herzberg 2002), which measures perceived self-esteem, including self-perceived popularity, and the Quality of Socialization Questionnaire (QSQ; Frankel & Mintz 2008), which assesses frequency of hosted and invited get-togethers with peers. Pearson correlation coefficients were calculated to examine the relationship between self-reports on the PHS-2 and the QSQ.
Results: Results indicate that greater number of hosted get-togethers on the QSQ are associated with higher levels of self-perceived physical attractiveness on the PHS-2 (p<.001). Moreover, frequency of invited get-togethers on the QSQ is associated with higher levels of self-perceived popularity (p<.001) and physical attractiveness on the PHS-2 (p<.001).
Conclusions: These findings reveal a relationship between self-esteem and social engagement among adolescents with ASD. Results suggest that greater self-perceived popularity and physical attractiveness is associated with greater social engagement with peers. Future research targeting increased self-esteem in youth with ASD might focus on interventions to increase social engagement as another mechanism to improve overall self-concept. With the trend to include adolescents with ASD in general education classrooms, interventions aimed at increasing social engagement in natural social settings, where youth with ASD are often socially isolated (White, Koenig, & Scahill 2006), may not only provide a means for improved social interaction, but may in turn increase self-esteem.

Piers-Harris 2

Quality of Socialization Questionnaire	Perceived Physical Attractiveness
Number of hosted get-togethers	.209
P-Value	<.001

Piers-Harris 2

Quality of Socialization Questionnaire	Perceived Physical Attractiveness	Perceived Popularity
Number of peers at initiated get-togethers	.215	.261
P-Value	<.001	<.001

176 **110.176** Exploring Levels of Self-Reported Sympathy and Distress in Individuals with Autism

R. Holt[1], *J. Upadhyay*[2], *P. Smith*[3], *C. Allison*[3], *R. Newman*[2], *T. Boardman*[2], *B. Chakrabarti*[4] *and S. Baron-Cohen*[3], *(1)Autism Research Centre, Department of Psychiatry, University of Cambridge, Cambridge, United Kingdom, (2)University of Cambridge, Cambridge, United Kingdom, (3)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (4)School of Psychology & Clinical Language Sciences, University of Reading, Reading, United Kingdom*

Background: Difficulties with aspects of social interaction, including empathy, comprise a core symptom of autism spectrum conditions (autism). Sympathy is considered an aspect of empathy involving both cognitive and affective empathy components.
Objectives: Here we present data from a new task of self-reported sympathy and personal distress. Aims: 1) To examine group differences between those with and without autism; 2) To examine sex differences within the autism and control groups; 3) To test for any association between the sympathy task, measures of personal distress, with the Empathy Quotient (EQ).
Methods: Participants with autism (93 males; 161 females) and controls (40 males, 93 females) took part in an online survey via the Autism Research Centre or Cambridge Psychology websites. Participants completed a task where they were asked rate 80 images according to the amount of sympathy they had for the individual and the personal distress they felt. The images consisted of emotionally distressing and non-distressing control images. Participants also completed the EQ and Autism Spectrum Quotient (AQ) questionnaires.
Results: Significant differences ($p < 0.001$) were found between the autism and control groups for both self-reported sympathy and distress, with participants with autism giving lower ratings than controls. When analysing the data from males and females independently the difference between females with autism and control females ($p<.001$) was more pronounced. Males with autism gave significantly lower sympathy ratings compared to controls ($p=.039$) but there was no significant difference for distress ratings. Typical females scored significantly higher than typical males in both sympathy ($p=.001$) and distress ($p=.011$). However sympathy and distress ratings did not differ significantly by sex in the autism group. EQ showed positive correlations with sympathy ($r=.332$) and distress scores ($r=.403$).
Conclusions: Using a new measure to assess levels of self-reported sympathy, this study showed that both males and females with autism gave lower ratings of sympathy when viewing people in distressing scenarios, compared to controls. Females with autism also reported lower levels of distress. Task ratings were correlated with self-reported scores of empathy, providing some validation for this task. The absence of the typical sex difference in autism confirms a pattern seen on other measures of sex differences in empathy. The findings provide further evidence of empathy performance in autism. This task could be useful tool in assessing sympathy as it is less dependent on language ability compared to some other measures. Future research could analyse performance in different subgroups and test physiological arousal to distressing scenarios as another index of how people with autism are different in their experience of sympathy. These results should not be taken to indicate that people with autism are uncaring, as there is considerable evidence that they do care; only that their processing of emotional cues in distressing scenes does not elicit the same level of self-reported sympathy or distress.

177 **110.177** Exploring the Mechanisms Underlying Reduced Emotion Contagion in Autism Spectrum Disorders

D. M. Berry[1] *and A. H. Osborn*[2], *(1)School of Psychology, Keele University, Staffordshire, United Kingdom, (2)School of Life Sciences, Keele University, Staffordshire, United Kingdom*

Background: Why is laughter 'contagious' and why might it be less contagious for people with autism spectrum disorders (ASD)? Typical adults often find certain emotional expressions contagious, particularly laughter. Observing someone laughing frequently results in the observer reciprocating laughter, even if the reason for the original laughter is unknown (Dimberg, 1982). This emotion contagion is suggested to have developed to serve a social function, bonding individuals involved in an interaction (Provine, 2005). Emotion contagion is thought to involve three processes: 1) a physiological response via the sympathetic nervous system 2) internalisation of the observed emotion in the form of a perceived change in subjective mood 3) mirroring the observed emotion by imitating the expression (laughing back).
Objectives: Recent research and numerous case reports suggest that people with ASD are less likely to demonstrate emotion contagion than typical people (Helt, Eigsti, Synder & Fein, 2010) but the reason for this reduced emotion contagion is unknown. The objective of the present research was to identify which of the three processes involved in emotion contagion is impaired in ASD by measuring physiological responses, changes in subjective mood, and time spent mirroring emotions, in adult participants with ASD compared to matched controls.
Methods: Twenty-two participants with ASD (20 males; Mean age = 22.2 years) were matched with 22 controls (20 males; Mean age = 21.1 years) on gender, age and National Adult Reading Test score. Participants viewed three naturalistic video montages of strangers laughing, yawning and crying. Physiological responses to the videos were measured using galvanic skin conductance recording throughout viewing. Internalisation of emotions was measured by comparing pre-and post-video questionnaire responses, in which participants rated their subjective moods. Mirroring was measured by video recording and subsequently coding the amount of time participants spent reciprocating the observed emotion using their facial expressions.
Results: The three processes were analysed separately using 2 (ASD, controls) x 3 (observing laughter, yawning, crying) mixed ANOVAs. Participants in the ASD group showed comparable skin conductance responses to controls while observing emotional expressions ($p>.05$). However, they were significantly less likely to perceive changes in their own emotions as a result of viewing emotional expressions ($p<.01$) and they also spent significantly less time than controls mirroring the observed emotions through their facial expressions ($p<.001$). This was particularly true for laughter, where the largest discrepancies between the ASD and control groups were found ($p<.001$).
Conclusions: Participants with ASD showed the same physiological reactions as controls to observing emotional expressions, which suggests a typically functioning sympathetic nervous system. However, they were significantly less likely to internalise or mirror these expressions, particularly laughter. Emotion contagion is thought to foster social cohesion, and sharing positive emotions may promote strong positive bonds between individuals. Consequently, this reduced emotion contagion in people with ASD, particularly noticeable for laughter, is likely to further impede social relationships, which may already be difficult.

178 **110.178** Exposure to Elements in Fetal and Early Postnatal Periods and Autistic Traits

M. Arora[1], *K. Tammimies*[2], *C. Gennings*[1], *C. M. Willfors*[3], *A. Reichenberg*[4] *and S. Bolte*[3], *(1)Preventive Medicine, Mount Sinai School of Medicine, New York, NY, (2)Karolinska Institutet, Stockholm, Sweden, (3)Department of Women's and Children's Health, Pediatric Neuropsychiatry Unit, Karolinska Institutet, Stockholm, Sweden, (4)Mount Sinai School of Medicine, New York, NY*

Background: Environmental factors likely play an important role in the etiology of autism, but are understudied. Of the many possible environmental risks, fetal and early childhood exposure to toxic metals as well as deficiencies of nutritional elements are interesting candidates for investigation as they have been associated with several adverse developmental outcomes.
Objectives: Using a novel tooth matrix biomarker this study examined exposure to multiple elements in relation to autistic traits.
Methods: Participants are members of the Roots of Autism and ADHD Twin Study in Sweden, a population based case-control twin sample recruited from nation-wide registries in Sweden. We used newly developed tooth matrix biomarkers to establish detailed temporal profiles of multiple metal toxicants and essential elements over the prenatal and early postnatal periods. Autistic- traits were assessed using the Social Responsiveness Scale-2 (SRS-2).
Results: From the Roots of Autism and ADHD Twin Study Sweden 51 members contributed teeth samples. Manganese was inversely associated with SRS-2 ($r = -0.3$ to -0.5), with this association being significant over the pre- and postnatal periods, suggesting that deficiencies are associated with increasing autistic symptomatology. A significant inverse association of zinc with SRS-2 was also observed in the third trimester. The relationship of other elements, including lead and copper, and SRS-2 severity, is currently undergoing and will also be presented.
Conclusions: Prenatal and early postnatal uptake of multiple metal toxicants and essential elements contributes to individual differences in autistic traits. Prenatal and early

life excess or deficiency of elements may contribute to autism risk.

179 **110.179** Gaze Following Atypicalities in Children with Autism: The Role of Motivation

***E. Thorup**, J. L. Kleberg and T. Falck-Ytter, Uppsala University, Uppsala, Sweden*

Background: Although impairments in joint attention are common in ASD, several studies have found intact gaze following accuracy. In a recent study (Falck-Ytter et al, 2014), we found that typically developing (TD) children displayed a first fixation duration (FFD) bias towards an object being attended to by another person, as compared to an unattended object. In an ASD-sample, no such FFD bias was found. This suggests that the FFD measure might detect subtle gaze following atypicalities that are not reflected by the more common accuracy measure. Given the explorative nature of the previous study, independent replication is required. More knowledge about the mechanisms underlying the altered response in ASD is also needed.
Objectives: The aim of the present study was twofold. First, we wanted to replicate the previous finding of a weaker processing bias for attended vs. unattended objects in ASD as compared to TD-children. Second, we aimed to explore the potential role of motivational factors.
Methods: The study included a group of high functioning children with ASD (n = 16, mean age = 81.6 months) and a group of typically developing children (n = 18, mean age = 73.6 months). Using eye tracking technology, the children's gaze patterns were recorded as they watched videos of a model looking at one of multiple objects. In the Circumscribed Interest (CI) condition, the objects were model trains and toy cars (common circumscribed interests, expected to be particularly motivating for children with ASD). The objects in the non-CI condition were plants. Two measures were used: (1) Gaze following accuracy was measured as a difference score (DS) with the number of incongruent gaze shifts subtracted from the number of congruent gaze shifts; (2) FFD bias was measured as a DS with the mean FFD at the unattended objects subtracted from the mean FFD at the attended object.
Results: The groups did not differ in terms of gaze following accuracy in neither condition, and no interaction effect was found (p:s > 0.05). More importantly, the previous finding of a reduced FFD bias for attended objects in ASD was replicated in the non-CI condition ($p < 0.05$). However, in the CI condition, no group difference was found. A 2x2 ANOVA confirmed that the manipulation modulated the responses differently in the two groups ($p < 0.05$).
Conclusions: The previously found greater FFD bias for attended objects in a TD- as compared to ASD-sample was replicated in the non-CI condition, suggesting that the FFD measure reliably tracks gaze following atypicalities in children with ASD. However, no group difference was found in the CI-condition, showing that the altered FFD response in ASD does not generalize across all object types. Rather, this demonstrates that when objects known to be particularly interesting for children with ASD are included, the performance of these children does not differ from that of their typically developing peers. This finding speaks to the importance of motivational factors in joint attention behaviors in ASD.

180 **110.180** Gender As a Moderator of the Association Between Social Responsiveness and Cognitive Ability for Children with Autism

***J. L. Irwin** and M. Beeghly, Psychology, Wayne State University, Detroit, MI*

Background: The male-female ratio for autism is 4-5:1 (Fombonne, 2011). Consequently, most autism research has focused on males, and the female autism phenotype is poorly understood. Also understudied is whether social responsiveness contributes to cognitive performance among children with autism, and whether gender moderates these associations.
Objectives: The aims of the current study were to evaluate whether male and female children with autism vary in cognitive profiles, whether social responsiveness contributes to cognitive functioning, and whether gender moderates these associations.
Methods: A sample of individuals with ASD (N=217, 53% male) was derived from the National Database for Autism Research. Cognitive profiles were evaluated using the DAS-II School Age (standard scores), and social functioning with the Social Responsiveness Scale (t-scores). Gender moderation was analyzed using the PROCESS macro for SPSS. Expectation maximization was used to address missing data.
Results: In separate analyses for each outcome/predictor pair (see Table 1), gender significantly moderated the association between 1) social motivation and general conceptual ability (adjusting for age); 2) social cognition, social communication, social motivation, autistic mannerisms and verbal IQ (adjusting for nonverbal IQ); and 3) social motivation and nonverbal IQ (adjusting for verbal IQ). For 1) and 2), the slope of each interaction was significant only for females, and for 3), the slopes for males and females were significant and in opposing directions (see Table 2).
Conclusions: Results show that the cognitive and social phenotype for females differs from that of males, underscoring the need for greater attention to females in autism research. Findings also demonstrate the utility of evaluating social as well as cognitive functioning in this population, and suggest that interventions for children with autism should consider gender differences in cognitive and social ability.
Acknowledgments: Data used in the preparation of this abstract reside in the NIH-supported NIMH Data Repositories, specifically in the National Database for Autism Research. Collection IDs and submitters are available upon request.

Table 1
Results of Moderation Analyses.

		Predicting GCA (N=166)			
		Coeff.	*SE*	*t*	*p*
Intercept	i_1	99.849	7.081	14.100	< .001
Social Motivation (X')	b_1	0.148	0.138	1.069	.287
Gender (M)	b_2	-11.339	3.803	-2.982	.003
Social Motivation × Gender ($X'M$)	b_3	0.668	0.322	2.075	.040
Age (C_1)	b_4	0.021	0.047	0.455	.650
R^2= 0.123, ΔR^2= 0.024, $F(1,161) = 4.307$, $p = .040$					
		Predicting Verbal IQ (N=217)			
		Coeff.	*SE*	*t*	*p*
Intercept	i_1	16.531	5.617	2.943	.004
Social Cognition (X')	b_1	-0.065	0.107	-0.609	.543
Gender (M)	b_2	2.681	2.108	1.272	.205
Social Cognition × Gender ($X'M$)	b_3	0.391	0.157	2.489	.014
Nonverbal IQ (C_1)	b_4	0.806	0.052	15.446	< .001
R^2= 0.568, ΔR^2= 0.013, $F(1,212) = 6.194$, $p = .014$					
Intercept	i_1	19.177	5.590	3.431	< .001
Social Communication (X')	b_1	-0.026	0.101	-0.261	.794
Gender (M)	b_2	1.291	2.123	0.608	.544
Social Communication × Gender ($X'M$)	b_3	0.407	0.140	2.912	.004
Nonverbal IQ (C_1)	b_4	0.782	0.052	15.046	< .001
R^2= 0.586, ΔR^2= 0.017, $F(1,212) = 8.482$, $p = .004$					
Intercept	i_1	19.221	5.415	3.550	< .001
Social Motivation (X')	b_1	-0.130	0.094	-1.384	.168
Gender (M)	b_2	1.331	2.009	0.663	.508
Social Motivation × Gender ($X'M$)	b_3	0.769	0.145	5.302	< .001
Nonverbal IQ (C_1)	b_4	0.779	0.050	15.515	< .001
R^2= 0.655, ΔR^2= 0.053, $F(1,212) = 28.110$, $p < .001$					
Intercept	i_1	18.544	5.712	3.247	.001
Autistic Mannerisms (X')	b_1	0.018	0.090	0.199	.843
Gender (M)	b_2	2.424	2.086	1.162	.247
Autistic Mannerisms × Gender ($X'M$)	b_3	0.246	0.118	2.087	.038
Nonverbal IQ (C_1)	b_4	0.789	0.053	14.908	< .001
R^2= 0.570, ΔR^2= 0.009, $F(1,212) = 4.354$, $p = .038$					
		Predicting Nonverbal IQ (N=217)			
		Coeff.	*SE*	*t*	*p*
Intercept	i_1	35.967	4.592	7.832	< .001
Social Motivation (X')	b_1	0.204	0.087	2.333	.021
Gender (M)	b_2	-7.667	1.806	-4.245	< .001
Social Motivation × Gender ($X'M$)	b_3	-0.482	0.141	-3.427	< .001
Verbal IQ (C_1)	b_4	0.682	0.044	15.515	< .001
R^2= 0.620, ΔR^2= 0.022, $F(1,212) = 11.745$, $p < .001$					

Note. $X' = X - \overline{X}$; GCA = General Conceptual Ability.

Table 2
Conditional Effects of X on Y by Gender.

	Social Motivation on GCA by Gender, Adjusting for Age			
	Effect	*SE*	*t*	*p*
Male	0.148	0.138	1.069	.287
Female	0.816	0.292	2.798	.006
	Social Cognition on Verbal IQ by Gender, Adjusting for Nonverbal IQ			
	Effect	*SE*	*t*	*p*
Male	-0.065	0.107	-0.609	.543
Female	0.325	0.115	2.837	.005
	Social Communication on Verbal IQ by Gender, Adjusting for Nonverbal IQ			
	Effect	*SE*	*t*	*p*
Male	-0.026	0.101	-0.261	.794
Female	0.380	0.097	3.925	< .001
	Social Motivation on Verbal IQ by Gender, Adjusting for Nonverbal IQ			
	Effect	*SE*	*t*	*p*
Male	-0.130	0.094	-1.384	.168
Female	0.638	0.112	5.691	< .001
	Autistic Mannerisms on Verbal IQ by Gender, Adjusting for Nonverbal IQ			
	Effect	*SE*	*t*	*p*
Male	0.018	0.090	0.199	.843
Female	0.263	0.078	3.361	< .001
	Social Motivation on Nonverbal IQ by Gender, Adjusting for Verbal IQ			
	Effect	*SE*	*t*	*p*
Male	0.204	0.087	2.333	.021
Female	-0.278	0.111	-2.502	.013

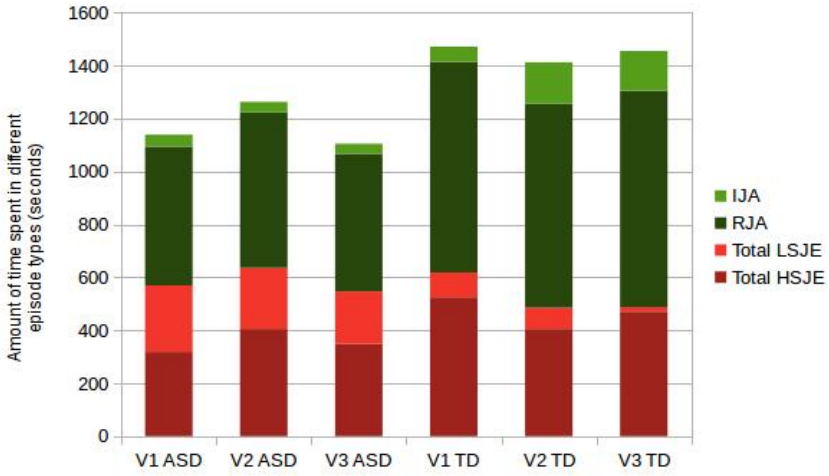
Note. GCA = General Conceptual Ability.

181 **110.181** High and Lower Order Supported Joint Attention in Autism and Typical Development

***A. M. Abdelaziz**[1], M. Wagner[2], D. A. Fein[3] and L. Naigles[4], (1)University of Connecticut, Mansfield Center, CT, (2)Literatures, Cultures, and Languages, University of Connecticut, Storrs, CT, (3)Psychology, University of Connecticut, Storrs, CT, (4)University of Connecticut, Storrs, CT*

Background:

Joint attention (JA) (i.e. the child and caregiver alternate between each other and an object) has been found to play a role in the language development of typically developing (TD) children, as well as children with ASD (e.g. 6). JA behaviors are generally impaired in children with ASD (e.g. 3, 4, 5, 7). However, more recent analyses of caregiver-child interactions have revealed that children with ASD participate in Supported Joint Engagement (SJE), in which the caregiver influences the child's object play, but the child engages with the caregiver without visually referencing him/her (1). Bottema-Beutel et al., (2014) also reported that by dividing SJE into Higher order (HSJE; the child responds by reciprocating and collaborating with the caregiver) and Lower order (LSJE; the child responds without reciprocal or collaborative exchange with the caregiver) types, HSJE predicted later social communication and expressive language in children with ASD. However, less is known about the relative proportions of time in which children with ASD participate in different types of social interactions and the nature of SJE activities in TD children.
Objectives:
We extend the paradigm of Bottema-Beutel et al. (2014) to a new sample of children with ASD, compare them to TD children, and investigate the amount of time TD children and children with ASD engage in episodes of SJE and JA.
Methods:
The sample includes 15 children with ASD ($ASD_{MA\ ge}$ = 34.93 months, 12 males), and 15 TD children (TD_{MAage} = 19.82 months, 13 males), who were recorded at 3 visits, 4 months apart, and matched on language level (raw scores) ($M\ ASD_{MullenEL}$ = 16.44(6.22), $M\ TD_{MullenEL}$ = 20.35(5.70)) at visit 1. Children and their parents engaged in 30-minute play sessions, which were coded for amount of time spent in HSJE, LSJE and JA episodes.
Results:
Figure 1 presents the mean episode durations of all TD children and children with ASD across the 3 visits. The TD children were engaged with their caregivers for approximately 77% of the play session whereas the children with ASD were engaged for 67% (p = .15). TD children spent more time in JA episodes than children with ASD (p = .006), whereas children with ASD spent more time in LSJE episodes than the TD children (p = .005). Interestingly, children with ASD spent approximately one-third of the play session engaged within JA episodes.
Conclusions:
Contrary to earlier findings, children with ASD participated in several different types of social interactions with their caregivers for about two-thirds of the play session, with considerable amounts of time spent in JA, LSJE, and HSJE. All three types of interactions were also observed in the TD group, although as expected the duration of JA episodes was longer, and LSJE episodes, shorter. These findings warrant further investigation into the predictive value of each interaction type for later development, as well as the more detailed examinations of the nature of the children's and caregivers' activities.



182 **110.182** How Do People with Autism Spectrum Disorder (ASD) Perform on the Ultimatum Game? Using Game Theory to Study Social Decision Making in ASD

*C. Cheung[1], K. Woodcock[2], D. H. H. Skuse[3] and **W. Mandy**[4], (1)Clinical Psychology, UCL, London, United Kingdom, (2)Psychology, Queens University, Belfast, Belfast, United Kingdom, (3)Institute of Child Health, London, United Kingdom of Great Britain and Northern Ireland, (4)University College London, London, United Kingdom*

Background: This research seeks to elucidate how people with ASD behave in real-world social situations, by studying social decision making, herein defined as the capacity to attend to, process, interpret and act upon information to inform spontaneous, effective interpersonal behaviour. Game theory researchers working in behavioural economics have developed psychometrically sound, ecologically valid tools for measuring social decision making, but these have rarely been used to study the strengths and difficulties of people with ASD. This study investigated social decision-making in ASD using a game theory task called the Ultimatum Game (UG), which is an interactive bargaining task measuring reciprocal responses to social norm violations and unfairness. In the UG, a sum of money, for example £10, is to be divided between two players – William and Mary. William chooses how to share the money, for example making a fair offer (£5) or an unfair offer (e.g. £2) to Mary. Mary can then decide whether to accept or reject William's offer. If she accepts, both parties will each receive the agreed share of the money. If she rejects, neither will receive anything. The "ultimatum" refers to the take-it-or-leave-it offer in the game.
Objectives: We sought to discover whether young people with high-functioning ASD showed atypical performance on the UG, compared to controls, both in terms of the proposals they made, and their decisions about whether to accept unfair offers. We also investigated whether elements of cognition associated with ASD (namely, difficulties with theory of mind, emotion regulation and executive function) predicted suboptimal performance on the UG.
Methods: Twenty young people (aged 11 to 17 years) with ASD and an IQ in the normal range participated in the UG, which was delivered as a computerized task. Their behaviours as proposers of offers, and their responses to offers (including unfair offers) were measured. Participants also completed measures of theory of mind, emotion regulation and executive function, and parents completed a questionnaire on EF. Two typically developing comparison groups were used, one matched on chronological age (n=20) and the other matched on developmental age (n=20).
Results: Young people with ASD proposed significantly fewer fair offers to their opponents in the UG, but did not differ from controls in their responses to unfair offers. In the ASD group, participants with better theory of mind were more likely to propose fair offers. Participants with better executive function – especially those with better emotional control and behavioural regulation – accepted more unfair offers.
Conclusions: Young people with ASD demonstrated preserved aspects of SDM in a 'reactive' social context, which appeared to recruit executive functioning, especially emotional control and behavioural regulation. They differed to their TD peers when behaving in a 'proactive' social situation, which seemed to depend partly on theory of mind abilities.

183 **110.183** How Social Others Form First Impressions of Adults with Autism Spectrum Disorder

***D. J. Faso**[1], K. E. Morrison[2] and N. J. Sasson[3], (1)University of Texas at Dallas, Allen, TX, (2)The University of Texas at Dallas, Dallas, TX, (3)University of Texas at Dallas, Richardson, TX*

Background: First impressions are rapidly formed and assert long-term influences on social preferences and behavior. Whether first impressions of adults with autism spectrum disorder (ASD) differ from those made of typically-developing (TD) adults, and the factors underlying their formation, is not well understood. Highlighting aspects of social presentation in ASD that affect evaluation by potential social partners may ultimately be used to mitigate social interaction impairments in ASD by educating social others about behavioral differences in ASD and inform ASD adults about these perceived differences.
Objectives: The ongoing project obtained first impressions from TD adults observing real-world behavior of adults with ASD, as well as TD comparison participants. We examined how specific information channels (i.e., visual cues, audio cues, and speech content) drove impression formation of adults with ASD across a range of personality traits and whether these impressions were associated with intentions to socially engage with the observed individual.
Methods: 147 TD observers, blind to the diagnostic status, rated twenty ASD adults and twenty TD comparison adults matched on gender, age, ethnicity and IQ engaging in a social presentation task. The first 10s of dialogue produced by participants was extracted to produce stimuli depicting five different presentation modalities: (a)audio content only, (b)video content only, (c)a written transcript of speech content, (d)a static frame, and (e)the full 10s clip with audio-visual. Observers gave first impressions across six character traits (attractiveness, intelligence, trustworthiness, likability, awkwardness, dominance) and indicated their intent to socially engage with the participant.
Results: A 6(traits) X 5(modality) X 2(group) mixed-model ANOVA revealed the ASD group was rated as more awkward, less attractive, less dominant, and less likeable than the TD group (all p's<.01), with no difference on trustworthiness or intelligence. A three-way interaction between group, modality, and trait ($F(20,760)=3.06$, $p<.001$) showed

that group differences largely persisted across the audio, video, static frame, and audio-visual modalities, with no group differences found for the transcript condition except for on awkwardness. Likeability was the strongest correlate with intent to socially engage for both groups (r=.88, ASD; r=.89, TD); however, awkwardness more strongly related to observers intent to socially engage with the ASD group (r=.560) compared to the TD group (r=.242), a significant difference using an r-to-z transformation (p=.004). Future factor analytic approaches (i.e., Correspondence Analysis) will examine how first impression ratings of each trait is distributed across the specific presentation modalities, and whether patterned profiles distinguish the ASD and TD groups.
Conclusions: Adults with ASD are generally perceived less favorably compared to TD matched comparison adults, except for ratings of intelligence and trustworthiness. These patterns were consistent across audio, video, static image, and audio-visual conditions, but not for the transcript of the speech content. This failure to find differences in the transcript conditions suggests that the content ASD adults choose to discuss does not seem to drive initial impression formation, rather all audio/visual social presentation cues appear to be similarly influential. Findings are pertinent for exploring situations where ASD adults are interacting with a novel social partner (e.g., job interview).

184 **110.184** Humor on the Autism Continuum

M. Brosnan[1] *and P. Welsh*[2]*, (1)University of Bath, Bath, United Kingdom, (2)Bathspa University, Bath, United Kingdom*

Background:
Autism Spectrum Disorder (ASD) is defined in part as a deficit in social communication and interaction. Humor can be key to developing and maintaining social relationships, referred to as a 'social lubricant' or a 'social glue'. Asperger drew attention to a 'humorlessness' in ASD, although also noting competence in wordplays. Subsequent research has suggested a preference in people with ASD for humor such as wordplay or slapstick, which do not necessitate taking the perspective of others. Additionally, recent theories of humour have proposed different styles of humour, namely socially-adaptive positive humour styles and socially-maladaptive negative humour styles.
Objectives:
To identify if those with higher levels of autistic traits from a general population and those with a diagnosis of ASD demonstrate a deficit in the appreciation of positive humour specifically (contrasted with negative humor). To explore differences in the preferences for different types of humor in ASD.
Methods:
Three studies were conducted. 1) Autistic traits were assessed in a general population (n=163) and contrasted with positive and negative: a) humor styles, b) humor experiences, and c) humor preferences. 2) A group diagnosed with ASD (n=16) were compared with a Typically Developing (TD, n=16) group to explore differences in positive and negative: a) humor experiences, and b) humor preferences. 3) A group diagnosed with ASD (n=26) were compared with a Typically Developing (TD, n=75) group to explore differences in a) humor preferences, and b) the perceived humor of five comedic principles (Concept-based; Character-based; Slapstick; Exaggeration & Escalation; Wordplay).
Participants completed the Autism Quotient and the Humor Styles Questionnaire (Study 1), the Humour Experiences Questionnaire and rated comedy clips for perceived humor (all studies).
Results:
In Study 1, higher AQ scores significantly and negatively correlated with positive humour style and positive humor experiences (controlling for gender). There were no correlations between AQ and negative humor style and negative humor experience. There was a trend for higher AQ to correlate with finding both positive and negative humor less funny.
In Study 2, there were no significant group differences in positive or negative humor experiences. The ASD group reported that the positive humor was significantly less funny than the control group. There were no group differences in the perceived funniness of negative humor.
In Study 3, the ASD group reported significantly less positive humour experiences than the control group with no differences in negative humor experiences (no gender differences). The ASD group reported that the clips demonstrating 1) Wordplay and 2) Character-based comedic principles were less funny than the control group, with no differences in the ratings of the other comedic principles.
Conclusions:
Taken together, the results suggest a diminished preference for, and experience with, positive humor associated with higher levels of autistic traits (including those with a diagnosis of ASD) which does not extend to negative humor. This is pertinent as positive humor if argued to be socially adaptive and facilitate social relationships. There is also evidence that humor is often rated as less funny by those with high autism traits and ASD.

185 **110.185** Imitation Impairments in Autism Spectrum Disorder: A Social Motivation or Motor-Execution Problem?

L. Chetcuti[1]*, K. Hudry*[1]*, M. Grant*[1] *and G. Vivanti*[1,2]*, (1)Olga Tennison Autism Research Centre, Melbourne, Australia, (2)Victorian ASELCC, Melbourne, Australia*

Background: Imitation is an important early developmental skill; it provides a means to acquire practical knowledge and to practice and develop interpersonal skills (e.g., Munson, Meltzoff, & Dawson, 2006). Imitation deficits are a characteristic feature of autism spectrum disorder (ASD) and, while several explanatory theories have been proposed, the mechanisms underlying these difficulties remain unclear (Edwards, 2014).
Objectives: Within a mixed quasi-experimental and individual differences design, this study examined the contribution of reduced social motivation and motor-execution difficulties for propensity to imitate among children with ASD.
Methods: Among 55 child participants – 35 with ASD, 20 typically developing (TD) – a novel imitation task was delivered via . This included four experimental conditions arising from manipulations of social and motor domains; to-be-imitated actions were presented by a *social* and an *asocial* model, and under conditions of *low-* (single action) and *high motor-demand* (multiple actions in sequence). Imitative performance in each condition was coded such that higher total score indicated more accurate imitation. Several standardized assessments were also conducted; fine motor coordination was assessed using the Vineland Adaptive Behavior Scales (VABS-II; Sparrow, Cicchetti, & Balla, 2005) and Mullen Scales of Early Learning (MSEL; Mullen, 1995), and social motivation was assessed among children with ASD using the Autism Diagnostic Observation Schedule, Social Affect domain (ADOS-2 SA; Lord et al., 2012).
Results: There was a nonsignificant trend towards overall reduced imitation by children with ASD vs. TD children. Imitative performance was significantly better in the low- relative to high motor-demand condition, for each group with no between-group differences in performance in either motor demand condition. There were no between-group imitation differences in response to the social vs. asocial model. However, a significant three-way interaction term revealed that children with ASD imitated more poorly during the high- relative to low motor-demand condition, when demonstration was by a social model. Among children with ASD, propensity to imitate was not associated with ADOS-2 SA score, and showed a conflicting pattern of correlations with fine motor skills as assessed via the MSEL (significant positive association) and VABS-II (no significant association).
Conclusions: While there was a trend for poorer imitation by children with ASD, the lack of clear group differences on this novel task of spontaneous imitation did not provide robust replication of previously-reported imitation deficits in this population. Moreover, findings of a) a lack of between-group differences in imitation in response to a social vs. asocial model, and under conditions of low- vs. high motor-demand, and b) nonsignificant correlations between imitation performance and standardized measures of sociability and fine motor skill suggest that neither social motivation nor motor-execution capacities decisively underpin the propensity to imitate by children with ASD. Interestingly, these data suggest that imitative performance in ASD may arise from a complex interplay between these factors, as imitation was poorer for children with ASD as both the social-processing and motoric task demands increased. Further research is warranted to understand precisely how social motivation and motor execution capacities combine to influence spontaneous imitation in ASD.

186 **110.186** Increased Eye Contact during Conversation Versus Play in Children and Adolescents with ASD

R. M. Jones[1]*, A. Hamo*[1]*, C. Carberry*[1]*, E. Komarow*[1]*, A. Southerland*[2]*, C. A. Bridges*[2]*, S. Nay*[2]*, E. Stubbs*[2]*, J. M. Rehg*[2]*, A. Rozga*[2] *and C. Lord*[1]*, (1)Weill Cornell Medical College, White Plains, NY, (2)Georgia Institute of Technology, Atlanta, GA*

Background: Atypical eye contact is a diagnostic hallmark of Autism Spectrum Disorder (ASD). Individuals with ASD typically make less eye contact overall than those who are typically developing (TD). Research on TD children suggests eye contact is limited during free-play interactions highlighting the importance of context for eliciting eye contact (Arnold et al., 2000). To date, there is limited research comparing the amount of eye contact across different contexts in ASD, which may be important for interpreting social communication behavior in a clinical setting.
Objectives: To determine if the amount of eye contact differs during distinct aspects of social interactions, specifically interactive play compared to conversations. We hypothesized that the amount of eye contact with an examiner would be less during play than during conversation segments in ASD.
Methods: 26 children and adolescents with ASD (M = 8.5 years, 5-17 years) completed the Brief Observation of Social Communication Change (BOSCC) assessment. The BOSCC is a 12-minute clinician-subject interaction that consists of two 5-minute play segments with a standardized set of toys, separated by a 2-minute conversation segment. The BOSCC was recorded via Pivothead Kudo glasses that are worn by an examiner. They contain an outward facing camera and readily capture the child's face and shifts in eye gaze to the examiner. The duration of eye contact was manually coded using ELAN, a video annotation software, to capture eye contact duration by the millisecond in both play and conversation. Proportions of eye contact with the examiner were calculated by dividing the duration of eye contact with the examiner by the total time for the play segment versus the conversation. A subset of 8 individuals had a second BOSCC session four weeks after the first session. Repeated Measures ANOVAs determined 1) differences in the duration of eye contact during play versus conversation; 2) stability across time in the duration of eye contact in participants who had two time points and 3) the impact of age, cognitive abilities (VIQ, NVIQ) and autism symptom severity (ADOS CSS) on eye contact duration in the two segments.
Results: The duration of eye contact was significantly greater during conversation as compared to play (p < 0.001, Mean Play = .05, Mean Conversation = .28). There was no significant interaction with age, severity of autism symptoms, NVIQ, or VIQ. Similarly, children made more eye contact during conversation versus play across two time points

($p < 0.001$) with no significant difference between the two time points, highlighting the stability of the findings.
Conclusions: School-aged children with ASD make less eye contact during play with an examiner than during conversation, independent of age, autism symptom severity, or cognitive abilities. In the absence of any distracting toys or materials, children made more eye contact, highlighting the importance of considering context and the environment when measuring different forms of social communication. The finding that the amount of eye contact was contingent upon environmental demands that are commonly used in clinical settings has important implications for studies that examine behavior changes during intervention.

187 **110.187** Increased Synchronous and Sustained Social Interactions Following a Social Skills Intervention for Adolescents with ASD

M. Murray[1], *A. Pearl*[2], *Z. Soulliard*[1], *K. C. Durica*[1], *A. Heintzelman*[3] *and S. Brown*[1], *(1)Penn State Hershey, Hershey, PA, (2)Penn State Milton S. Hershey Medical Center, Penn State College of Medicine, Hummesltown, PA, (3)Penn State College of Medicine, Hershey, PA*

Background: Despite increases in research examining the efficacy of social skills interventions for individuals with Autism Spectrum Disorder (ASD), few studies have targeted adolescents. This is problematic as peer relationships during adolescence demand interactions that display complex social behaviors (i.e. behaviors occurring at the same time as each other) for optimal impact and efficiency.
Objectives: This study examined the effectiveness of a social skills intervention for adolescents with ASD as evidenced by an increase of synchronized behaviors (i.e., eye contact, affect, and verbalization) at post-intervention of the social skills project compared to pre-intervention.
Methods: Twenty-one adolescents between the ages of 13- and 18-years-old ($M = 14.57$, SD = 1.40) completed a 5-minute unstructured conversation with a same-age peer confederate pre- and post-intervention. The adolescents (71% male, 90% Caucasian) were diagnosed with ASD, confirmed by parent reports on the Checklist for Autism Spectrum Disorders (CASD; $M = 23.29$, SD = 3.80). Additionally, verbal IQ was estimated using the Kaufman Brief Intelligence Scale, Second Edition (KBIT-2; $M = 97.38$, SD = 17.72). The target participants' behaviors were coded using Noldus Information Technology software. The 5-minute dyad conversations were coded for seconds of eye contact and positive affect. Verbal activity was also coded, including the number of questions, validating statements, commenting statements, topic changes, run-on statements, and social niceties. Finally, the number of four-part conversations were coded between the participant and same-age peer confederate.
Results: *T*-tests were conducted to compare the participants' use of synchronized behaviors at pre- and post-intervention. The duration of synchronized behaviors increased greatly at post-intervention, including the integration of affect, verbalizations, and eye contact during conversations ($t = -4.31$, $p < 0.001$). Additionally, participants increased the length of use of affect paired with eye contact ($t = -4.31$, $p < 0.001$), affect paired with verbalizations ($t = -5.33$, $p < 0.001$), and verbalizations paired with eye contact ($t = -5.77$, $p < 0.001$). Participants also engaged in significantly more four-part conversations ($t = -3.32$, $p < 0.001$) with same-aged peers.
Conclusions: Presently, there is little research regarding the efficacy of social skills interventions for adolescents with ASD. Results of the current study show an overall increase in adolescents' use of complex social behaviors, as well as an increase in reciprocal conversation with peers. These skills can be an indicator of quality conversations, though the skills often need to be explicitly taught to individuals with ASD to increase social functioning. The study shows preliminary evidence that an intervention targeted specifically to adolescents is successful in increasing these complex social behaviors.

188 **110.188** Individual Differences in Cooperation and Equality: Data from ASD

I. M. Eigsti*, University of Connecticut, Storrs, CT*

Background: Society must balance the demand of *community*, associated with interdependence and empathy, with those of *autonomy*, associated with free will, independence, and self-fulfillment. To meet these demands, both individuals and societies (Fukuyama, 1995) requirse cooperation and trust (Balliet & Van Lange, 2013) as well as the ability to predict others' behaviors (McAllister, 1995). Empathy and mentalizing play a critical role in the development of a shared system of values and principles of conduct (Smetana et al., 2012). This study evaluated individual differences in mentalizing (Baron-Cohen, Leslie, & Frith, 1985) and empathy (e.g., Sigman et al., 1992) by including individuals with autism spectrum disorder (ASD), who may show differences in both.
Objectives: We measured social values orientation (SVO), the degree to which an individual prioritizes community over autonomy, and its association with empathy and mentalizing, in 1) adults with a verified ASD diagnosis, recruited through the Interactive Autism Network (IAN); and 2) adults recruited via M-Turk. Mentalizing abilities were assumed to fall along a broad continuum. We evaluated the degree to which mentalizing (associated with ASD symptomatology) and empathy mapped onto SVO.
Methods: SVO research has often relied upon complex narratives (e.g., Barnes et al., 2009) and verbally-demanding questions such as *did the victim suffer* or *is the agent responsible* (e.g., Buon et al., 2013), which typically excludes individuals with lower verbal skills. The current study made use of an experimental SVO game, which has been shown to reveal three primary patterns: (1) a *prosocial* orientation, in which cooperation and interdependence is a goal; (2) an *individualist* orientation that maximizes one's own outcomes with no regard for others' outcomes; and (3) a *competitor* orientation that maximizes one's own outcomes relative to others, seeking a relative advantage (Van Lange, Otten, De Bruin, & Joireman, 1997). This game requires participants to imagine another person, with whom they are playing, and then to assign points to themselves and the other person on successive trials. We measured ASD symptomatology via the Autism Spectrum Quotient self-report questionnaire (Baron-Cohen et al., 2001) and empathy via the Empathy Quotient self-report questionnaire (Wheelwright et al., 2006). Our measures were programmed in Qualtrix and collected on-line.
Results: Participants included adults with (n=114) or without (n=45) ASD. Results showed that adults with ASD were significantly less likely to adopt a competitive SVO, p<.001. In the M-Turk group but not the ASD group, AQ score was correlated with prosocial SVO. SVO patterns were not associated with empathy.
Conclusions: ASD characteristics in the general population were associated with a preference that all participants in a game experience equal outcomes, compared to individuals low in ASD symptomatology. Individuals who met the full diagnostic criteria were less likely to maximize their outcomes and penalize their competitors. Social values of equity or fairness may depend more on an interest in rules and incentives (Balliet, Mulder, & Van Lange, 2011) than on mentalizing. Future research will evaluate the relationship of SVO to biological measures of perceived fairness (Aoki, Yomogida, & Matsumoto, 2015).

189 **110.189** Inference or Integration? Mechanisms of Mental State Understanding in High-Functioning Autism

J. Korman[1], *B. F. Malle*[1], *M. Leboyer*[2,3], *A. Gaman*[2,3] *and T. Zalla*[4], *(1)Cognitive, Linguistic, & Psychological Sciences, Brown University, Providence, RI, (2)Department of Psychiatry, INSERM U 955, IMRB & University Paris Est Créteil, AP-HP, Henri Mondor-Albert Chenevier Hospitals, Créteil, France, (3)Fondation FondaMental, French National Science Foundation, Créteil, France, (4)Institut Jean Nicod, CNRS, Ecole Normale Supérieure, PSL Research University, Paris, France*

Background:
By the time many high-functioning individuals on the autism spectrum (henceforth HFA individuals) reach adulthood, they have acquired partial competence in dealing with other people's mental states—a partial "Theory of Mind" (ToM). Nevertheless, HFA adults do not make full use of mental state information for moral judgment (Moran et al., 2011; Zalla and Leboyer, 2011; Zalla et al., 2011), and in faux pas tasks (e.g., Baron-Cohen et al., 1999; Zalla et al., 2009). In particular, they detect unintentional offenses (or "faux pas") but struggle to understand that such offenses stem from the offenders' false beliefs.
Objectives:
In this project we probe the specific mechanisms underlying continued ToM deficits in adulthood. We address two possible accounts of HFA adults' struggle to understand the offender's false belief in the faux-pas task. First, HFA adults may lack the ability to infer novel mental state information from behavior. Second, even if HFA adults might glean such mental state information, they may lack the ability to integrate the information into a coherent understanding of behavior. We seek to distinguish between these two accounts by manipulating the participants' task to either infer mental state information or integrate provided mental state information.
Methods:
15 HFA adults (diagnoses confirmed with the ADOS and ADI-R, Lord et al., 2000), and 34 typically developing, age, gender, and IQ-matched controls completed the study online. Each participant saw a total of 8 "faux pas" stories, in which a character committed an unintentional offense because he or she had a false belief. The stories represented a three-level within-subject factor. In the "no information" condition, the stories contained no explicit references to the character's mental states. In the "belief" condition, the false belief underlying the character's behavior was made explicit; in the "desire" condition, the character's desire was made explicit. For each story, participants (1) answered a question about whether the character possessed a false belief, and (2) provided open-ended explanations for the faux pas.
Results:
Control participants scored barely higher on the belief question ($M = 1.65$ correct, $SD = .49$) in the no-information condition than did HFA participants ($M = 1.47$ correct, $SD = .52$), $t(47) = 1.18$, ns. While both control and HFA participants benefited from receiving explicit belief information $F(1, 47) = 17.69$, $p < .001$, only HFA participants benefited from explicit desire information, $t(14) = 3.06$, $p < .01$. Overall HFA and control participants gave comparable numbers of mental states in their behavior explanations, $F(1, 26) = .09$, ns; but in the "no-information" condition, HFA participants provided even more mental state explanations than control participants, $F(1, 29) = 3.62$, $p = .06$.
Conclusions:
We showed some evidence for the integration hypothesis, as HFA adults improved on the belief question when being given either belief information or desire information. Interestingly, when explaining no-information stories, HFA individuals offered more mental states than controls (even though they had marginally poorer performance on the belief question), suggesting that merely mentioning mental state information does not constitute genuine faux-pas understanding.

190 **110.190** Information-Theoretic Approaches to Optimizing Early Detection of ASD in Toddlers Based on Preferential Attention to Audiovisual Synchrony

G. Ramsay[1], *A. Abraham*[2], *J. B. Northrup*[3], *D. Lin*[4], *A. Klin*[5] *and W. Jones*[5], *(1)Marcus Autism Center, Children's Healthcare of Atlanta & Emory University School of Medicine, Atlanta, GA, (2)Vanderbilt University, Nashville, TN, (3)University of Pittsburgh, Pittsburgh, PA, (4)Department of Neurology, Massachusetts General Hospital, Boston, MA, (5)Department of Pediatrics, Emory University School of Medicine, Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, GA*

Background: Children with ASD exhibit atypical patterns of visual attention to the social world, responding differently to physical and social contingencies relative to non-autistic peers. In previous studies examining preferential attention to audiovisual synchrony, we showed that ASD infants are relatively insensitive to social contingencies afforded by talking faces, focusing instead on physical contingencies between light and sound. By manipulating audiovisual stimuli comprising faces and shapes synchronized with speech and tones, we found that TD controls exhibited a preference for synchronous faces and speech, lacking in ASD participants, even though groups did not differ in baseline sensitivity to audiovisual synchrony. In those studies, significant differences were found based on simple measures of visual attention derived from mean relative fixation durations. Although these measures are traditional in eye-tracking research, inspection of our data clearly revealed complex statistical patterns that were predictive of autism, but were not captured by simple tests of differences in mean fixation on any one region of interest alone. Accordingly, we applied techniques from information theory to quantify differences between full probability distributions of eye-tracking trajectories across groups.
Objectives: Our goal was to test whether information-theoretic measures of differences in visual attention between TD and ASD toddlers outperform traditional statistics, to determine whether current approaches to detection of autism may be significantly under-exploiting the discriminative power of behavioral probes.
Methods: Toddlers with autism (N=34) and typically developing controls (N=20) participated in a simple preferential-looking paradigm based on split-screen presentation of video stimuli (faces and shapes) paired with audio stimuli (speech and tones). Using different combinations of video and audio stimuli, and manipulating audiovisual synchrony between the two, we tested for differences in attention to social and physical contingencies. Eye-tracking was used to quantify response. Using machine learning techniques, we derived optimal measures of overall attention and attention to social target across all stimulus combinations, focusing on responses to speech and non-speech. We used a permutation test to determine significant differences between the entire joint distribution of our measures across groups, based on the information divergence calculated from kernel density estimates. We contrasted these results with traditional measures calculated from relative percentage of total fixation time on the social target, testing for differences in means using ANOVA. Receiver operating characteristics were further used to quantify classification performance.
Results: We found highly significant differences in the full probability distributions ($P<0.00001$), which were not reflected in tests of differences in centroids alone ($P<0.01$). Sensitivity and specificity improved from 78.5%/83.3% for single mean fixation measures to 79.5%/97.4% using our information-theoretic approach.
Conclusions: Significant differences in visual scanning exist between ASD and TD children that cannot be fully quantified without characterizing the mutual information between entire probability distributions of responses. Current approaches to screening of children at risk of autism based on group means significantly underexploit information present in behavioral measures of the syndrome.

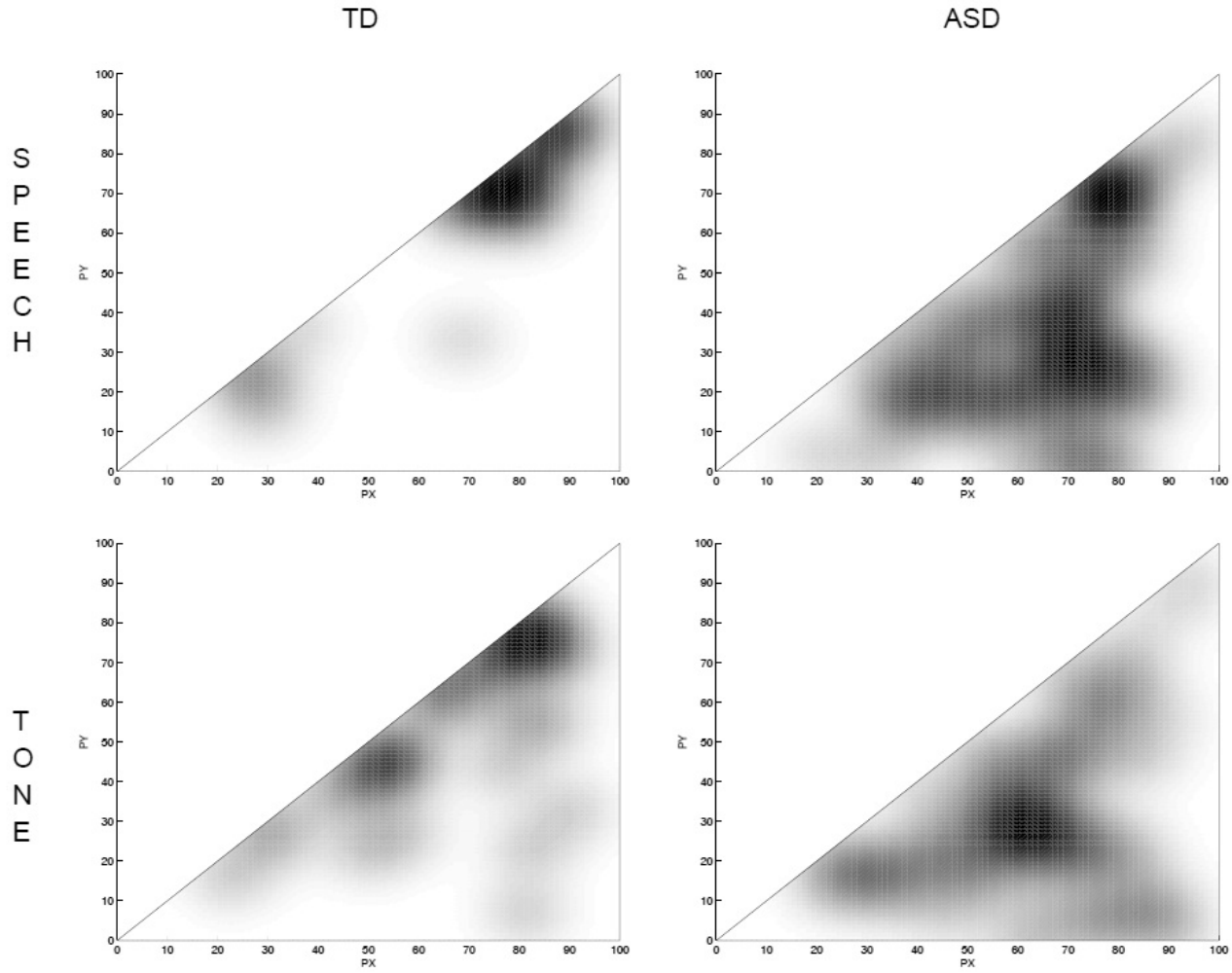


Figure 1. Joint probability density functions for two composite measures of visual attention using results from our preferential-looking paradigm. Results were combined across all video conditions with either speech or tone as the audio soundtrack, for TD and ASD participant groups. PY is a measure of visual fixation on the synchronous target, whereas PX is a measure of overall attention to the screen; both are derived via machine learning techniques from the eye-tracking trajectories. Group differences in the full 2D distributions are not captured by differences in 1D means alone.

191 **110.191** Interactions Between Children with Autism Spectrum Disorder and Their Younger Sibling

***C. Bontinck**, P. Warreyn, S. Van der Paelt, E. Demurie and H. Roeyers, Ghent University, Ghent, Belgium*

Background: Due to the complementary and reciprocal nature of sibling interactions, siblings play a unique socialization function in the early development. Research however suggests that interactions between young infants and their older sibling with autism spectrum disorder (ASD) differ from those in which no child with ASD is involved. Given that siblings of children with ASD have an increased risk of developing ASD or subclinical features of ASD (Broader Autism Phenotype), early sibling interactions may be especially important for them.
Objectives: The aim was to explore differences in early sibling interactions between high-risk infants and a low-risk control group. Additionally, social-communicative characteristics of both children were taken into account.
Methods: Sibling interactions between 18-month-old infants and their older sibling (21 high-risk dyads and 29 low-risk dyads) were observed and videotaped during a play observation at home. Frequencies and/or durations of interactive behaviour (initiation-response, interaction with each other/experimenter/parent) and non-interactive behaviour (orientation toward sibling, doing nothing, solitary play, repetitive/stereotyped behaviour, distress) were coded. Social-communicative skills were examined using the ADOS2 and the Social Responsiveness Scale.

Results: Preliminary analyses in a subsample show that children with ASD tended to use more negative initiations than older typically developing children (U=65; p=.071). Second, in the control group, older children took a more dominant role (more positive (Z=-3.30, p<.001) and negative (Z=-4.51, p<.001) initiations than their younger sibling) while younger children followed their lead (more positive (Z=-4.50, p<.001) and negative (Z=-2.38, p=.016) responses). In the high-risk group, only the negative initiations were significantly more prevalent in older siblings with ASD (Z=-2.12, p=.047).
In both groups, we found positive correlations between the number of initiations of the youngest/oldest child and the number of responses of the oldest/youngest child (range r: .53 to .83). These higher levels of initiations and responses were positively correlated with mutual shared attention (range r: .43 to .94). In the high-risk group, social difficulties of the child with ASD were positively correlated with the youngest child's positive initiations (r=.58). Furthermore, we found that interactive behaviour of the youngest child at 18 months (positive initiations, responses) was negatively associated with social difficulties (ADOS) at 24 months (range r: -.53 to -.63). More elaborate analyses on the whole sample will be presented at the conference.
Conclusions: The current study confirms that interactions between young infants and their older sibling with ASD differ significantly from interactions between young infants and their older typically developing sibling. While in typical development roles are more asymmetric and reciprocal (e.g., teacher and learner), younger siblings of children with ASD seem to compensate more for the social difficulties of their older brother/sister. In addition, younger siblings of children with ASD who were more interactive with their brother/sister at 18 months showed better social-communicative abilities at 24 months.

192 **110.192** Is Social Categorization the Missing Link Between Weak Central Coherence and Theory of Mind Abilities in Autism?

***D. Skorich**, T. Gash, K. Stalker, A. May, L. Talipski, M. Hall, A. Dolstra and B. Gunningham, Australian National University, Canberra, Australia*

Background: Autism Spectrum Disorder (ASD) is currently understood as a 'fractionated' disorder, composed of separate but co-occurring clusters of features. At present, no common causative mechanism has been identified to explain why these different clusters of features co-occur in the disorder. In the current research, we present evidence that the cognitive process of social categorization could explain the co-occurrence of at least two of these clusters: those related to Theory of Mind (ToM) dysfunction and to Weak Central Coherence (WCC).
Objectives: To determine whether social categorization might be the missing link between WCC and ToM dysfunction in ASD.
Methods: Participants from the general population were asked to complete a category confusion task, in which hierarchically-embedded categories and social information were made to co-vary at the local level, the global level, both levels simultaneously, or at neither level. Participants were then asked to infer the mental states of novel category members, and to complete the Autism-Spectrum Quotient (AQ).
Results: Results revealed a positive relationship between AQ and categorization at the local level, and a positive relationship between AQ and mental state inference at the local level, when there was competing covariation at both the local and global levels. The pattern of social categorization was also found to predict the pattern of mental state inferences, thus demonstrating a causal relationship between central coherence and ToM abilities.
Conclusions: These results provide preliminary evidence that WCC and ToM abilities in ASD might be related via a social categorization mechanism, and suggest the possibility of a more unified cognitive account of the disorder.

193 **110.193** Joint Attention Behaviors Across Contexts in Young Children with ASD

***K. M. Walton** and R. Kirchner, The Ohio State University, Columbus, OH*

Background: Young children with autism spectrum disorders (ASD) show early-emerging impairments in joint attention. During both naturalistic observations and structured assessments, they show fewer joint attention behaviors, such as pointing, showing, and following another person's gaze or pointing gesture. Joint attention is a particularly important skill, as it is thought to underlie the development of more sophisticated language and social skills later in development. Despite the importance of joint attention in development, quantifying joint attention in young children still remains challenging. Two of the most frequent strategies for measuring joint attention include the use of the Early Social Communication Scales (ESCS) and coding of specific joint attention behaviors from videotaped interaction in more naturalistic settings (e.g., free play or a parent-child interaction). Children with ASD appear to use fewer joint attention behaviors than typical children in both structured and unstructured play contexts. However, is unclear how children's joint attention behaviors compare across these contexts, or how patterns of visual attention to people and objects during these interactions relates to children's use of higher-level joint attention behaviors, such as pointing and showing.
Objectives: This study will compare children's joint-attention related gaze behaviors across two contexts—a parent-child interaction and the Early Social Communication Scales. In addition, we will examine how visual attention (i.e., gaze at people at objects) in each context relates to children's scores on measures of higher- and lower-level joint attention behaviors during the ESCS.
Methods: Young children with ASD (N=12) and typical development (N=17) participated in two videotaped assessments: the ESCS and a 10-minute parent-child interaction. Gaze behaviors (gaze at objects and gaze at people) were then coded from videotape to determine the frequency and duration of different gaze types, and the frequency of gaze switches between objects and people. In addition, higher-level (e.g., pointing, showing) and lower-level (e.g., gaze alternation) joint attention behaviors were scored from the ESCS.
Results: Preliminary analyses suggest that there are marked differences in gaze patterns between the ESCS and the parent-child interaction context, with both typically developing children and children with ASD engaging in many fewer object-person gaze shifts during the parent-child interaction compared to the ESCS. Additional analyses with the full sample will examine the relationships between gaze behaviors in each context and joint attention scores on the ESCS to examine to what extent these measures tap the same constructs.
Conclusions: These results highlight the importance of considering context when assessing joint attention in young children, as observations in different types of play contexts are likely to yield different numbers of joint attention behaviors. Future research should focus on understanding what types of assessment contexst yield the most useful information in relationship to diagnostic status and relationships with other key developmental skills (e.g., language, social engagement patterns).

194 **110.194** Learning about Objects from Referential Gaze Versus Arrows in Children with and without ASD

***J. Bang** and A. Nadig, McGill University, Montreal, QC, Canada*

Background: Children with autism spectrum disorders (ASD) often struggle with understanding another's subtle communication cues, such as referential gaze (looking at an object). This is important in different contexts: when a person labels a new object and looks at it (*word learning*, **WL**), or when a person looks at an object they will act on next (*action understanding*, **AU**). Successful learning from gaze is often attributed to understanding another's communicative intentions, and poorer learning in ASD has been attributed to a lack of understanding intent. Yet gaze may simply direct attention -- successful learning may not require understanding intent. Prior work has not explored how children with ASD learn from referential gaze across contexts, or versus an attentional control.
Objectives: We investigate how 6- to 10-year-old children with ASD and typically-developing (TD) children learn in both **WL** and **AU** contexts. Specifically, we examine how children attend to and learn from referential gaze versus a moving arrow (attentional control).
Methods: Participants were children with ASD (n = 18) or TD (n = 18) matched on age, gender, and nonverbal IQ. Children watched videos that taught the name of a new word (**WL**) and how to build a tower (**AU**). In both contexts a cue (referential gaze vs. an arrow) directed attention to one of two objects. An eye-tracker recorded children's on-line attention during baseline, teaching, and test phases. Children were also asked to point to the learned object during test.
Results: 2 (group) x 2 (cue condition) x 2 (context) mixed ANVOAs were conducted (alpha = .05). During teaching, there was no main effect or interaction with group. All children looked significantly longer at gaze (M = .212, SD = .178) versus the arrow (M = .127, SD = .122). Children also looked significantly longer at the cues in **AU** (M = .200, SD = .181) versus **WL** (M = .142, SD= .128). No main effects or interactions were found for looking at the target during teaching.
During test, results differed by context and group. In **WL** many children successfully pointed to the target regardless of cue (10 ASD, 14 TD); for successful pointers, there were no main effects or interactions for latency of first look to or proportion of time looking at the target. Remaining children included: inconsistent pointers with either cue (5 ASD, 3 TD), selective pointers with arrow (1 ASD, 1 TD), and unsuccessful pointers (2 ASD). In contrast, few children successfully pointed in **AU** (1 ASD, 5 TD), and many were consistently unsuccessful (12 ASD, 5 TD). Remaining children included: inconsistent pointers (1 ASD, 3 TD), selective pointers with gaze (2 ASD, 4 TD), and selective pointers with arrow (2 ASD, 1 TD).
Conclusions: When learning about an object, children with and without ASD treat referential gaze differently from an arrow, both in *word learning* and *action understanding*. Despite similar attention to the targets during teaching, TD and ASD groups differed at test. Future analyses will address relationships between teaching and test and the quality of learning over time.

Figure 1. Example action understanding (top) and word learning context (bottom) video phases, with arrow (top) and referential gaze cues (bottom) illustrated

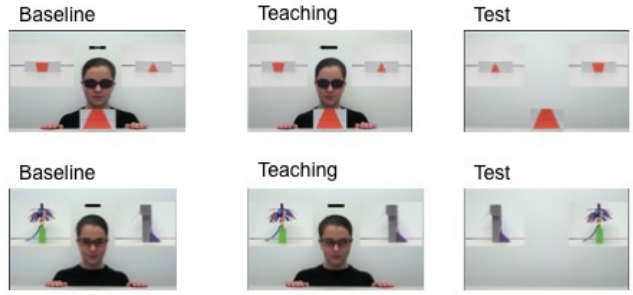
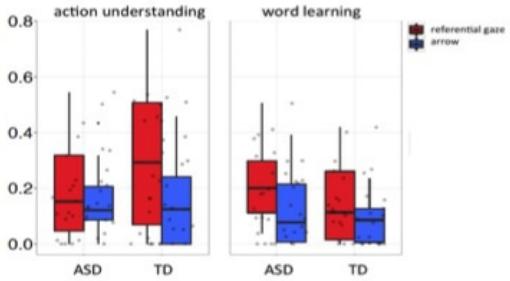


Figure 2. Proportion of time looking at the gaze vs. arrow region in action understanding (left) and word learning (right) contexts



195 **110.195** Let Us Face It! a Meta-Analysis of Atypical Viewing Patterns in Individuals with ASD

K. Evers[1,2,3,4], *J. Prinsen*[4,5], *R. Van der Hallen*[1,4] *and J. Wagemans*[1,4], *(1)Laboratory of Experimental Psychology, KU Leuven, Leuven, Belgium, (2)Parenting and Special Education Research Unit, KU Leuven, Leuven, Belgium, (3)Department of Child Psychiatry, UPC-KU Leuven, Leuven, Belgium, (4)Leuven Autism Research (LAuRes), KU Leuven, Leuven, Belgium, (5)Research Group for Neuromotor Rehabilitation, KU Leuven, Leuven, Belgium*

Background: Reduced eye-contact is one of the core symptoms of ASD, sometimes already present early in infancy. Some studies have indeed found that individuals with ASD made fewer fixations at faces, more specifically at eyes, and that they fixated mouths or the background more often than a control sample. Other studies, however, obtained no evidence for atypical viewing patterns in individuals with ASD. Differences are sometimes very subtle and the exact pattern of results appears strongly dependent on task and stimulus factors.
Objectives: Instead of yet another empirical study evaluating the fixation patterns of individuals with ASD, the field is in need of a systematical and quantitative overview of all the evidence. We therefore wanted to examine and combine all available empirical data on this topic, by means of a meta-analysis, in which the effect size across different studies was calculated, evaluating the overall evidence for differences in social attention between individuals with and without ASD.
Methods: Our literature search yielded over 2,500 articles, of which all abstracts were further reviewed, applying a set of strict inclusion and exclusion criteria. The remaining set of 57 articles was included in our quantitative meta-analysis. Several moderator variables, such as participants' age, gender, stimulus and task characteristics, and region of interest, were incorporated as moderator variables in our analysis. Hedges' *g*effect sizes were examined.
Results: Overall, results provided evidence for a reduced saliency of faces in individuals with ASD (Hedges' *g* effect size = -0.52, $p < .0001$), which was stronger for upper ($g = -0.79$, $p < .0001$) compared to lower ($g = -0.32$, $p = .0341$) face regions. These viewing pattern differences were partially overcome by using task instructions, compared with free-viewing tasks ($F(1,208) = 5.96$, $p = .0154$). Group differences appeared strongest in age groups between 12 and 25 years old, and for individuals with average IQ scores between 85 and 115.
Conclusions: This meta-analysis provided evidence for atypical viewing patterns in individuals with ASD, characterized by a reduced saliency of faces and – more specifically – all internal facial features, with moderate to strong effect sizes. The impact of several moderator variables will be discussed.

196 **110.196** Linkage Between Autism-Spectrum Quotient (AQ) of Parents and Autism Severity of Their Children with Autism: An Italian Experience in the Field of the Broader Autism Phenotype

A. Narzisi[1], *M. Pinzino*[2], *S. Calderoni*[3], *G. Scarselli*[4], *J. Barsotti*[4], *R. Tancredi*[5] *and F. Muratori*[6], *(1)IRCCS Stella Maris Institute, Pisa, PI, Italy, (2)University of Pisa, Calambrone, Italy, (3)Magnetic Resonance Laboratory, Division of Child Neurology and Psychiatry University of Pisa; Stella Maris Scientific Institute, Pisa, Italy, (4)IRCCS Stella Maris, Calambrone, Italy, (5)University of Pisa – Stella Maris Scientific Institute, Pisa, Italy, (6)IRCCS Stella Maris Institute, Pisa, Italy*

Background: Features of the Broad Autism Phenotype (BAP) are disproportionately prevalent in parents of a child with autism, highlighting familial patterns indicative of heritability.
Objectives: The main aim of this research was to identify phenotypes in mothers and fathers that are specifically associated with disturbances in social affect and repetitive behaviours in their young children (age range 4-11 yrs) with autism spectrum disorder (ASD) in an Italian sample.
Methods: Autistic traits in parents were evaluated using the italian version of the Autism-spectrum Quotient (AQ), in 42 parents (21 mothers and corresponding fathers) of children with ASD and in a sample of parents (mothers and fathers) of typically developing (TD) children. For the measurement of autistim severity in children we employed the ADOS-2, for autism quotient we used AQ-Child. For the measurement of IQ, in children, we employed the Wechsler scales. With typically developing (TD) children we used also AQ-Child.
Results: In the five AQ subscales the parents (mother and father) of ASD children scored significantly higher than did the parents of TD children. In addition, in mothers of ASD children, there were significant positive correlations between the five AQ subscales and AQ-Child subscales and ADOS-2-calibrated severity score in their children. In ASD children IQ was not correlated with AQ-Child and with AQ of parents.
Conclusions: This study demonstrate that some autistic traits in parents (above all mothers) are specifically associated with disturbances in the social impairments of their young children with ASD, as measured by the AQ-Child and ados-2 calibrated severity score. Further study are necessary to confirm these preliminary results .

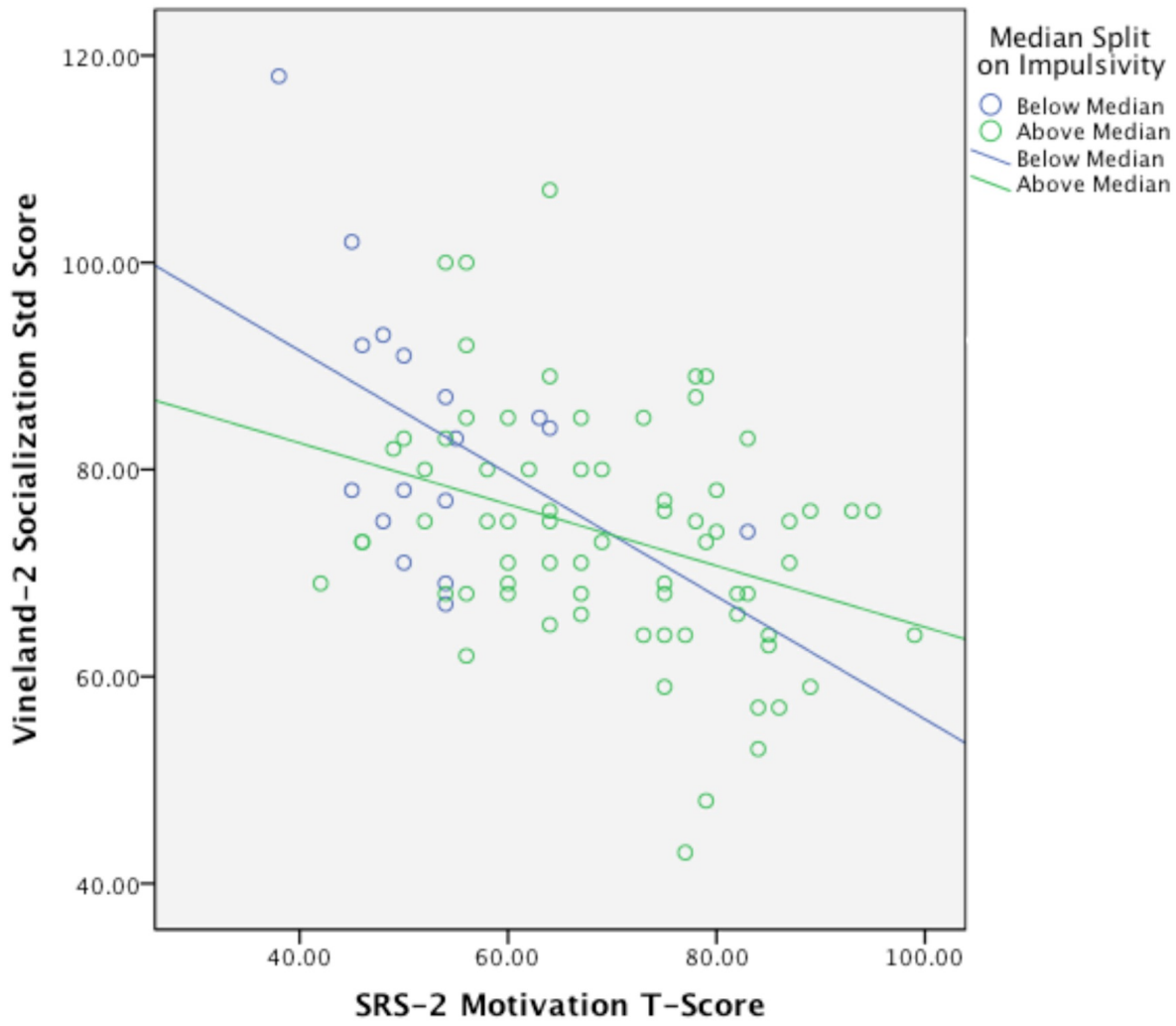
197 **110.197** Linking Social Motivation to Social Skill: Contributions of Anxiety & Impulsivity

E. E. Neuhaus[1], *A. Kresse*[2], *E. J. Libsack*[2], *S. J. J. Webb*[3], *R. Bernier*[3] *and K. Pelphrey*[4], *(1)PO Box 5371, Seattle Children's Hospital, Seattle, WA, (2)Seattle Children's Research Institute, Seattle, WA, (3)University of Washington, Seattle, WA, (4)Yale Child Study Center, Yale School of Medicine, New Haven, CT*

Background: Several recent models propose that social motivation deficits underlie social dysfunction in ASD. Such models assume that social motivation is fundamental to social skill. Although likely, this assumption is not well established empirically. Moreover, additional traits likely contribute to social functioning among children. Both anxiety and impulsivity are plausible candidate traits that may blunt the facilitative effects of social motivation – high levels of anxiety and impulsivity may inhibit appropriate social behavior and exacerbate inappropriate social behavior, respectively. Indeed, impaired social skills are commonly observed among children with heightened anxiety, as well as those with heightened impulsivity.
Objectives: We aim to explore the contributions of social motivation, anxiety, and impulsivity to determine whether individual differences in these traits promote or inhibit social success among children with and without ASD.
Methods: Data were obtained from two related studies spanning four research sites across the US, for a total sample of 160 children and adolescents (66 female; mean age=11.9 yrs, SD=2.7, range=8 to 18) with ASD (n=87) or typical development (TD; n=73). All children were verbally fluent, at or above average IQ levels, and all ASD children met clinical cut-offs on ADOS-2, ADI-R, and DSM-5 criteria. Social motivation was assessed via parent report on the SRS Social Motivation subscale. Social skill was measured via the Vineland Socialization domain. CBCL subscale T-scores were used as measures of parent-reported impulsivity and anxiety.
Results: For the full sample, social motivation accounted for 49.7% of the variance in social skill ($F(1, 159)=158.36$, $p<.000$). Stronger motivation was associated with better

skills. The addition of impulsivity and the Motivation x Interaction accounted for an additional 10% of variance in skill ($F(3, 159)=79.58$, $p<.001$). The inclusion of anxiety did not account for additional variance, however ($p=.853$). Next, relationships were examined within the ASD and TD groups separately. For TD children, social motivation was associated with social skill and accounted for 15.3% of the variance ($F(1, 72)=13.99$, $p<.001$), with no evidence of influence by either anxiety or impulsivity ($ps>.16$). In contrast, for the ASD group, a model containing social motivation, impulsivity, and their interaction accounted for 24.8% of the variance in social skill ($F(3, 86)=10.45$, $p<.001$), with significant contributions from motivation and impulsivity ($ps<.03$). Better skills were associated with stronger motivation and lower impulsivity. The interaction between these traits was marginal ($F(3, 86)=10.45$, $p=.069$); the association between social motivation and skill was weaker for children with higher levels of impulsivity (Figure 1).
Conclusions: Our results suggest that social motivation facilitates social skills, but also indicate a role for behavioral impulsivity. This relationship was most apparent for children with ASD, highlighting an additional target for interventions aiming to improve social functioning. Notably, anxiety did not appear to contribute to social skills for children with ASD. Neither anxiety nor impulsivity contributed to social skill for typically developing children, suggesting that additional factors not included in our analyses may be important for understanding social functioning more broadly. Findings underscore the complexity of behavioral factors promoting social success and engagement during childhood.

Figure 1: Interaction of social motivation and impulsivity in predicting social skills among children with ASD



198 **110.198** Loneliness and Friendship Quality in School-Aged Children with ASD

A. Dominguez[1], *M. Mladenovic*[2], *W. I. Shih*[3], *R. Landa*[4], *C. Lord*[5], *B. King*[6] *and C. Kasari*[7], *(1)UCLA Center for Autism Research and Treatment, Los Angeles, CA, (2)UCLA, Los Angeles, CA, (3)UCLA, Monrovia, CA, (4)The Kennedy Krieger Institute, Baltimore, MD, (5)Weill Cornell Medical College, White Plains, NY, (6)University of Washington and Seattle Children's Hospital, Seattle, WA, (7)University of California Los Angeles, Los Angeles, CA*

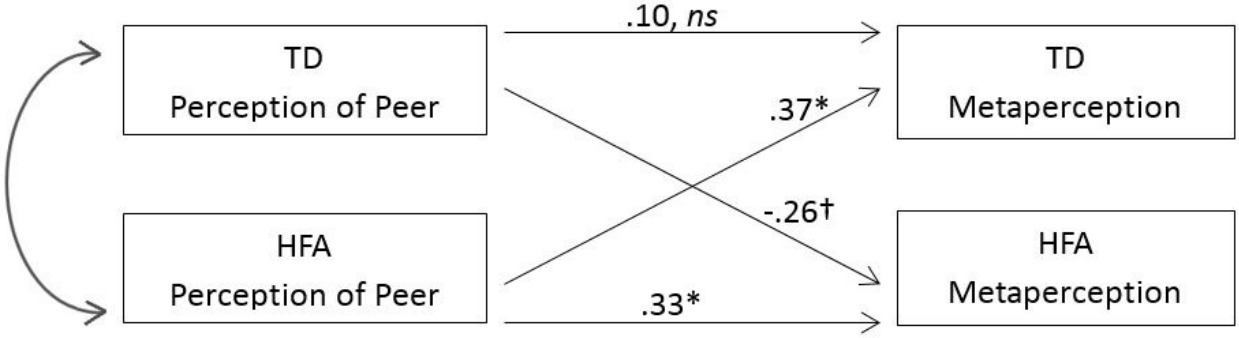
Background: Deficits in social skills and poor peer relationships are characteristic of individuals with autism spectrum disorder (ASD) (Chamberlain, Kasari, & Rotheram-Fuller, 2006). Adolescents with ASD often report more loneliness at school than their typically developing classmates (Bauminger, Shulman, & Agam, 2003). Loneliness tends to be higher in older children than younger children (Burner, Orlich, Dean et al., submitted). Previous studies have suggested that greater child-reported feelings of loneliness may be tied to poorer quality friendships or peer relationships at school (Bauminger & Kasari, 1999). Further, children who are isolated or peripheral in their social network relative to classmates may exhibit more loneliness. However, few studies have investigated the connection between loneliness in elementary-aged children with ASD and friendship quality or social connectivity to peers.
Objectives: This study aimed to 1) explore how quality of friendships and social connection with classmates are related to loneliness in children with ASD, and 2) compare self-reported ratings of loneliness in school-aged children with ASD to those of their typically developing peers.
Methods: Participants were 135 children with ASD (mean age = 8.13) and 239 typically developing classmates enrolled in mainstream classrooms. The data were collected at four sites across the U.S. as part of a larger study conducted by the Autism Intervention Research Network on Behavioral Health (AIR-B). Children with ASD completed three questionnaires: a) Loneliness Questionnaire (Asher, Hymel, & Renshaw, 1984) measured feelings of loneliness, b) Friendship Survey (Cairns & Cairns, 1994) analyzed social connectivity within the classroom using child nomination of classmates as friends, and c) Friendship Qualities Scale (FQS; Bukowski, Hoza, & Boivin, 1994) assessed aspects of companionship, conflict, help, security, and closeness within each child's relationship to his or her best friend. Typically developing peers from the same classrooms as the children with ASD also completed the Loneliness Questionnaire.
Results: Comparing children with higher ($n = 43$) versus lower scores ($n = 45$) on the Loneliness Questionnaire, children with ASD who reported less loneliness also reported more companionship ($p \leq .05$) and more closeness ($p \leq .05$) in friendship quality with their best friend. However, loneliness scores were not related to social network connectivity within the classroom. No differences were found between loneliness scores of children with ASD and their typically developing peers.
Conclusions: While previous research indicates that adolescents with ASD report greater feelings of loneliness than their typically developing peers, our results suggest that this distinction may not be as salient among younger children with ASD. Nevertheless, the child's relationship quality with his or her best friend was found to be an early indicator of emerging feelings of loneliness. This finding stresses the importance of targeting peer relationships at a young age in social interventions that aim to increase feelings of companionship and closeness in relationships between children with ASD and their peers. Given the association between higher quality friendships and lower levels of loneliness, these interventions should begin at early ages in hopes of decreasing loneliness of children with ASD before they reach adolescence.

199 **110.199** Metaperception in Adolescents with High Functioning Autism: Accuracy and Associations with Perceptions of Others

L. V. Usher[1], *C. A. Burrows*[1] *and H. A. Henderson*[2], *(1)University of Miami, Coral Gables, FL, (2)University of Waterloo, Waterloo, ON, Canada*

Background: During everyday social interactions with peers, individuals formulate both perceptions of their peers and impressions of what peers think about them, or metaperceptions (Laing, Phillipson, & Lee, 1966). The ability to accurately perceive others' impressions is crucial for interpersonal success (Carlson & Kenny, 2012). The association between perception and metaperception has not been examined in adolescents or in those with high functioning autism (HFA), but may offer insight into mechanisms underlying deficits in social reciprocity observed in adolescents with HFA.
Objectives: We aimed to quantify both adolescents' perceptions of an unfamiliar peer and their metaperceptions using a novel self-report measure. We also examined the associations between dyadic perception and metaperception.
Methods: This study included 24 dyads composed of gender-, age-, and verbal IQ-matched adolescents with HFA paired with unfamiliar typically developing adolescents (M_{age}=14.40, *SD*=1.41). Immediately following a five-minute unstructured social interaction, each participant completed the Perceptions and Metaperceptions Questionnaire (PAMQ) indexing *perception* of the peer (e.g., "How cool is ___?") and *metaperception*, or predictions of peer's impressions (e.g., "How cool does ___ think you are?").
Results: Multilevel modeling was used to estimate the effect of an adolescent's own perceptions of the peer on his or her own metaperception, and the effect of the peer's perception on the adolescent's metaperception (see Figure 1). For adolescents with HFA, their perception of the peer was positively associated with their metaperception, β=.33, *t*(28)=2.27, *p*=.03, indicating that the higher they rated their peers, the higher they believed their peers would rate them. However, for TD adolescents, their perception of the peer was independent of their metaperception, β=.10, *t*(28)=.71, *p*=.49.
Agreement between an individual's metaperception and the peer's perception of them differed by diagnostic group, β=.31, *t*(35)=2.25, *p*=.03. Specifically, for typically developing adolescents, metaperception was positively associated with partner's perception, β=.37, *t*(24)=2.27, *p*=.03, indicating accuracy of metaperception. The higher the partner rated the typically developing adolescent, the higher the adolescent predicted the partner rated him/her. In contrast, for adolescents with HFA, metaperception was marginally and negatively associated with the partner's perception , β=.-.26, *t*(34)=-1.93, *p*=.06. The higher the partner rated the adolescent with HFA, the lower the adolescent predicted the partner would rate him/her, indicating poor accuracy of metaperception.
Conclusions: Results indicate that while TD adolescents display relatively accurate metaperceptions, adolescents with HFA experience difficulty distinguishing between perspectives of the self and other. HFA participants' lack of ability to accurately interpret social partners' impressions may be a factor that impedes social functioning in adolescents with HFA, and presents interesting implications for targeted social skill treatment. These novel findings will be discussed in terms of ecological validity.

Figure 1. Actor-partner interdependence model (APIM) for examining dyadic perception and metaperception in unfamiliar dyad members.



Note. * $p < .05$, † $p < .07$. HFA = high functioning autism, TD = typically developing

200 **110.200** Morality in Autism: As Understood through the Empathizing-Systemizing (E-S) Theory

D. M. Greenberg[1,2], *R. Holt*[3], *C. Allison*[3], *P. J. Rentfrow*[4], *D. J. Stillwell*[4], *M. Kosinski*[5], *J. Haidt*[6] *and S. Baron-Cohen*[3], *(1)Departments of Psychology and Psychiatry, University of Cambridge, Cambridge, United Kingdom, (2)Department of Clinical Psychology, City University of New York, New York, NY, (3)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (4)University of Cambridge, Cambridge, United Kingdom, (5)Stanford University, Stanford, CA, (6)New York University, New York, NY*

Background: What is the nature of morality in autism? Children and adults with autism are able to distinguish and judge moral transgressions, but little is known about their moral profile. The present research addresses this gap using Moral Foundations Theory (MFT), which postulates that all of our moral judgments can be explained by five universal 'moral foundations': Care, Fairness, Loyalty, Authority, and Sanctity.
Objectives: The aim of this research is to use several large datasets to (a) investigate the moral profile in autism; (b) understand how individual differences in moral foundations are underpinned by empathizing-systemizing 'brain types'; and (c) examine which components of empathy (cognitive vs affective) drive moral foundations the most.
Methods: In Study 1, 193 adults with autism completed the Moral Foundations Questionnaire (MFQ) via the Autism Research Centre's database. In Study 2, 7,595 adults without autism completed the MFQ and short versions of the Empathizing Quotient (SQ) and Systemizing Quotient (SQ) at YourMorals.org. In Study 3, 1,676 adults without autism completed the full 60-item version of the EQ via the MyPersonality Facebook Application, which allowed for examination of the different components of empathy to be made.
Results: In Study 1, adults with autism rated Fairness significantly greater than Care and the other moral foundations. In Study 2, on average, people with empathizing 'brain types' (Extreme Type E and Type E) had a moral profile that placed the highest value on Care, and people with systemizing 'brain types' (Type S and Extreme Type S) had a moral profile that placed the highest value on Fairness/reciprocity. In Study 3, affective empathy was a stronger predictor than cognitive empathy for Care, Fairness, and Sanctity morals. Strikingly affective empathy was a stronger predictor than demographic factors, political ideology and the Big 5 personality traits, where previous associations with moral foundations have been reported.
Conclusions: The findings show that individuals with autism rate Fairness over Care and that this profile may be due to their heightened systemizing tendencies. This moral profile resembles findings from previous research which has shown that libertarians also rate Fairness over Care. Future research needs to explore the extent to which the moral profile of autism resembles a hybrid of that shown previously by liberals and libertarians. Importantly, this work also provides evidence that individual differences in moral foundations are rooted in part by empathizing-systemizing 'brain types' in the general population.

201 **110.201** National Service and University Studies in Young Adults with ASD in Israel

C. Shulman[1], *S. Hanan*[2] *and J. Koller*[3], *(1)The School of Social Work, Hebrew University of Jerusalem, Jerusalem, Israel, (2)The Hebrew University of Jerusalem, Jerusalem, Israel, (3)School of Education, Hebrew University of Jerusalem, Jerusalem, Israel*

Background:
After high school most 18-year olds in Israel choose some form of national service. Individuals choose to volunteer in the civil sector or, if they meet criteria, to do military service. Until three years ago, individuals with ASD were automatically exempt from military service and could only volunteer to do civil service. High-functioning individuals with ASD are now inducted in the Israeli army, although many still choose other forms of national service or not to serve at all. After their service, many high functioning individuals with ASD begin university. The interface between national service and academic studies has not been examined in young adults with ASD, although the social demands in both may be challenging for individuals with ASD.
Objectives:
The present study examines choices made by young adults with ASD regarding national service and university study and their relationship to utilization of social support, reports of loneliness and social affiliation.
Methods:
Twenty-seven young adults with ASD (5 females), ranging from 22-27 years of age, presently enrolled in a university in the center of the country which has a support system

for students with ASD, participated in this research. Each participant completed an online, anonymous questionnaire which surveyed demographics, utilization of social support and feelings of loneliness and social competence.
Results:
Significant differences in social competence between participants who chose some form of national service (n=16) and those who did not (n=11). Those who did not serve reported more loneliness ($t(1, 25) = 1.37$, $p < 0.05$) and less social affiliation ($t(1,26) = 5.23$, $p = < 0.01$). These differences in social affiliation and loneliness were also reflected in reports of their social experience in university, with the group who did national service reporting significantly more ($t(1,26) = 0.45$, $p < 0.02$) social satisfaction. When reporting about their social support systems in university, all but five reported that they made use of the support provided by the university for students with ASD, which included mentors, activities and academic help. The five who did not take advantage of the supports within the university reported that they felt unaffiliated and that they found social support was outside the university.
Conclusions:
Findings suggest that young adults with ASD can successfully serve in some form of national service, which is correlated with higher social affiliation scores and lower loneliness scores. Those who served report that at university, they use social supports and feel more socially involved than young adults who did not experience any form of national service. Understanding choices that young adults with ASD make and their implications for social competence may help professionals support young adults with ASD as they begin to navigate adulthood.

202 **110.202** Not Knowing What I Feel: Emotional Empathy in ASD

E. Trimmer[1], *S. McDonald*[2] *and J. A. Rushby*[3], *(1)University of New South Wales, Sydney, NSW, Australia, (2)Psychology, University of New South Wales, Sydney, Australia, (3)University of New South Wales, UNSW, Sydney, NSW, Australia*

Background: Empathy can be defined as "natural tendency to share and understand the emotions and feelings of others in relation to oneself" (Jean Decety & Meyer, 2008, p. 1053). Empathy involves both a cognitive (understanding other's intentions and meaning) and an emotional (feeling what another person is feeling) component. Individuals with Autism Spectrum Disorder (ASD) have been shown to have difficulties with cognitive empathy and perspective taking. Less is known about emotional empathy in these individual and the present literature is inconsistent.
Objectives: This study examines the emotional empathy of individuals with ASD whilst watching emotionally-driven stimuli.
Methods: Twenty-four individuals aged 16 or older (22 males; mean age 28 years) with a diagnosis of ASD and 25 matched controls (21 males, mean age 27) watched a series of five emotionally distressing film clips and five non-emotional clips. Participants then rated their mood and level of arousal on a 9-point Likert scale. Skin conductance was recorded as a measure of arousal along with corrugator EMG as a measure of emotion expression.
Results: No significant differences were found between groups for either of the psychophysiological measures indicating comparable physiological responding. Participants with ASD rated less negative mood to the emotional clips than control participants indicating a flattening of self-report affect, whereas self-reported arousal was similar between groups.
Conclusions: Whilst individuals with ASD appear to experience similar levels of physiological responding to emotionally-driven stimuli, they appear to interpret this response as having less emotional salience than controls. This has significant implications for understanding empathy impairments in the ASD population.

203 **110.203** Patterns of Visual Engagement Differ As a Function of Cognitive Profile in School-Aged Children with ASD

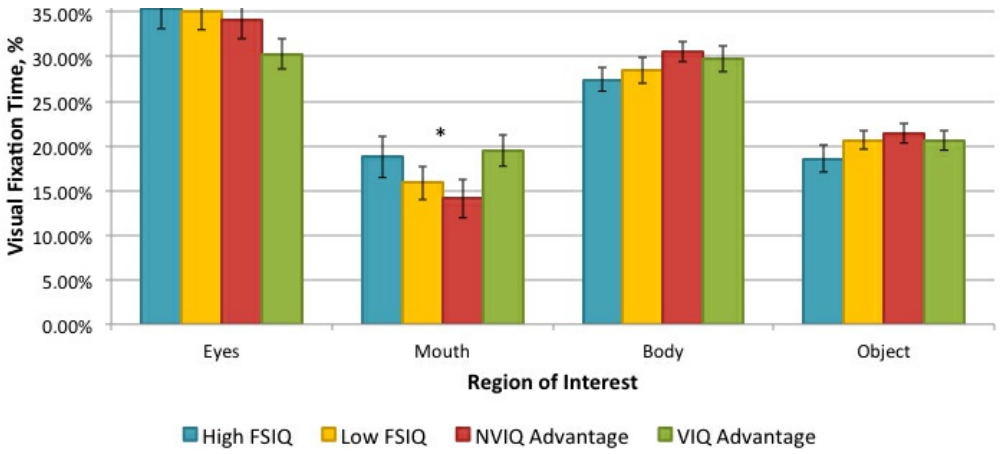
J. R. Yurkovic, *I. Stallworthy, E. Coben, W. Jones, A. Klin and S. Shultz, Department of Pediatrics, Emory University School of Medicine, Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, GA*

Background: Heterogeneity in autism spectrum disorder (ASD) is an obstacle to advancements in identifying and treating causes of the disorder. Measures capturing the core underlying features of ASD, such as reduced interest in socially adaptive stimuli, may provide a means for parsing phenotypic heterogeneity in ASD. For example, previous research has revealed that the social adaptive value of *where* children looked when viewing social scenes differed significantly based on IQ profile (Rice et al., 2012). To further investigate how different patterns of visual engagement are related to cognitive functioning, the present study uses a novel approach for quantifying not only *where* a child is looking but also their *level of engagement* with scene content.
Objectives: Examine whether visual *engagement* with scene content differs between subgroups of ASD characterized by different cognitive profiles.
Methods: School-age children with ASD (n=174) watched age-appropriate, socially relevant videos while eye-tracking data were collected. The ASD sample was divided into four subgroups as in Rice et al. (2012): Participants with a verbal IQ (VIQ) advantage (VIQ-NVIQ>12), a non-verbal IQ (NVIQ) advantage (NVIQ-VIQ>12), an even IQ profile and higher full-scale IQ (FSIQ), and an even IQ profile and lower FSIQ (see Table 1). Viewer engagement was quantified by measuring patterns of eye-blink inhibition, a method that capitalizes on the finding that people unconsciously adjust the timing of eye-blinks to minimize the likelihood of missing critical information (Shultz et al. 2011). Probabilistically, people are *least likely* to blink when *highly engaged* with what they are viewing and *most likely* to blink when *less engaged*. Permutation testing identified periods of statistically significant blink inhibition (indicating moments when children were highly engaged) and statistically significant increased blinking (moments when children were less engaged) for each subgroup separately. Percentage of visual fixation time on eyes, mouth, body, and object regions were calculated for each child.
Results: Comparisons of visual fixation over the entire viewing session revealed that VIQ and high FSIQ subgroups looked more at mouths compared with the NVIQ subgroup ($p<.01$) (Figure 1A). No other differences were found. In contrast to the relatively similar patterns of visual fixation between subgroups, patterns of eye-blinking revealed striking differences in *when* subgroups were highly engaged with scene content. Only 1.24% of highly engaging movie frames were perceived as engaging to all 4 subgroups. By contrast, 75.76% of highly engaging movie frames were perceived as engaging by only one subgroup (Figure 1B). These data suggest that subgroups likely engage with and experience these movies in very different ways. Ongoing analyses are aimed at further investigating the type of content that is perceived as engaging to each ASD subgroup.
Conclusions: This study identified patterns of visual engagement in one of the largest eye-tracking samples of school-age children with ASD. Our findings demonstrate that patterns of engagement with social content are influenced by the cognitive profile of children with ASD. These measures provide a promising means for parsing heterogeneity in ASD and represent an important step towards developing interventions tailored to an individual's specific learning style.

Table 1: Comparison of Characterization Measures across Four Distinct Cognitive Profile Subgroups of Children with ASD.

	High Even FSIQ Subgroup (n = 38)	Low Even FSIQ Subgroup (n = 49)	NVIQ Advantage Subgroup (n = 48)	VIQ Advantage Subgroup (n = 39)	Full Sample (n = 174)	P Value
Gender male/female	30 / 8	40 / 9	40 / 8	28 / 11	138 / 36	0.58
Age	10.04 (2.92)	10.76 (3.41)	10.47 (3.07)	10.92 (3.03)	10.56 (3.12)	0.62
ADOS Calibrated Severity Scores	6.71 (2.49)	7.41 (2.17)	7.90 (1.96)	6.80 (2.25)	7.23 (2.24)	0.13
ADOS Restricted and Repetitive Behavior Score	2.28 (1.28)	2.97 (1.73)	3.72 (2.19)	2.90 (1.95)	2.98 (1.87)	0.03
ADOS Social Affect Score	9.31 (4.16)	10.66 (4.46)	11.97 (4.41)	8.73 (3.82)	10.23 (4.37)	0.02

Note: Data are mean (SD). Higher Autism Diagnostic Schedule (ADOS) severity scores denote higher levels of social disability. FSIQ = full scale IQ; NVIQ = nonverbal IQ; VIQ = verbal IQ.



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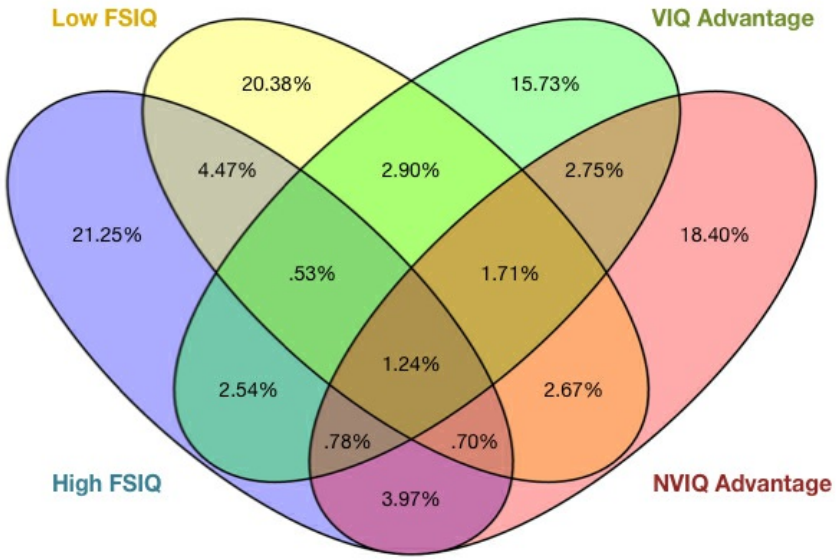


Figure 1: Patterns of Visual Fixation and Visual Engagement across Four Subgroups of Children with ASD. **(a)** Percent fixation time on regions of interest in subgroups of children with ASD. *p<0.05. The VIQ advantage and high FSIQ subgroups looked more at mouths than the NVIQ advantage subgroup. **(b)** Venn diagram showing percent overlap in frames perceived as engaging by children with ASD. Only 1.24% of highly engaging movie frames were perceived as engaging by all 4 subgroups. 3.71% of highly engaging frames were engaging to three subgroups, and 19.30% were engaging to two subgroups. 75.76% of highly engaging frames were perceived as engaging by only one subgroup. Values presented in all elements of the Venn diagram sum to 100%. In contrast to the relatively similar patterns of visual fixation (a), patterns of eye-blinking (b) reveal differences in *when* subgroups were highly engaged with scene content.

204 **110.204** Patterns of Visual Fixation during Moments of High Engagement in School-Age Children with and without Autism Spectrum Disorder

I. Stallworthy, *E. Coben, J. R. Yurkovic, W. Jones, A. Klin and S. Shultz, Department of Pediatrics, Emory University School of Medicine, Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, GA*

Background: Atypical perceptions of the social world are a hallmark feature of Autism Spectrum Disorder (ASD). When viewing social scenes, individuals with ASD spend less time looking at the eyes of others and more time looking at less socially relevant features, such as objects (Rice et al., 2012). This atypical pattern of visual attention suggests that individuals with ASD experience the world in profoundly different ways compared to their typically developing (TD) peers. For greater insight into the subjective experience of individuals with ASD, this study examines not only *where* children with ASD look when viewing social scenes, but also how *engaged* they are with what they are looking at. Viewer engagement is quantified by measuring patterns of eye-blink inhibition, a novel method that capitalizes on the fact that blinking temporarily interrupts incoming visual information. Because blinking interrupts visual information, people unconsciously adjust the timing of their blinks to minimize the likelihood of missing critical information. Probabilistically, people are *least likely* to blink when looking at what they *perceive to be most important* and *most likely* to blink during moments *perceived to be least important*. Thus, by measuring patterns of visual fixation and blinking we can examine *where* children with ASD look when they are *highly engaged*.
Objectives: To investigate: (1) where children with and without ASD look when viewing naturalistic social scenes; and (2) whether looking patterns are modulated by engagement with scene content.
Methods: Eye-tracking data were collected while 92 children with ASD (mean age=10.32(3.2) years; 28 female) and 44 age- and IQ-matched TD children (mean age=10(2.9) years; 15 female) watched age-appropriate movies. Permutation testing was used to identify periods of statistically significant blink inhibition (indicating moments when children were *highly engaged*) and statistically significant increased blinking (indicating moments when children were less engaged) for each group separately (Figure 1). Percentage of visual fixation time on eyes, mouth, body, and object regions were calculated for each child over: (1) the entire viewing session; (2) periods of high engagement; and (3) periods of less engagement.
Results: Multivariate ANOVAs showed that, over the entire viewing session, TD viewers fixated more on eyes and mouths compared to children with ASD, who instead looked more at objects and bodies (all *p's*<0.0001). These group differences were also observed during periods of high engagement (all *p's*< 0.05; Figure 2a). Finally, there was a significant interaction between diagnosis and level of engagement, with TD viewers looking more at mouths when highly engaged compared to when they were less engaged (p<0.05; Figure 2c).
Conclusions: Results show that children with ASD and their TD peers perceive social stimuli in markedly different ways. TD viewers attend more to faces, while viewers with ASD attend more to objects. Critically, these differences become even more pronounced during periods when viewers were *highly engaged* with the stimuli. Ongoing analyses, examining between-group differences in the timing of *when* children are engaged and with *what* type of content, will further elucidate the subjective experience of individuals with ASD.

205 **110.205** Perceiving Pain in Others: Altered Physiological and Cognitive Regulation of Distress in ASD

M. Hoogenhout *and S. Malcolm-Smith, Department of Psychology, University of Cape Town, Cape Town, South Africa*

Background: Perceiving the pain of others normally activates the affective brain areas responsible for perceiving self-pain. These responses are thought to be required for feeling empathic concern for others, but need to be down-regulated in order to minimise personal distress and facilitate prosocial behaviour. Evidence from neuro-imaging studies suggest that vicarious responses are poorly regulated in autism spectrum disorder (ASD), but corresponding electrophysiological evidence is scant. Furthermore, there is evidence that poor self-regulation may stem in part from deficits in perspective-taking and own-emotion understanding (alexithymia).
Objectives: We investigated affective and sensory-motor empathy in individuals with varying levels of autism traits in response to viewing sensory pain displays. We also investigated the relationship of perspective-taking ability and alexithymia to self-reported personal distress and empathic concern. We hypothesised that participants with higher autism traits would show (1) poorer perspective-taking and higher levels of alexithymia, and (2) greater muscle activation, distress and sympathetic arousal when observing pain.
Methods: 105 individuals (27 ASD; ages 14 – 46) completed the Toronto Alexithymia Scale (TAS-20), the Interpersonal Reactivity Index (distress and empathic concern indices) and the Emotional Contagion Scale. Autism trait scores were calculated using participants' Autism Diagnostic Observation Schedule 2 algorithm and Autism Spectrum Quotient scores. Participants were shown videos of painful stimuli (a hand being stabbed), during which muscle activity in the participant's hand was measured at 100ms intervals using surface electromyography. Skin conductance responses were sampled as a measure of sympathetic activity. Using multilevel modelling, autism traits were correlated with (1) self-reported trait empathic concern, personal distress, emotional contagion and alexithymia, and (2) muscle activation and skin conductance when observing pain.
Results: High levels of alexithymia ($p = .0006$) and emotional contagion ($p < .0001$), and higher autism traits ($p = .038$), predicted higher personal distress. In contrast, good perspective-taking ($p < .0001$), low alexithymia ($p = .0002$) and high emotional contagion scores ($p < .0001$) predicted higher levels of empathic concern. Autism trait scores did not predict empathic concern ($p = .550$). Participants with high levels of autism traits had significantly higher muscle activity; with the highest activity occurring at the time of highest pain intensity in the video ($p = .0043$). Skin conductance was significantly higher in participants with high autism traits and those with high trait levels of distress ($p = .0064$).
Conclusions: The study replicates and extends previous findings showing that people with ASD experience increased levels of distress and physiological arousal when witnessing painful stimuli. Alexithymia and poor perspective-taking in this group may contribute to the distress experienced. Physiologically, participants with high autism traits had significantly greater sympathetic arousal and muscle activation than those with low autism traits and low trait levels of distress. Autism trait levels were not correlated with empathic concern. These findings suggest intact empathic concern in ASD, but poorer self-regulation of vicarious emotion at the cognitive and physiological levels. Our data speak to the potential value of incorporating self-regulation strategies into ASD interventions to reduce distress and promote prosocial behaviour.

206 **110.206** Perceptions of Self and Other: Gaze Patterns and Social Perception of Children with and without ASD

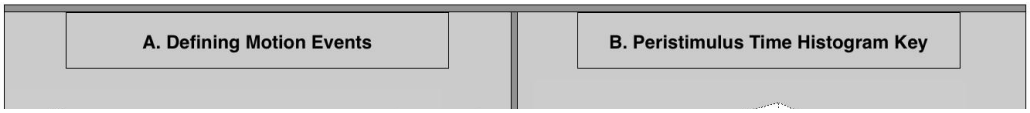
R. B. Grossman*, E. Zane, J. Mertens and A. Nikolaidis, Emerson College, Boston, MA*

Background:
First impressions are formed quickly and have lasting effects. Previous research shows that – without knowing the diagnosis of a child in a video clip - typical adults perceive children with ASD as social awkward after as little as one second (Grossman 2014). Typical adults also assume within a few seconds that children with ASD have fewer friends, are less socially engaged, and get along less well with others (Grossman at al. 2015). However, no evidence is available yet on how children with and without ASD perceive themselves and each other.
Objectives:
To understand the experience of a first encounter with an unfamiliar age-peer who may or may not have ASD, we analyzed gaze patterns to faces, as well as responses to questions probing the willingness of participants to engage with potential social partners.
Methods:
We showed brief (1.4 to 4.1 seconds) video clips of children (ages 10-17) with and without ASD retelling fragments of stories without revealing diagnoses. Participants were 9 children with ASD and 32 TD controls matched on age (mean 13:5, range 10:8-17:2), sex, IQ, and language ability. After conclusion of each video clip, participants were asked to rate (by moving a cursor on a continuous scale) how likely the person in the video would be to engage with others and whether the rater would be willing to engage with the person in the video. We used an SMI remote eyetracker to capture gaze patterns to the face, eyes, and mouth of children in the videos.
Results:
Behavioral responses and eye gaze patterns were significantly affected by the diagnosis of the child in the video but not by the diagnosis of the raters.
Both participant groups rated children with ASD significantly less likely to get along with others ($p < .001$), more likely to spend time alone ($p = 0.03$), and more likely to be socially awkward (($p < .001$) than their TD peers. Similarly, raters indicated they were significantly more likely to start a conversation ($p < .001$) and sit at lunch ($p < .001$) with TD children than children with ASD. There was no main effect for participant group, indicating that both cohorts rated videos of children with ASD more negatively than those of TD children.
Eye gaze analysis shows that both participant groups gazed significantly longer at TD children than children with ASD across all areas of interest ($p = 0.01$ for eyes, $p < 0.001$ for mouth, and $p < .001$ for face). There were no significant between-group differences in fixation durations to face, eyes, and mouth of the children in the videos.
Conclusions:
Children with and without ASD prefer to interact with and gaze at TD peers rather than peers with ASD. These data suggest that first impressions of children with ASD evoke a reduced willingness in their peers to visually and socially engage with them, even if those peers also have an ASD diagnosis. This may significantly contribute to the difficulties in social integration experienced by individuals with ASD.

207 **110.207** Physical Properties of Social Scenes Modulate Visual Engagement in School-Age Children with Autism Spectrum Disorder

E. Coben*, J. R. Yurkovic, I. Stallworthy, W. Jones, A. Klin and S. Shultz, Department of Pediatrics, Emory University School of Medicine, Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, GA*

Background: While reduced engagement with the social world is a defining feature of Autism Spectrum Disorder (ASD), less is known about what *is* perceived as important to individuals with ASD. Building on previous research demonstrating that individuals with ASD show increased attention to physical cues, including inanimate objects (Rice et al., 2012), objects in motion (Shultz et al. 2011), and audiovisual synchrony (Klin et al. 2009), the present study examines the extent to which viewers with ASD are *engaged* by physical cues within naturalistic social scenes. Viewer engagement is quantified by measuring patterns of eye-blink inhibition, a method that capitalizes on the fact that blinking temporarily interrupts visual information (Shultz et al., 2011). To accommodate this interruption, viewers unconsciously adjust the timing of their eye-blinks to minimize the likelihood of missing critical information. Probabilistically, people are *least likely* to blink when looking at what they *perceive to be most important*. Thus, by measuring change in rate of eye-blinking relative to ongoing scene content we can index *engagement* in viewers with ASD.
Objectives: Determine whether physical properties within social scenes, such as motion, luminance, and loudness, are engaging to children with ASD.
Methods: Eye-tracking data were collected from 92 children with ASD (mean age=10.3(3.2) years; 28 female) and 44 age- and IQ-matched typically-developing (TD) children (mean age=10.0(2.9) years; 15 female) during viewing of movies depicting age-appropriate social scenes. Motion, luminance, and loudness were quantified at each movie frame. Peristimulus time histograms were created to quantify percent change in blink rate relative to movie frames with physical property values exceeding a percentile threshold. A range of percentile thresholds were used to examine how engagement varies as a function of onscreen physical properties (Figure 1).
Results: Preliminary analyses revealed that both TD and ASD viewers are highly engaged when viewing motion, with engagement increasing as onscreen motion increases (Figure 2A). However, level of engagement was highest amongst ASD viewers, even at lower motion thresholds, with absolute change in blink rate peaking at 21.4% relative to movie frames with motion values above the 70th percentile. By contrast, absolute change in TD blink rate peaked at 15.1% relative to frames with motion values above the 80th percentile (Figure 2B). Both groups showed greater engagement immediately before and after motion events, with ASD engagement peaking approximately 350ms before and 330ms after motion events and TD engagement peaking approximately 650ms before and 950ms after motion events (Figure 2C).
Conclusions: While motion modulates engagement for both groups, viewers with ASD showed a more pronounced increase in engagement that was also more closely time-locked with motion events compared to TD viewers. These findings suggest that viewers with ASD show greater sensitivity towards motion and perceive motion to be more salient compared to TD viewers. Future analyses will ascertain the influence of luminance and loudness on visual engagement in viewers with ASD. These efforts will shed light on cues that engage individuals with ASD and may identify alternate viewing strategies used by these individuals to make sense of complex scenes.



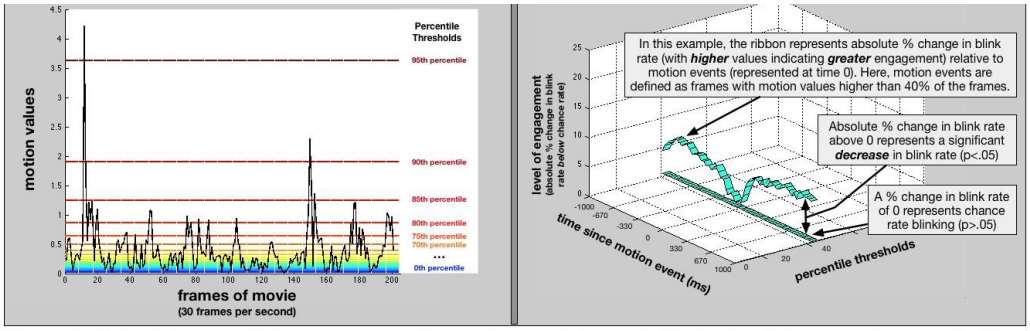


Figure 1. Methods for quantifying onscreen motion and percent change in blink rate relative to motion events. (A) Motion values, calculated as the absolute change in grayscale pixel values between frames, at each movie frame. Colored dashed lines mark percentile thresholds used to define motion events. Twenty sets of motion events were defined using 20 evenly spaced percentile thresholds, ranging from the 0th to the 95th percentile. A 200-frame excerpt from video data is shown. **(B)** A key for interpreting the peristimulus time histograms presented in Figure 2. Y-axis shows absolute percent change in blink rate *below* chance levels (p<.05, with greater percent change in blink rate indexing *increased* engagement) relative to motion events (represented at time 0 on the X-axis). The Z-axis shows the percentile thresholds used to define motion events.

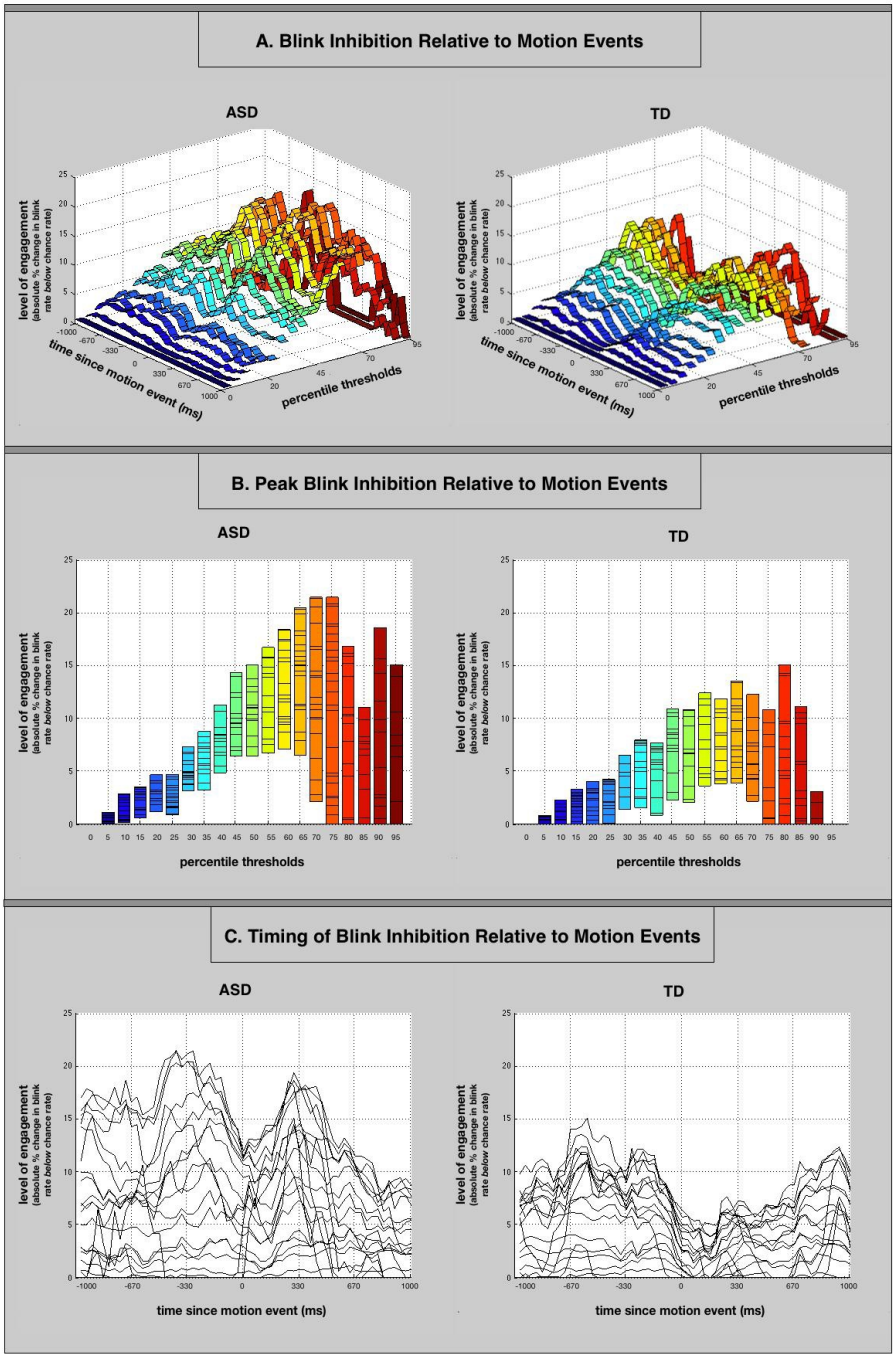


Figure 2. Absolute percent change in blink rate relative to motion events. (A) Peristimulus time histograms (PSTHs) show absolute percent change in blink rate *below* chance rates relative to motion events. One PSTH is plotted for each percentile threshold used to define motion events. **(B)** Peak absolute percent change in blink rate for each percentile threshold used to define motion events. **(C)** PSTHs (plotted for each percentile threshold) showing the timing of change in blink rate relative to motion events (represented at time 0).

208 **110.208** Promoting Reciprocal Social Interaction through Comprehensive Imitation Training for Nonverbal and Minimally Verbal Children with Autism in Japan

Y. Ishizuka[1], *N. Naoi*[2], *A. Matsuzaki*[2], *S. Matsuda*[3], *Y. Minagawa*[4] *and J. Yamamoto*[4], *(1)Japan Society for the Promotion of Science, Tokyo, Japan, (2)CREST, Japan Science and Technology Agency, Tokyo, Japan, (3)University of Tsukuba, Ibaraki, Japan, (4)Dept. of Psychology, Keio University, Tokyo, Japan*

Background:
Imitation skills are one of the most pivotal behaviors emphasized within teaching programs for children with autism. In particular, previous studies have shown effects of imitation training on social communication abilities such as language, joint attention and play skills (Ingersoll, 2012; Ingersoll & Schreibman, 2006). However, few studies have examined the effect of low intensity imitation training for children with autism and shown effects on imitation skills (Warreyn and Roeyers, 2014). In addition, more studies are needed to understand the effects of imitation training on reciprocal social interaction. Finally, little is known about how visual fixation patterns may change during imitation tasks following imitation training.
Objectives:
The purpose of this study is to examine whether a low intensity comprehensive imitation training program promotes reciprocal social interaction and changes socially relevant eye gaze behavior in children with autism.
Methods:
Six children with autism participated in this study, in a multiple baseline design. The range of chronological ages was 4 years to 6 years, and developmental age ranged from 1 year to 3 years. Children came to the laboratory once or twice per week and received 60-minute imitation training sessions, for approximately 12 weeks. During the training, children were taught motor imitation, object imitation, and vocal imitation skills and were trained to imitate actions sequentially for as long as they could. Imitation training was conducted primarily in a structured setting. To demonstrate the process of acquiring imitation skills, we utilized a multiple baseline across target behaviors experimental design. We also utilized six dependent variables in pre and post assessments to evaluate the effect of imitation training, as follows: (1) Imitation skills: Motor Imitation Scale (MIS); (2) Reciprocal social interaction: Proportion of social engaged imitation, frequency of spontaneous language, and the duration of chained mutual imitation through 5-minute video observations between child and mother and child and therapist; (3) Gaze behavior: Change of visual fixation pattern during imitation tasks using eye tracker Tobii; (4) Motor development : Scores on the Developmental Voluntary Movement Test. Pre to Post assessment changes were evaluated using Wilcoxon signed-rank tests.
Results:
All children improved in their imitation skills sequentially through multiple baseline design. Preliminary results suggest that low intensity comprehensive imitation training produced significant increases in imitation skills which were not used in the training in pre and post assessment (Wilcoxon signed-rank test: Z =-2.14, p=0.032, two-sided). The results also showed that imitation training increased the proportion of socially engaged imitation and spontaneous language production in the post assessment. Children also changed their visual fixation patterns during imitation tasks after training, looking at an adult's face more than during the pre-training assessment. Finally, motor development also improved from the pre to post assessment.
Conclusions:
The current findings suggest that a low intensity comprehensive imitation training program promoted reciprocal social interaction between mother and child. The finding of increased looking time at the adult's face following imitation training provides further information and support for the observed behavioral effects on reciprocal social interaction.

209 **110.209** Relationship Interest, Knowledge and Experiences Among Young Adults with Autism Spectrum Disorder

N. C. Cheak-Zamora[1], *M. Teti*[2], *C. Regan*[3] *and A. Maurer-Batjer*[3], *(1)University of Missouri, University of Missouri, Columbia, MO, (2)University of Missouri- Columbia, Columbia, MO, (3)University of Missouri, Columbia, MO*

Background:
Sexuality and intimacy are important parts of all adolescent development and influence health and quality of life. Recent research has debunked the notion that young adults with ASD (YA-ASD) lack sexual experiences and desires. However, developing and maintaining sexual and romantic relationships are difficult for YA-ASD due to communication barriers and lack of social awareness. Further, a dearth of research exists about YA-ASD 's sexual and romantic relationship experiences and desires from the perspectives of YA-ASD themselves.
Objectives:
The objective was to explore the perspectives and experiences of YA-ASD regarding their sexual and romantic relationships using qualitative methods.
Methods:
Subjects were recruited from three major ASD treatment and support sites in different cities within the Midwest United States. We conducted 45 minute semi-structured interviews with 27 YA-ASD to explore sexuality and intimacy. Interviews were transcribed verbatim totaling over 1,000 pages of session transcripts and 150 pages of observational notes. The data was analyzed using theme analysis, which included initial and axial coding, analytical memos, and organizational matrices and reports. An iterative process was used and three separate investigators coded all data to ensure coder agreement.
Results:
The 27 young adult participants ranged in age from 16-25 years old (= 19.19). The majority of participants in the study were non-Hispanic white (96%) and male (74%). Most participants described themselves as having Asperger's Syndrome (41%) or Autism/ Autistic Disorder (33%) and having mild ASD symptomology (74%).
Four thematic categories were uncovered that defined YA-ASD's sexual and romantic relationship experiences and perspectives including: 1) Interest in relationships, 2) Imagined ideal partners, 3) Reality of relationships, and 4) Seeking advice. Although many YA-ASD expressed wanting to be in a relationship, few reported having partners. Among those that had present or past relationships, the actual relationships rarely met their ideals. YA-ASD talked to their parents and friends but rarely health care providers about relationships and sexuality. The few reported conversations with providers were usually vague and about future planning (ex. Marriage). Most young adults, even those uninterested in having a relationship, expressed the desire for more and clearer information about sex and relationship building.
Conclusions:
This study was the first to talk to young adults about sexuality and romantic relationships and provides greater insight into how young adults perceive romantic relationships, their experiences and desires for the future. We found that YA-ASD are interested in romantic and sexual relationships but are relatively unprepared to develop or sustain them. Very few young adults had conversations about sexual safety with health care providers or formal sexual health education.
These findings are important because they not only improve our understanding of sexuality of YA-ASD, but also demonstrate a sound methodological procedure (individual interviews) to facilitate input from YA-ASD.
We recommend that sexual education is introduced early and includes social/relationship skills-building and courtship modeling. Caregivers, educators and health care providers must initiate discussions about sexual health with YA-ASD including concepts of sexual self-hood and risk. Future research should examine issues of sexuality from the young adult's perspective.

210 **110.210** Self-Referential Processing in Autism: Does Valence Matter?

C. A. Burrows[1], *L. V. Usher*[1] *and H. A. Henderson*[2], *(1)University of Miami, Coral Gables, FL, (2)University of Waterloo, Waterloo, ON, Canada*

Background: A strong sense of self incorporates both affective self-attributions, and social-cognitive processes. Individuals with high-functioning autism (HFA) endorse a less positive view of themselves than typically-developing individuals, and do not preferentially remember self-relevant over other-relevant information. These differences represent atypical organization of both affective and cognitive components of the self in individuals with autism. However, the associations between the affective encoding and later memory for personally-relevant information, and dissociable correlates of each have not been examined on the self-referenced memory task.
Objectives: The goals of the current study were to examine 1) group differences in endorsement of positively- versus negatively-valenced information about self and others on the self-referenced memory task, 2) associations between endorsement and memory for self- and other-referenced information and 3) affective and socio-cognitive correlates of the endorsement and memory phase of the task in children with HFA and a matched comparison sample (COM).
Methods: Children and adolescents with HFA (N=76, 65 males, Mage=12.51, SD=2.58) and a comparison sample (N=72, 52 males, Mage=13.28, SD=2.15) completed a self-referenced memory paradigm, where they judged positive and negative trait adjectives with reference to themselves, and a familiar other person (i.e., Harry Potter). After a delay, participants were asked whether they recognized the adjectives from a list among distractor adjectives. An index of Self-Positivity Bias (SPB) was calculated as the difference in endorsement between self-referenced adjectives of positive and negative valence. In the recognition phase, self- and other-referenced memory, as well as the difference between the two (i.e., Preferential Self-referenced Memory) were computed. Self-reported Internalizing problems were evaluated by the Behavior Assessment Scale for Children (BASC). A Theory of Mind (ToM) composite was created by standardizing and averaging performance on two tasks: Reading the Mind in the Eyes and Strange Stories.
Results: Controlling for gender and VCI, HFA participants displayed a lower Self-Positivity Biases and reduced Preferential Self-referenced Memory, than COM participants, $F(1, 145) = 6.98$, $p=.009$, $\eta^2_{partial}=.05$, and $F(1, 145) = 21.27$, $p<.001$, $\eta^2_{partial}=.13$, respectively. The Self-Positivity Bias was predictive of Preferential Self-referenced Memory in the COM group, $r(71)=.23$, $p=.049$, but not the HFA group, $r(75)=-.06$, $p>.05$ (Figure 1). Self-reported internalizing problems were inversely related to Self-Positivity Bias (p's<.05; Figure 2), but not preferential self-referenced memory in both groups. In contrast, the ToM composite was associated with memory performance in the self- and other-referential conditions, but not the difference score in the HFA (p's<.001), but not COM group (p's>.05).
Conclusions: Typically-developing children demonstrated a coherent sense of self, where positive affective self-understanding supported enhanced socio-cognitive

processing. However, the same was not true in children with HFA. Children with HFA may demonstrate a more dissociated sense of self, with positive self-perceptions linked to lower levels of internalizing problems, while recognition of self- and other-referenced adjectives supports social cognition. Two avenues of intervention could target the dissociated sense of self for children with HFA. Certain individuals may benefit from interventions that target negative self to reduce internalizing problems, while others need training of socio-cognitive skills to improve awareness of themselves and others.

Figure 1. Self-positivity bias was associated with preferential self-referenced memory in the comparison sample (COM) but not in the participants with HFA.

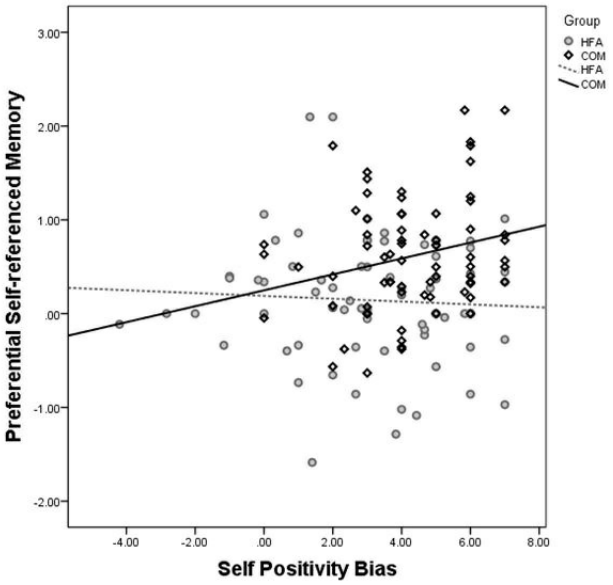
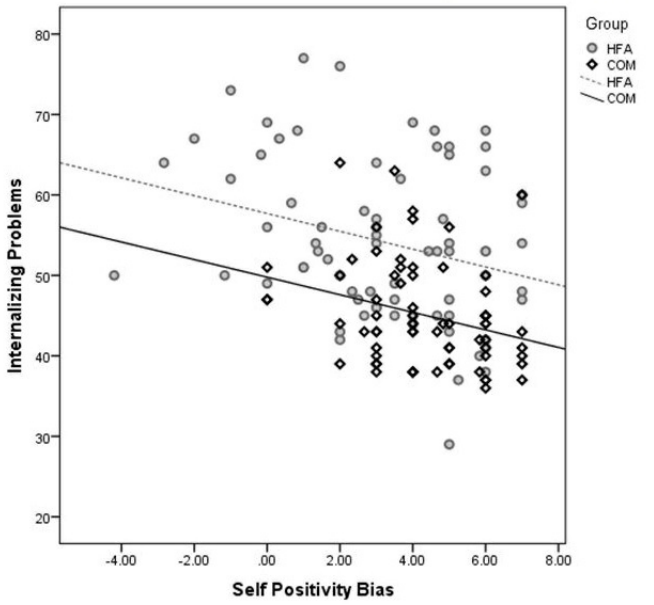


Figure 2. Self-positivity bias was associated with levels of internalizing problems in both groups.



211 **110.211** Sex Differences Across Parent, Clinician, and Performance-Based Measures of Social Behavior in Autism Spectrum Disorder

J. M. Moriuchi[1], *A. Klin*[2] *and W. Jones*[2], *(1)Emory University, Atlanta, GA, (2)Department of Pediatrics, Emory University School of Medicine, Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, GA*

Background:
Previous results on sex differences in Autism Spectrum Disorder (ASD) have been ambivalent. Although there have been limited differences in the clinical phenotype of social disability in ASD in past studies, as measured by standardized instruments, underlying genetics and brain function do seem to differ across sexes. Females with ASD tend to carry more genetic mutations, have distinct structural brain differences, and show differential activation patterns in social brain regions when compared to males with the disorder. Based on these identified biological differences, it is possible that measures utilized in past studies may not have been sensitive or detailed enough to detect potential sex differences in social behavior. Because information source has been cited repeatedly as a factor impacting equivalence across measures, the current study sought to clarify the effect of sex on the manifestation of social disability in children with ASD by leveraging multiple levels of behavioral metrics.
Objectives:
The current study aimed to examine differences both within and across methods of ascertainment, including parent report of social behavior, clinician rating of social behavior, and performance-based measures of social visual engagement.
Methods:
Participants included 161 children with ASD (114 male, 47 female) representing a broad range of ages (mean=10.1(2.8), range=5 to 17 years) and cognitive functioning (DAS-II GCA: mean=94.5(22.8), range=32 to 149). Males and females did not differ based on chronological age or level of cognitive functioning. Social behavior was measured by parent report using the Social Responsiveness Scale (SRS); by clinician rating using the Autism Diagnostic Observation Schedule, 2nd Edition (ADOS-2); and by performance-based measures of social visual engagement collected via eye-tracking. Eye-tracking data were recorded while children viewed social scenes of children and adults engaged in naturalistic, age-appropriate social interaction within everyday settings.
Results:
Across methods of ascertainment, males and females with ASD did not exhibit between-group differences on summary measures of social disability (SRS: p=0.91; ADOS-2 Social Affect: p=0.12; Eyes fixation: p=0.20). However, sex significantly moderated the relationship between parent rating and clinician rating of social behavior (B=-0.18, p=0.03) as well as the relationship between clinician rating and performance-based measurement of social behavior (B=15.95, p=0.04). Parent and clinician ratings were more strongly correlated in females with ASD than in males. In contrast, clinician ratings and performance-based measurement of social behavior were more strongly correlated in males with ASD than in females. Parent ratings and performance-based measurement of social behavior were not significantly correlated in either males or females with ASD.
Conclusions:
In the absence of mean differences in social behavior between males and females with ASD across parent ratings, clinician ratings, and performance-based measurement, there were significant sex differences in the relationships between measures of social behavior. These differences suggest that the underlying structure of social disability may differ across sexes in ASD and have implications for the clinical assessment of ASD in males and females.

212 **110.212** Sex Differences in Social Cognition, Executive Functioning and Repetitive Behaviours in Children and Adolescents with ASD

R. Leung[1,2], *V. M. Vogan*[1,3], *V. Yuk*[1,2] *and M. J. Taylor*[1], *(1)Diagnostic Imaging, The Hospital for Sick Children, Toronto, ON, Canada, (2)Psychology, University of Toronto, Toronto, ON, Canada, (3)School and Clinical Child Psychology, Ontario Institute for Studies in Education, Toronto, ON, Canada*

Background: One of the most replicated findings in the field of Autism Spectrum Disorder (ASD) research is a male preponderance. Recent studies suggest that the frequently stated 4:1 male to female ratio is influenced by many biases including differences in symptom presentation, IQ, and diagnostic criteria. Females with ASD have been observed to show increased social behaviour, higher language ability and less repetitive behaviours, relative to their male counterparts. These findings collectively suggest that the skewed sex ratio may be due to males exhibiting more disruptive and stereotypical symptoms of ASD that warrant clinical attention, relative to females. Females who have ASD and higher IQs may thus 'mask' their ASD symptomology, and diagnosis may be missed altogether, which in turn contributes to the skewed sex ratio in this population. Investigating sex differences in ASD symptomology contributes to better understanding and characterization of the female ASD phenotype, which in turn has implications for diagnosis and the treatment of ASD.
Objectives: To investigate sex differences in executive functioning, social skills and repetitive behaviours in children and adolescents with and without ASD.
Methods: We collected data in 187 children and adolescents: with ASD (N=96, M=10.54+2.32 years, IQ=100.89+15.46; females only: N=14, M=11.07+2.22 years, IQ=99.33+15.47) and typically developing controls (N=91, M=11.02+2.55 years, IQ=113.36+12.19; females only: N=23, M=10.39+2.25 years, IQ=114.05+14.67). For all participants, parents filled out the parent form of the Behavior Rating Inventory of Executive Function (BRIEF), Social Responsiveness Scale (SRS), and Repetitive Behaviour Scale – Revised (RBS-R). It should be noted that all participants, including the clinical sample, were high-functioning as they were recruited as part of a larger neuroimaging study.
Results: A two-way ANOVA with IQ as a covariate showed a main effect of group for all SRS, BRIEF and RBS-R variables ($p<0.001$) as well as a significant group by sex interaction on the Social Awareness subscale of the SRS ($F(1, 156) = 6.38$, $p=0.01$). Females with ASD were more impaired in social awareness relative to males with ASD, whereas in the control group scores reflected a greater social awareness in females relative to males. Sex effects were also found in the Restrictive and Repetitive Behaviour subscale of the SRS ($F(1, 156) = 5.12$, $p= 0.03$), with males showing consistently greater restricted and repetitive behaviours relative to females.
Conclusions: These preliminary results suggest that impairment in social awareness is particularly heightened in female children and adolescents with ASD. Reduced social awareness in child and adolescent females with ASD reflect difficulties in picking up social cues during social interactions. Our finding highlights that impaired social awareness may be a defining trait in the female ASD phenotype.

213 **110.213** Shortcutting Reciprocity: Using Similar, Low-Recursion Learning Styles to Predict Humans and Machines Behavior Underpins Strengths and Weaknesses in ASD. a Computational Psychiatry Study

*M. Devaine[1], J. Daunizeau[2], A. Duquette[3] and **B. Forgeot d'Arc**[4], (1)Brain and Spine Institute, Paris, France, (2)Brain and Spine Institute, INSERM, Paris, France, (3)Psychology, Université de Montréal, Montréal, QC, Canada, (4)Psychiatry, Université de Montréal, Montreal, QC, Canada*

Background: Beyond the common notion that Theory of Mind (ToM) might be altered in the autism spectrum, the alternative cognitive strategy used by individuals with autism spectrum conditions in reciprocal social interactions remains poorly understood. It is known that typically developed adults (TDA) use ToM to anticipate others' decisions. Such strategic anticipation may even culminate in recursive ToM when competitors also use ToM to anticipate one's own decision. In the context of repeated interactions, this yields (recursive) learning styles that differ from simpler alternative strategies such as imitation or (anti)-perseveration.
Objectives: Here, we ask whether, similarly to TDA, adults with autism spectrum disorder (AwASD) switch to a recursive learning style when engaged in a social interaction. In particular, we hypothesize that (1) AwASD would use similar learning styles when interacting with humans or machines, (2) they would use low-recursion learning styles, eventually impairing performance when interacting with ToM agents.
Methods: AwASD and TDA matched for age, IQ and gender took part to the study (n=48). AwASD had been assessed with ADOS-G and met DSM-IV criteria for an ASD. All participants had FSIQ>85. Participants with self-reported depression (Beck depression Inventory score>20) were excluded. We used a previously validated computerized game (Devaine et al. 2014) to access participants' learning styles by varying the ToM sophistication of their virtual opponents. This sophistication ranged from a random sequence with a bias to artificial ToM with two steps of recursion. Critically, the task was either framed as an on-line competitive game played against another participant or as a slot machine game. We captured participants' learning style in terms of the trial-by-trial impact of previous choices onto their current decision (as quantified by logistic regressions). We then analyzed both participants' performance and learning style patterns, across opponents and framing conditions.
Results: Contrary to TDA, AwASD had strikingly similar performance patterns in both framings (AwASD:r^2=.60, p=.003/TDA:r^2=-.20, p=.57) and did not appear to modulate their learning style. Moreover, learning style and performance of AwASD were different from TDA's in both framings. More precisely, AwASD performed better than TDA (p=2e-6) against opponents with low sophistication and worse than controls (p=7e-6) against sophisticated opponents in the social framing. Only TDA varied their learning style in response to the framing manipulation, eventually engaging in recursive ToM inference in the social framing.
Conclusions: Our results are consistent with the idea that learning style involves both imitation of the other player's previous moves and strategic (adaptive) choice alternation. Contrary to TDA, knowing that they interact with other humans does not change the learning style of AwASD, which leads to performance losses when playing against agents with recursive ToM. Critically however, the learning style of AwASD is more efficient than TDA's against artificial agents that do not possess recursive ToM (even when these agents are capable of learning).
Overall, this study constitutes an important input from computational psychiatry to understand ToM reasoning and its alternatives in autism, and to resolving the apparent paradox of co-occurring strengths and weaknesses of autistic cognitive style.

214 **110.214** Sniff Check! Adults with Greater Autism Symptoms Report Odors As Being More Positive

***E. N. Keenan**, T. Rosen, E. Kang and M. D. Lerner, Stony Brook University, Stony Brook, NY*

Background:
Many have speculated that hypoactivation of the amygdala is a key feature of autism spectrum disorder (ASD) (Baron-Cohen et al., 2000). While evidence for amygdala hypoactivation is mixed, there is some support for the notion that abnormal connectivity of the amygdala and orbitofrontal cortex may be implicated in the social deficits seen in ASD (Zalla and Sperduti, 2013). Evidence indicates that the amygdala and the orbitofrontal cortex are also involved with the attribution of emotional valence to olfactory stimuli (Zald and Pardo, 1997).
A growing literature suggests the presence of aberrant olfactory processing in ASD. For example, evidence suggests that odor identification, though not detection, is impaired in ASD (Suzuki et al., 2003). Likewise, children with ASD do not adjust their sniff response time to unpleasant versus pleasant odors, an atypical pattern which correlates with social impairment (Rosenkrantz et al., 2015). Similarly, it has been speculated that children with ASD are less likely to report emotional attributions to odors (Legiša et al., 2013). However, to date, no study has assessed odor valence rating as a function of ASD symptomatology.
Objectives:
This study examined relationship between ASD symptomatology and bias in emotional valence to olfactory stimuli. It was hypothesized that adults with greater subclinical ASD symptoms would show a less negative response to typically aversive scents.
Methods:
Thirty-one typically developing adults (21 female, 10 male; ages 18 - 47, M_{age} = 22.2, SD_{age} = 6.0) completed a self-report measure of autism symptomology, the Social Responsiveness Scale-2 (SRS-2; Constantino & Gruber, 2012), as well as an olfaction task (Jin et al., 2015). The task featured 9 scents that varied by positive, negative, and neutral valence. Participants rated the valence and familiarity of each scent on a continuous scale.
Results:
There was a correlation between greater autism symptoms and rating negatively-valenced odors more positively (r = .355, p =.007), an effect which remained significant after controlling for familiarity (r = .412, p = .002). The correlation was also significant for both subscales of the SRS-2, but moreso for social communication (r = .468, p < .001) than for restricted and repetitive behavior (r = .331, p = .013).
Conclusions:
Adults with greater levels of sub-clinical ASD symptoms subjectively reported negatively-valenced odors as more pleasant. This could explain the aberrant sniff response found by Rosenkrantz et al., as perhaps individuals with ASD do not perceive negatively-valenced scents as negatively as TD controls. Taken together, these findings converge with past studies suggesting a potential relationship between ASD symptoms, particularly in the social communication domain, and atypical olfactory processing. Given that intact amygdala and orbitofrontal cortex functioning is needed to identify the pleasantness of an odor, these findings may provide a behavioral index of abnormal amygdala and orbitofrontal cortex connectivity in ASD (Zalla and Sperduti, 2013). When presented, these results will be augmented via the inclusion of 30 adults with ASD as well.

215 **110.215** Social Anxiety in Young People with Autism: Cognitive and Behavioural Models

*H. Wood[1], S. Rusbridge[1] and **A. J. Russell**[2], (1)psychology, university of bath, bath, United Kingdom, (2)University of Bath, Bath, United Kingdom*

Background:
Social anxiety is more prevalent in adolescents with autism spectrum disorder (ASD) than typically-developing adolescents (Bellini, 2004), and is one of the most common anxiety disorders in adolescents with ASD (White et al., 2009). Whilst the cognitive model of social anxiety has a well-established evidence-base for typically-developing individuals (Clark & Wells, 1995), its applicability for individuals with ASD is unclear. The cognitive model outlines how appraisals about one's own social performance and self-focused attention are central factors in the development and maintenance of social anxiety and are important focii for any intervention. Historically interventions for social anxiety in ASD have adopted a deficit model with improvements in social skills considered essential. Adolescents and young adults with ASD (n=52) took part in a paradigm designed to elicit social anxiety (adapted from Cartwright-Hatton et al., (2003)).
Objectives: to explore the role of cognitive factors in social anxiety in Autism.
Methods: An adapted paradigm provoking social anxiety was employed, and individual ratings of social performance were compared with objective observer ratings. Self focused attention was measured using an adapted autonomic perceptions questionnaire.
Results: Approximately 50% of the group scored above clinical threshold on a measure of social anxiety. Group differences in the discrepancy between self-and observer ratings of social performance skills were recorded, with the socially anxious group rating social performance as significantly poorer than observer ratings. An adapted version of the Autonomic Perceptions Questionnaire also revealed between-group differences in the extent of self-focused attention.
Conclusions: These findings suggest that cognitive factors may be as relevant in our understanding of social anxiety in young people with ASD as typically developing youth and have implications for psychological treatments.

216 **110.216** Social Attention and Empathy in High Functioning Women with Autism Spectrum Disorders

***M. P. Ketelaars**[1], A. In't Velt[2], A. Mol[3], H. Swaab[1], F. Bodrij[4] and S. Van Rijn[1], (1)Department of Clinical Child and Adolescent Studies, Leiden University, Leiden, Netherlands, (2)Centrum Autisme Rivierduinen, Leiden, Netherlands, (3)Altrecht, Nieuwegein, Netherlands, (4)Centre for Child and Family Studies, Leiden University, Leiden, Netherlands*

Background : Females with autism spectrum disorders (ASD) have become the focus of research only recently after clinical reports of an altered phenotype. This altered phenotype may be responsible for delays in diagnosing females on the spectrum. There is, however, limited research into the female phenotype and its possible underlying mechanisms. A promising avenue in ASD research is social attention. Social attention has been shown to relate strongly to ASD symptoms, and information on this mechanism in the female population may provide us with valuable information for diagnostic assessment and treatment of this specific group.
Objectives : The present study investigates social attention using sensitive and ecologically valid measures by assessing gaze fixation patterns. In addition, social attention

is related to the behavioral level by examining its relation to informant ratings of empathic abilities.
Methods : Participants consisted of 31 adult women with ASD and 29 non-clinical controls. Social attention was assessed by measuring eye fixation patterns using eye tracking while participants watched four real-life movie clips in which children displayed differing emotions. Empathic abilities were assessed using the informant reported Interpersonal Reactivity Index (IRI).
Results : Results show decreased fixation duration on the face and mouth in women with ASD compared to non-clinical controls. No differences were found in fixation duration on the eyes, objects and outside the areas of interest. Women with ASD showed reduced cognitive empathy, and more personal distress in stressful situations compared to non-clinical controls. Additionally, there was a negative correlation between personal distress and total fixation duration to the face for this group.
Conclusions : The current findings suggest subtle impairments in social attention in women with ASD, though fixation on the eyes was normal. Since lack of eye contact is the hallmark of ASD, this may put women with ASD at risk of underdiagnosis. As the pattern of impairment is contrary to the current research findings on the male population, it warrants caution in assuming that current research findings regarding social attention in individuals with ASD automatically apply to the female ASD population. In addition, the negative relationship between face fixation and feelings of personal distress is suggestive of the involvement of the arousal system, with a possibility that women with ASD have problems downregulating their arousal in social situations.

217 **110.217** Social Functioning in Children with Autism: Which Processes to Measure?

***A. P. F. Key**, D. Jones and B. A. Corbett, Vanderbilt University, Nashville, TN*

Background: Social functioning depends on optimal brain mechanisms, cognitive processes, and behavioral skills. Examining social deficits in children with ASD using a multidimensional approach should yield more detailed information about their strengths and weaknesses associated with social interactions.
Objectives: The purpose of this study was to investigate which neural mechanisms supporting social cognition (perception of vs. memory for faces) are associated with social behavior during peer interactions in children with autism.
Methods: Brian mechanisms supporting face perception and memory were evaluated using visual event-related potentials (ERPs) in 74 children with autism (age 7-16 years) during passive viewing of color photographs depicting unfamiliar smiling young adults or front views of houses, a subset of which were randomly selected and repeated throughout the test session while the rest were shown only once. Social cognition was assessed using NEPSY Memory for Faces test. Social behavior was documented using caregiver reports (Social Communication Questionnaire, Social Responsiveness Scale, Adaptive Behavior Assessment System, Child Behavior Checklist) and coded observations of playground behaviors with peers.
Results: All participants demonstrated perceptual discrimination of faces vs. houses as reflected in the larger N170 responses to the former, suggesting social perception mechanisms comparable to those of typical individuals, but only the youngest group (7-9 years) evidenced increased N170 amplitudes following stimulus repetition regardless of stimulus category. These effects on the N170 amplitude decreased with age (face vs. house: r=.526, p<.001; repeated vs. single: r=.416, p<.001). N170 latency varied with IQ, with shorter responses to houses vs. faces observed only in the high-IQ (>115) group. Examination of the social memory processes indexed by the frontal and parietal “old/new” responses in the 300-500ms interval revealed familiarity with (FN400) but not recall (parietal) of the repeated houses in the youngest (7-9 years) and oldest (13-16 years) groups, while no significant differences were observed for faces due to high inter-individual variability. Social brain-behavior correlations demonstrated that larger N170 amplitudes to faces and to repeated stimuli were associated with fewer parent-reported social problems (CBCL). Conversely, larger FN400 responses to repeated faces were associated with fewer autism symptoms (ADOS communication and total scores), higher verbal IQ, better performance on NEPSY memory for faces (immediate), fewer social problems (CBCL), as well as more cooperative play, gestures, and verbal communication during a playground interaction with peers. Perceptual and memory responses to houses correlated with age and IQ, but not social behavior.
Conclusions: Examination of social functioning in children with autism using neural, cognitive, and behavioral assessments suggests that neural measures of more complex social cognition processes, such as face memory reflected in the “old/new” ERP responses, may be more informative about social functioning in children with autism than early perceptual brain responses due to more extensive connections with social cognition and behavior.
Social functioning depends on optimal brain mechanisms, cognitive processes, and behavioral skills. Examining social deficits in children with ASD using a multidemensional approach should yield more detailed information about their strengths and weaknesses associated with social interactions.

218 **110.218** Student-Teacher Closeness Impacts School Engagement

***B. Hedges**[1], C. Kasari[2], W. I. Shih[3], C. Lord[4], R. Landa[5] and B. King[6], (1)Semel Institute for Neuroscience and Human Behavior, University of California, Los Angeles, Los Angeles, CA, (2)University of California Los Angeles, Los Angeles, CA, (3)UCLA, Monrovia, CA, (4)Weill Cornell Medical College, White Plains, NY, (5)The Kennedy Krieger Institute, Baltimore, MD, (6)University of Washington and Seattle Children's Hospital, Seattle, WA*

Background:
Mainstream education incurs both benefits and risks for children with autism spectrum disorders. Despite typical peer models, these children are often socially isolated in the mainstream classroom (Chamberlain 2007). A recent study examined the efficacy of different social skills interventions for children with ASD in mainstream classrooms (Kasari 2015), finding that teacher reports of closeness to the target children moderated the children’s responsiveness to intervention. Previous research indicates that the student-teacher relationship has an impact on the social functioning of typically developing preschoolers (Howes 2008), as well as academic success (Hamre and Pianta, 2001). A study of intellectually disabled children found that the student-teacher relationship was less close and less stable than typically developing peers. Child behavior problems in ID youth predicted greater student-teacher conflict whereas social skills predicted greater closeness (Blacher 2009). We have yet to examine how the student-teacher relationship affects peer to peer relationships of children with ASD.
Objectives:
To understand the relationship between student-teacher closeness and peer engagement at school for children with ASD.
Methods:
Participants included 134 children, 110 males. The average age was 8 years. All children were in general education classrooms for at least 80% of the day and had ADOS-confirmed diagnosis of ASD. Data was collected using the Student Teacher Relationship Scale (Pianta 2001), the Behavioral Assessment System for Children (Reynolds, 2004), and a classroom friendship survey which included the number of classmates the target child nominated as a friend (out-degrees) and the number of times the target child was nominated as a friend by classmates (in-degrees). Peer engagement was measured using the Playground Observation of Peer Engagement (Kasari et al 2005).
Results:
Correlational analyses were used to examine teacher-child closeness with adaptive functioning, in-degree and out-degree nominations, peer engagement on the playground, and student-teacher conflict. Teacher –child closeness was positively linked to higher scores of observed peer engagement on the playground (r=.214, p=.0198). Additionally, higher closeness was associated with in-degrees (r=.346,p<.001). Children with higher teacher closeness tended to be rated higher on measures of adaptive functioning by both teacher and parent (r=.484, p<.001 and r=.218, p=.0257, respectively). High teacher closeness was negatively correlated with teacher reports of conflict within the teacher-child relationship (r=-.323, p<.001). Finally, no significant relationship between child’s IQ and teacher-child closeness was found.
Conclusions:
Children with ASD who are rated as having a closer relationship with their teachers tend to have higher engagement with peers on the playground and more positive peer nominations. Classroom interventions focused on improving social engagement in children with autism rarely target the teacher-child relationship directly; further research may be warranted to investigate whether teacher-child closeness has an effect on social engagement in young children with autism spectrum disorders.

219 **110.219** Subtle Differences in Explicit Facial Identity and Facial Expression Recognition in Young Adults with ASD

***S. Vettori**[1,2], C. Dillen[1,2], H. Op de Beeck[3], J. Steyaert[1,2] and B. Boets[1,2], (1)Child and Adolescent Psychiatry, KU Leuven, Leuven, Belgium, (2)Leuven Autism Research consortium (LAuRes), KU Leuven, Leuven, Belgium, (3)Laboratory of Biological Psychology, KU Leuven, Leuven, Belgium*

Background:
Fluently recognizing faces and facial expressions is highly important for our social interactions. Impaired and atypical face processing have often been postulated as a key deficit in autism spectrum disorders (ASD). Despite the great amount of research on face identity and facial expression recognition in ASD, the results are mixed. This is partly because many studies included a relatively small sample of participants and administered only a single face processing task.
Objectives:
Therefore, our goal is to examine face identity and facial expression recognition in a substantial sample of young adults with ASD and matched typical control subjects, assessed with a battery of explicit face processing tests targeting identity and emotion recognition via matching and memory tasks. In addition, we will investigate mutual associations between face processing performance, and associations with self-reported autism characteristics and symptoms of depression and anxiety.
Methods: 26 high-functioning young men with ASD and 26 male healthy control subjects without any psychiatric disorder completed computerized versions of the Benton Facial Recognition Test (BFRT), the Cambridge Face Memory Test (CFMT), the Emotion Recognition Index (ERI) and the Emotion Recognition Task (ERT). In addition to verbal, performal and total IQ, clinical assessments included ADOS and self-report questionnaires assessing quantitative autism characteristics (Social Responsiveness Scale, SRS), symptoms of depression (Beck Depression Inventory) and symptoms of anxiety (State-Trait Anxiety Inventory).
Results:
Results on both face identity recognition tasks (CFMT and BFRT) showed that there were no main group differences in performance between ASD and control subjects. However, on the CFMT, adults with ASD were more hindered by increasing task difficulty through increasing noise and tended to perform worse than controls. Further, we

found no group differences on average accuracy on both facial expression recognition tasks (ERI and ERT). Yet, individuals with ASD needed more time to provide correct answers on the ERI. In the presentation we will further expand these results by showing correlations between face processing performance and symptom severity and IQ scores.
Conclusions:
We examined a series of face processing abilities with widely used standardized tests. Overall, we found no obvious group differences in face identity recognition and facial expression recognition performance in this sample of adults with ASD versus controls. None of the tests showed an overall group difference, but results on the ERI and the CFMT suggest that subjects with ASD memorize facial identity slightly less accurately and process facial expressions slightly more slowly. In sum, this study indicates that explicit face processing abilities are fairly intact in men with ASD. However, this finding does not rule out that altered face processing is still a key deficit in ASD. If the nature of this deficit is implicit, than the widely used task tapping explicit face processing may give an incomplete estimate of face processing abilities in ASD.

220 **110.220** Successfully Directing Eye Gaze Does Not Improve Face Recognition Ability in Children with ASD

S. J. Thompson, *S. R. Leekam, G. Powell and C. Jones, School of Psychology, Cardiff University, Cardiff, United Kingdom*

Background: Individuals with ASD show unusual patterns of eye gaze to the face and perform poorly on face processing measures. However, whether prompting individuals with ASD to look at optimal face regions will improve accuracy is unknown. In previous research we found that when told to look at the mouth, neurotypical adults showed difficulty inhibiting an unconscious preference for first looking to the eye region. In addition, prompting instructions improved accuracy. What remains unknown is: (i) whether individuals with ASD show a first look eye preference (ii) whether directing eye gaze can improve their accuracy.
Objectives: (1) To establish whether typically developing (TD) and ASD children have a preferred first look location that is difficult to inhibit. (2) To establish whether directing eye gaze improves accuracy.
Methods: Fourteen children with ASD (8–13 years) and 24 matched TD children participated. Using a forced-choice face recognition paradigm, participants had to distinguish the previously seen target face from an alternative image, where the eyes or mouth were digitally altered. This was first conducted with no looking instructions (unprompted condition) and then with instructions to look to the changed region (prompted condition). Eye movements and task performance were measured. A control task using houses was also included.
Results: Both child groups showed the same eye tracking patterns found in neurotypical adults. With respect to objective 1, first looks were significantly more often made to the eyes than mouth in the unprompted condition by both groups. With respect to objective 2, when prompted to look to the mouth, the first look for both groups was as often to the mouth as to the eyes, whereas when directed to the eyes, first looks reflected task instruction. Analysis of dwell time indicated no group differences, with both groups spending more time looking at the prompted region. However, the groups differed on task performance. Unlike the TD group, the ASD group did not show better face recognition ability when prompted where to look than in the unprompted condition, and did not show better performance when the eyes were the changed region compared to the mouth. Performance on the control task was comparable between groups.
Conclusions: Children with ASD showed similar looking patterns to TD children; they had a bias for first looking to the eye region. Further, this bias was difficult to inhibit even when it was an optimal strategy for task performance. Both groups overcame this initial bias and spent most time looking at the prompted region. The data indicate that it is possible for children with ASD to show typical patterns of looking to the face, albeit in a controlled laboratory environment. However, unlike the TD group, children with ASD could not benefit from the prompts and their behavioural performance did not improve.

221 **110.221** Support Needed for Japanese Adolescent Girls with ASD: The Gap Between Girls with and without ASD

Y. Nishio[1] *and M. Torii*[2]*, (1)Kobe University, Osaka, Japan, (2)Kobe University, Kobe, Japan*

Background:
Only a few studies have been conducted on females with Autism Spectrum Disorder (ASD). Females often have different difficulties than males. If we focus on the sex differences, we should direct our attention to adolescence. It's a period in which not only physical changes but mental ones appear in the development of secondary sex characteristics. Accordingly, their social relationships change and the child-parent relationship often becomes strained. When we consider those with autistic characteristics, adolescents with ASD have higher risks of maladjustment than others. Especially in Japan, more for girls than boys, changes in social behavior tend to be expected after puberty. Since the status of women is still lower in Japanese culture, "femininity" is required of them.
Objectives:
The purpose of our study is to clarify support needed for adolescent girls with ASD from the both sides of autistic traits and sex differences.
Methods:
Participants: The typical development (TD) group consisted of 330 adolescents, comprising 174 boys and 156 girls. The ASD group consisted of 43 adolescents, comprising 23 boys and 20 girls. The two groups were matched in age (Mean±SD, TD group: 12y6m±1y2m, ASD group: 11y5m±1y2m).
Materials: We created a questionnaire about attachment to parents (e.g. "Even if I don't tell anything, parents understand my feeling."). There're also sections about distressing experiences of 7 items. Then participants ranked their advisers.
Results:
With regard to attachment to parents, A factorial ANOVA revealed a significant main effect for group ($F_{(1)}$=20.99, p<.001). The ASD group (M=2.79, SD=.77) scored higher than the TD group (M=2.22, SD=.76).
Chi square test and residual analysis compared distressing experiences . Regardless of group, girls had significantly more troubled experiences with health ($\chi^2_{(6)}$=33.08, p<.01) and friendship ($\chi^2_{(6)}$=61.07, p<.01). Only the TD group had significantly sex differences, and TD girls had troubled experience with personality than TD boys ($\chi^2_{(6)}$=33.57, p<.01).
As shown in Table, a similar ANOVA was conducted to compare advisers in group and sex. There was a significant main effect for sex ($F_{(1)}$=6.88, p<.01), girls reporting less consulted with their father than boys. There was a significant main effect for group ($F_{(1)}$=18.22, p<.001), with the ASD group regarding their teacher as an adviser than the TD group. With respect to friends, there were significant main effects of both group ($F_{(1)}$=28.80, p<.001) and sex ($F_{(1)}$=9.18, p<.01).
Conclusions:
These results suggest the ASD group was further behind when it comes to psychological separation from their parents than the TD group. Because it is difficult for the ASD group to promote friendship, their relationship seems to be hard to shift. Consequently, they ask teachers for advice next to parents. Especially TD girls rely on their friends, which was markedly different from girls with ASD. This gap poses a large problem because learning various things from friendship is very important part of growing up socially. A further direction of this study will be to create the support program for adolescent girls with ASD considering not only autistic traits but also sex differences.

Table Comparison of advisers by group and sex

Adviser	ASD		TD		*F*-test
	Boy *M* (*SD*)	Girl *M* (*SD*)	Boy *M* (*SD*)	Girl *M* (*SD*)	
Mother	1.86(1.09)	1.78(.85)	1.71(1.01)	1.92(.93)	Group: $F_{(1)}=.000$, $p=.99$ Sex: $F_{(1)}=.19$, $p=.67$ Interaction: $F_{(1)}=.86$, $p=.36$
Father	0.94(.83)	.66(.55)	1.06(.83)	.69(.71)	Group: $F_{(1)}=.331$, $p=.57$ Sex: $F_{(1)}=6.88$, $p<.01$ Interaction: $F_{(1)}=.15$, $p=.70$
Brother/ Sister	.35(.55)	.41(.64)	.49(.66)	.70(.75)	Group: $F_{(1)}=3.48$, $p=.06$ Sex: $F_{(1)}=1.47$, $p=.23$ Interaction: $F_{(1)}=.45$, $p=.50$
Friend	.33(.45)	.71(.63)	1.01(.83)	1.41(.80)	Group: $F_{(1)}=28.80$, $p<.001$ Sex: $F_{(1)}=9.18$, $p<.01$ Interaction: $F_{(1)}=.01$, $p=.93$
Teacher	.70(.57)	.93(.71)	.47(.56)	.38(.54)	Group: $F_{(1)}=18.22$, $p<.001$ Sex: $F_{(1)}=.59$, $p=.44$ Interaction: $F_{(1)}=3.12$, $p=.08$

Score: First place→3 points, Second place→2 points, Third place→1 point

222 **110.222** Surfing Safely: An Examination of Online Dating Skills in Young Adults with Autism Spectrum Disorder

M. E. Roth[1,2] *and J. Gillis*[3]*, (1)Department of Child and Adolescent Psychiatry, The Child Study Center at New York University Langone Medical Center, New York, NY, (2)Department of Psychology, Auburn University, Auburn University, AL, (3)Department of Psychology, Binghamton University, Binghamton, NY*

Background: Adults with Autism Spectrum Disorder (ASD) have difficulty forming romantic relationships, despite having motivation to establish them. The lack of success through traditional, face-to-face dating may lead adults with ASD to pursue relationships through other modalities, such as online dating. There are a number of advantages offered by online dating for adults with ASD; however, there are also a number of disadvantages to online dating for the population, including potential victimization. Although it has been thought that adults with ASD are at a higher risk for victimization, compared to other clinical populations, only one study to date has examined victimization risk in a sample of adults with ASD (Brown-Lavoie et al., 2014). In addition, it is thought that the core deficits of ASD put adults with ASD at risk for inappropriate courting, also known as "stalking," which was demonstrated by Stokes and colleagues (2007). With regards to online dating, one survey study (Roth & Gillis, 2014) revealed that adults with ASD use online dating, however safety was a primary concern. The victimization risk of adults with ASD, and risk of inappropriate courtship, in online settings has yet to be examined empirically.
Objectives: To date there has not been an empirical examination of online safety skills or online dating skills in adults with ASD, which was the aim of the current study.
Methods: Participants included 30 adults with ASD and 57 typically developing adults, whom were compared on a number of variables including ASD symptoms, dating history, online dating history, sources of learning about dating, online victimization history, inappropriate courtship behaviors, online dating safety knowledge, online dating safety skills, and motivation to remain safe while online dating. Participants completed measures online.
Results: The results revealed that adults with ASD had fewer previous relationships, sources to learn about relationships, and behavioral skills in online dating. Conversely, the ASD group had more online dating experience, previous online victimization, and inappropriate methods of courting. The two groups had equal knowledge of online dating and motivation to remain safe.
Conclusions: Although adults with ASD are interested in, and are using, online dating services, they are less successful in dating compared to same aged peers. In addition, safety concerns may be interfering with adults' ability to enjoy the benefits of online dating. Given that the current study indicates that adults with ASD have poor knowledge regarding online dating safety, fewer sources to learn about dating safety, more online victimization history, more history engaging in inappropriate courting, and less behavior safety skills, it is important for the field to capitalize on the population's motivation to remain safe while online and help adults with ASD lead safe and productive social and romantic lives.

223 **110.223** Systematic Evaluation of Self-Esteem, Internalizing Symptoms, and Theory of Mind in Youth with ASD, ADHD, and Typical Development

J. B. McCauley[1,2]*, M. A. Harris*[2]*, M. C. Zajic*[3]*, H. K. Schiltz*[2]*, L. E. Swain-Lerro*[3]*, T. Oswald*[1]*, N. S. McIntyre*[3]*, K. Trzesniewski*[2]*, P. C. Mundy*[4] *and M. Solomon*[5]*, (1)University of California at Davis MIND Institute, Sacramento, CA, (2)Human Development, University of California at Davis, Davis, CA, (3)University of California at Davis MIND Institute, Davis, CA, (4)Education and Psychiatry, University of California at Davis, Sacramento, CA, (5)MIND Institute, Sacramento, CA*

Background: Although self-esteem is a robust indicator of a wide range of clinically significant mental health outcomes in youth with typical development (TYP) and with Attention Deficit Hyperactivity Disorder (ADHD), little is known about these relations in youth with autism spectrum disorder (ASD). Self-esteem reports from youth with ASD may provide a new barometer of mental health within the population. Although, impairments in social-cognitive skills thought to be requisite for self-assessment, such as theory of mind (ToM), may compromise the validity of these reports.
Objectives: The objectives of the current study were to: (1) describe how individuals with ASD rate their self-esteem compared to age-matched individuals with ADHD, and TYP; (2) test how self-esteem relates to anxiety and depression in all three groups; and (3) examine if ToM performance moderated these associations.
Methods: 98 children and adolescents, aged 9 to 17 (See Table 1), were administered a battery of questionnaires and assessments as part of a longitudinal study of academic functioning. Participants completed two measures of self-esteem -- the Marsh SDQ (Marsh, 1992), and the Lifespan Self-esteem questionnaire (LSE; Harris, 2015) -- along with measures of depressive symptoms (Center for Epidemiological Studies-Depression Scale [CES-D; Radloff 1977]), and anxiety symptoms (Multidimensional Anxiety Scale for Children, 2nd edition [MASC-2; March 1997]). Furthermore, participants were administered two tasks of ToM capabilities, the Strange Stories (Happe, 1994), and the Silent Films (Devine & Hughes, 2013) tasks. ANOVAs, correlations, and multiple regressions were performed using SPSS 22.
Results: There were no significant differences between the ASD, ADHD, and TYP group ratings of self-esteem assessed on both the Marsh SDQ, $F(2, 94) = 2.25$, $p=.11$, and the LSE, $F(2, 94)=2.10$, $p=.13$. As predicted, self-esteem ratings were negatively correlated with depressive symptoms across all three groups (Pearson's r's ranged from -.62 to -.47). Self-esteem was negatively associated with anxiety symptoms in the ADHD ($r(23)=-.56$) and TYP groups ($r(32)=-.60$), but had a positive association in the ASD group ($r(37)=.31$) that was driven by the Obsessions and Compulsions and Harm Avoidance subscales of the MASC-2, suggesting that endorsing items on these scales, emphasizing following rules and insistence on sameness, may be closely related to self-worth for individuals with ASD. Furthermore, there was no evidence that ToM moderated the relations between self-esteem and both depressive symptoms and anxiety symptoms in the ASD and ADHD groups.
Conclusions: All three groups demonstrated comparable self-esteem ratings that were negatively associated with depression. There were inconsistencies between the groups' reports of the relations between self-esteem and anxiety symptoms. The ASD group reported that self-esteem was positively associated with anxiety symptoms involving following rules and compulsive behaviors, suggesting they may be interpreting some anxiety symptoms idiosyncratically. Finally, there was no evidence that ToM moderated the relations between self-esteem and internalizing symptoms in the ASD and ADHD groups, indicating that ToM abilities are not impacting the validity of these reports. Consequently, these results indicate that children and adolescents with ASD can report self-esteem relatively accurately and may provide insights to mental health functioning across groups.

Table 1
Sample Characteristics

	ASD (n=39)	TYP (n=34)	ADHD (n=25)
Males (%)	33 (85%)	22 (65%)	18 (72%)
Females (%)	6 (15%)	12 (35%)	7 (28%)
Chronological Age (SD)	12.75 (2.22)	12.82 (2.26)	13.01 (2.20)
Verbal IQ (SD)	96.97 (15.62)	110.56 (14.44)	100.96 (14.75)
Nonverbal IQ (SD)	104.41 (15.57)	117.06 (15.04)	100.68 (15.10)
Full-Scale IQ (SD)	100.48 (13.91)	115.59 (13.83)	100.96 (15.04)
ADOS-2 Total	10.46 (2.87)	NA	3.48 (3.88)
ADHD Comorbidity	8 (21%)	NA	NA

224 **110.224** The Extent and Nature of Conflict within the Peer Relationships of Adolescents on the Autism Spectrum

F. R. Sedgewick[1], *V. Hill*[2] *and E. Pellicano*[1], *(1)Centre for Research in Autism and Education (CRAE), UCL Institute of Education, University College London, London, United Kingdom, (2)Psychology and Human Development, UCL Institute of Education, London, United Kingdom*

Background: Friendships are a crucial part of our development as social individuals, from childhood through to adulthood. Conflict within these relationships is a ubiquitous phenomenon and can offer insight into the extent and nature of social relationships, particularly the maintenance of friendships. While there has been a great deal of research on autistic children and adolescents' friendships and on the conflict that occurs outside of friendships (in the form of bullying), to our knowledge there is no research on the conflict experienced by autistic adolescents *within* their friendships and peer relationships.
Objectives: This study sought to understand the extent and nature of the conflict experienced within the relationships of adolescents on the autism spectrum, using interview and questionnaire-based methods. We also investigated the relationship between adolescents' social awareness and the degree of conflict within their friendships.
Methods: Data collection is ongoing. Nine adolescents with autism, aged 11–16 years, have taken part. Participants completed an in-depth semi-structured interview about their friendships, in addition to the Friendship Qualities Scale (FQS), a test of perceived best-friendship quality (which included a Conflict subscale), the Revised Peer Experiences Questionnaire (RPEQ), a measure of aggressor/victim status in peer interactions, and The Awareness of Social Inference Test (TASIT), a test of social awareness.
Results: Adolescents on the autism spectrum reported many conflicts with their friends, although these were often unresolved due to the adolescents' focus on their friends' actions rather than underlying motivations. Furthermore, we found that adolescents with greater social awareness had a lower level of conflict within their best-friendship ($r = -.68$, $p < .05$). The effect was similar in direction and strength for two aspects of social awareness (as measured by the TASIT), including sarcasm-awareness ($r = -.55$, $p < .05$) and lie-awareness ($r = -.35$, $p < .05$). Finally, higher conflict levels were associated with a greater likelihood of aggressor-status in peer interactions ($r=.50$, $p < .05$).
Conclusions: These results suggest that conflicts within the friendships of adolescents on the autism spectrum often go unresolved because they fail to focus on the underlying cause of the conflict. These qualitative data were supported by the data from questionnaires, which showed that those who are more aware of others' motivations were more able to negotiate their interactions with peers (i.e. without conflict) and, as a result, more likely to maintain their friendships. These findings highlight the importance of managing conflict within friendships with peers, which might be a limiting factor in autistic adolescents' ability to both obtain and sustain social relationships and should be an important target for intervention.

225 **110.225** The First Step of Reciprocity: Bidirectional Social Influence Intact in ASD. a Computational Psychiatry Study

M. Devaine[1], ***B. Forgeot d'Arc***[2], *A. Duquette*[3] *and J. Daunizeau*[4], *(1)Brain and Spine Institute, Paris, France, (2)Psychiatry, Université de Montréal, Montreal, QC, Canada, (3)Psychology, Université de Montréal, Montréal, QC, Canada, (4)Brain and Spine Institute, INSERM, Paris, France*

Background: Autism originally means « egocentrism ». Despite recent examples of preserved social influence in ASD, the hypothesis that individuals with ASD might be less influenced by others (reduced social influence) and be more influenced by their own ideas when understanding others (strong projection bias) remains appealing
Objectives: In this study, we ask whether adults with ASD (AwASD) learn about and from others' pseudo-personality traits (impatience and prudence) similarly to typically developed adults (TDA). In particular, we want to investigate: (1)whether AwASD's projection bias is stronger than TDA's, (2)whether learning others' pseudo- traits is preserved in AwASD, (3)whether AwASD are immune to social influence for such pseudo- traits.
Methods: AwASD and TDA matched for age, IQ and gender took part to the study (n=48). AwASD had been assessed with ADOS-G and met DSM-IV criteria for an ASD. All participants had FSIQ>85. Participants with self-reported depression (Beck depression Inventory score>20) were excluded. In a series of trials, participants were presented with binary choices involving a trade-off between a cost (in terms of delay or risk) and a reward (high vs low). Participants had to successively make their decisions (block 1,3,5) and predict the choices of another (virtual) participants (block 2,4). Note that, in blocks 2 and 4, participants were given feedback to enable them to learn the virtual participant's pseudo-trait. Based on their choices, we could estimate participants' personality traits (impatience and prudence) in each decision block. In turn, we could manipulate the similarity of the virtual participant, which was endowed with similar (*Same* condition) or different (*Different* condition) pseudo-traits. We measured participants' projection bias by comparing their prediction performance in the Same vs Different conditions (prior to learning), and their sensitivity to social influence by estimating the drift in their trait after having tried to predict the choices of a *Different* other.
Results: Prediction accuracy at the beginning of the prediction blocks was higher in the Same condition than in the Different condition for both groups (AwASD:p=.003,TDA:p= 1e-4), indicating a significant projection bias that was otherwise not different between groups (p=.6). Second, at the end of the prediction phase, accuracy was good in both conditions and did not differed between groups (AwASD:85%,TDA:89%,p=.2).
Moreover, we found that both participants in both groups increase (resp., decrease) the frequency of prudent or impatient choices they make if they previously tried to predict somebody who was more (resp., less) prudent or impatient than themselves (p=.005). This resulted in an alignment of pseudo-traits that was not different between groups (p=.3).
Conclusions: This study is in line with recent results suggesting that social influence is not affected in ASD. For the first time, it also demonstrates that AwASD and TDA differ neither in terms of their underlying projection bias nor in their ability to learn others' pseudo-traits. Altogether, our results suggest that the first step of reciprocity (i.e. observational Theory of Mind) is intact in ASD. Further work remains to be done to understand how AwASD cope with reciprocal social interactions.

226 **110.226** The Impact of Social Skills Development on Fear of Negative Evaluation and the Prediction of Positive Mental Health Outcomes Among Adolescents with ASD

A. McVey[1], *B. Dolan*[1], *A. M. Carson*[2], *J. S. Karst*[3], *S. Stevens*[4], *K. S. Willar*[1], *C. Caiozzo*[1], *E. Vogt*[1], *S. Potts*[1] *and A. V. Van Hecke*[1], *(1)Marquette University, Milwaukee, WI, (2)Autism Center & Psychology Service, Baylor College of Medicine/Texas Children's Hospital, Houston, TX, (3)Children's Hospital of Wisconsin, Wauwatosa, WI, (4)University of Minnesota, Minneapolis, MN*

Background: Fear of negative evaluation (FNE) is defined as a fearfulness of being viewed poorly by others (Winton, Clark, & Edelmann, 1995). FNE often results in hypervigilance during and avoidance of social situations (Mogg, Bradley, De Bono, & Painter, 1997; Wieser, Pauli, Weyers, Alpers, & Mühlberger, 2009). Although this pattern is most common among individuals with social anxiety, research suggests that social anxiety and autism spectrum disorder (ASD) often co-occur, and therefore vigilance-avoidance merits examination in ASD (Bellini, 2004, 2006; Kuusikko et al., 2008). Specifically, research demonstrates that social skills deficits in ASD may significantly influence the development of a fearful response in social situations for these individuals (Bellini, 2003).
Objectives: The primary objectives of this study were to examine if self-report of FNE symptoms significantly decreased over the course of an empirically validated social skills intervention and whether such changes were predictive of improved mental health.
Methods: Seventy-two adolescents ($N = 72$; 10 female) between the ages of 11 and 16 with high-functioning ASD participated in this study. Participants included in this

analysis represent those in the experimental treatment group from a randomized controlled trial. Adolescents received the *Program for the Education and Enrichment of Relational Skills* (PEERS®), a 14-week social skills intervention demonstrated to be effective at improving social competence among teens with ASD (Laugeson, Frankel, Mogil, & Dillon, 2009). Adolescents completed the Social Anxiety Scale (SAS; La Greca, Dandes, Wick, Shaw, & Stone, 1988), the Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998), and the Short Mood and Feelings Questionnaire (SMFQ; Sharp, Goodyer, & Croudace, 2006) at pre-test, post-test, and six months following post-test.
Results: Participants demonstrated a significant decrease in their self-report of FNE (SAS-FNE) from pre-test to six-month follow up ($F(2, 78) = 7.83$, $p = .001$, partial $\eta^2 = .167$). Furthermore, scores on the SAS-FNE were significantly correlated with lower scores on the SIAS ($r(38) = .36$, $p = .022$) and SMFQ ($r(20) = -.538$, $p = .010$) at six-months follow up.
Conclusions: Results suggest that, with the improvement of social skills, adolescents with ASD demonstrate significant declines in symptoms of FNE. These declines are demonstrated, not only from pre- to post-intervention, but also six-months after the treatment period ends. In addition, these improvements predicted lower levels of overall social anxiety and decreased depressive symptoms at six-month follow up. This is consistent with existing literature on social anxiety and ASD that describes a cycle of fear and avoidance that results in a lack of development of social skills which only perpetuates fear and avoidance of social stimuli (Bellini, 2006). This is the first study, to our knowledge, to provide empirical support for the development and maintenance of social skills as functioning to break this cycle and promote lower social anxiety and depressive symptoms among adolescents with ASD.

227 **110.227** The Impact of Transition from Primary to Secondary School on the Psychosocial Adjustment, Sense of School Membership and Academic Progress of Children with Autism Spectrum Disorders

J. S. Hebron, *Oxford Road, University of Manchester, Manchester, England, United Kingdom*

Background: The experience of education has a profound influence on the lives of children, from academic progress through to social understanding, ultimately informing the way in which adult life is negotiated. Secondary school requires a high degree of self-organisation among pupils as they move from the top of the social hierarchy at primary school to the bottom of a more complex one. Despite this, research indicates that deleterious effects are transitory for most children. However, for children with autism spectrum disorders (ASD) the challenge of transition can be significant, and the residual difficulties can be profound and long-lasting. The child-centred environment of a primary school can be difficult to replicate in a secondary school where children have multiple subject staff, whose awareness and understanding of ASD may be limited. In adjusting to secondary school, children are expected to form new social relationships in unfamiliar settings and adapt to changes in routine, both of which are major challenges for pupils with ASD. Despite this apparent vulnerability, there are very few quantitative studies in this area, none of which explore the post-transition trajectory using multiple timepoints. Developing knowledge and understanding of such issues is a crucial step towards designing effective interventions.
Objectives: To explore the effects of the primary to secondary school transition for young people with ASD compared to their typically developing peers (TD), with particular reference to psychosocial adjustment, sense of school membership and academic progress.
Methods: This is a longitudinal study approaching completion. There are four points of data collection (T1-4):

- T1 = June/July 2014 (Year 6, final term of primary school*).
- T2 = November/December 2014 (Year 7 term 1, first year of secondary school)
- T3 = June/July 2015 (Year 7 term 3, first year of secondary school)
- T4 = November/December 2015 (Year 8 term 1, second year of secondary school)

*In England the school year contains three terms and starts on September 1st.
Students were aged between 10 years 9 months and 11 years 9 months at T1. At each time point, students in the ASD ($N = 38$) and TD ($N = 22$) groups, their parents and teachers complete a quality of life questionnaire, with an additional questionnaire for the students on school membership. Attainment in Mathematics/English and attendance are also recorded at each time point. Parents of pupils with ASD completed the Social Responsiveness Scale (2nd ed.) at T1 to permit exploration of within group differences according to severity of autistic symptoms. Background data were collected on each student including gender, support provided in school and educational placement.
Analysis will include descriptive statistics and inferential statistics to assess change over time within and between groups and according to respondent.
Results: Longitudinal findings exploring within and between group differences from T1 to T4 will be presented for the first time at the conference, following the final wave of data collection in November/December 2015.
Conclusions: Findings will be discussed in relation to the existing broader literature, along with a consideration of the implications for policy and practice.

228 **110.228** The Level of Intelligence Modulates the Recognition of Emotional Point-Light Displays in Children with Autism Spectrum Disorder (ASD): A Comparison Between High Functioning and Low Functioning ASD

N. Mazzoni[1], *T. Del Bianco*[1], *I. Landi*[2], *P. Ricciardelli*[3,4], *R. Actis-Grosso*[3,4] *and P. Venuti*[1], *(1)Department of Psychology and Cognitive Science, University of Trento, Rovereto, TN, Italy, (2)MPBA/Center for Information and Communication Technology, Fondazione Bruno Kessler, Trento, TN, Italy, (3)Dept. of Psychology, University of Milano - Bicocca, Milano, MI, Italy, (4)Milan Centre for Neuroscience, Milan, Italy*

Background:
The moving human body is a nuance-rich cue of others' attitude: patients with Autism Spectrum Disorder (ASD) often fail to figure out its meaning and show anomalous pattern of brain activation during motion perception. Besides, their ability to recognize emotion is generally impaired, especially when conveyed by biological elements – motion included. Point Light displays (PLD) are reliable tools to assess the ability to identify the emotion shown through a moving human body. Evidence in the literature mostly involves high-functioning (HF) ASD samples and there is a lack of information on low-functioning (LF) ASD population's abilities. It is still debated if the ASD's impairment in social interaction is related to the processing of biological motion (BM), besides it is unclear the relation between emotion recognition and IQ level.
Objectives:
We explored the ability to understand BM with different emotional valence in children with ASD. We enquired if their impairment was specific for the recognition of emotions or widespread to BM in general. Moreover, we explored the role played by the IQ level in this ability.
Methods:
24 typically-developing (TD) children, 23 children with HF ASD and 17 with LF ASD took part in our study. Respectively, the mean age and IQ of each group were 9.05, 111; 9.5,100; 12.2,49. After each PLD clip, we asked the children to categorize the emotion (fear, happiness, neutral) by pressing the corresponding key. Emotional categories were presented coupled in three separated blocks. The dichotomous choice allowed also LF ASD children to perform the task. Accuracy and response times (RTs) were measured.
Results:
Total accuracy was significantly different according with the functioning: TD children outperformed children with ASD, children with HF ASD showed higher levels of accuracy than children with LF ASD. A positive correlation between accuracy and IQ was found in all the groups, though the generalized linear model which takes IQ into account explained accuracy only in the two ASD groups.
Considering RTs relative to recognized stimuli, TD were significantly faster than ASD; no differences emerged between HF and LF ASD groups. IQ resulted negatively correlated with rapidity and significantly predicted it in the generalized linear model for all the three groups.
Comparing performances between the three emotional categories: TD were significantly more accurate and faster in recognizing of all the three classes of stimuli, while no differences between ASD groups emerged.
Conclusions:
Our findings suggests that the ability to recognize the emotional meaning of BM is impaired in ASD children, independently of its emotional content.
Cognitive level seems pivotal for recognizing affective biological motion in children with ASD. Although IQ doesn't seems to impact the accuracy of this mechanism when it works properly, it is important when the mechanism is impaired. A more efficient cognitive substrate might mediate the acquisition of compensatory mechanisms, which help ASD children to better understand the human gestures. Besides, for all participants IQ is important for promptly recognize the stimuli. Therefore, the IQ level seems to mediate the efficiency of the biological motion processing, boosting its rapidity.

229 **110.229** The Preschool Imitation and Praxis Scale (PIPS): Measure Standardization and Autism Spectrum Disorder (ASD)-Specific Imitation Profiles in High-Functioning Preschoolers

M. Vanvuchelen[1] *and H. Roeyers*[2], *(1)Faculty of Medicine and Life Sciences- Rehabilitation Research Centre (REVAL), Hasselt University, Diepenbeek, Belgium, (2)Ghent University, Ghent, Belgium*

Background:
Although imitation impairments are often reported in children with ASD, previous work has not yet determined whether there is a profile of preserved and impaired imitative abilities that is specific to ASD. Insight into this profile has the potential to make a significant difference in our ability to facilitate social learning in this population.
Different ways of copying others' actions often serve different functions and reflect distinct underlying processes; for instance copying to learn about objects (i.e., procedural imitation) versus copying to be social (i.e., bodily imitation). Studies of imitation have also compared meaningful and meaningless actions. The factor of meaning is almost inevitably confounded with familiarity because such actions are likely to have been performed before. Meaningless actions are often novel. Another dimension explored in a

number of studies concerns the temporal complexity of the demonstrated actions (i.e., singular versus sequential actions) (Vivanti & Hamilton, 2014).
The general pattern emerging from the available literature is that children with ASD imitate actions on objects better than actions that do not involve objects, have more difficulties in the imitation of meaningless than meaningful gestures, and find it more difficult to imitate sequences of actions than singular actions (Vivanti & Hamilton, 2014). However, major drawbacks of former studies are that different types of actions are not investigated at once in a single study and that they have looked at the accuracy of imitation performance without controlling for age and developmental level. Given these gaps it is impossible to come to a firm conclusion about an ASD-specific imitation profile.
Objectives:
The present study aims to report the standardization of the Preschool Imitation and Praxis Scale (PIPS) and to apply this measure to examine the imitation profile of high-functioning preschoolers with an ASD.
Methods:
To construct the PIPS action types with different effects (salient environmental in procedural, internal in bodily imitation), representational levels (meaningful, meaningless), temporal complexities (singular, sequential) and visual monitoring possibilities (transparent, opaque) were chosen to tap the full range of possible imitation mechanisms. Performances on the 30 imitation tasks are scored on a 3 to 5 point scale, which evaluates the spatiotemporal resemblance between the modelled and copied actions. 654 typically developing children (TDC) and 33 children with ASD between 23 and 53 months of age (performance IQ 85-113) participated in the standardization study.
Results:
PIPS scale has produced high internal consistency and demonstrates acceptable intra- and interrater and test-retest reliability. Bodily and procedural imitation age-equivalents were derived from PIPS scores of 654 TDC between 12 and 59 months of age (Vanvuchelen, et al., 2011a,b,c). Further details on the results will be presented at the meeting.
Conclusions:
The PIPS is a much-needed and comprehensive measure of imitation skills and abilities, which has been standardized on a population of TDC. The application of this measure to young, high-functioning children with ASD in the current study is a critical first step towards a detailed understanding the unique profile of imitation skills in this population, which has been elusive to date.

230 **110.230** The Recognition of Self-Conscious Emotions from Situational Contexts in Children with and without Autism Spectrum Disorders

D. Davidson[1] *and E. Hilvert*[2]*, (1)Loyola University Chicago, Chicago, IL, (2)Loyola University, Chicago, IL*

Background: The ability to understand and reflect upon one's own emotions and the emotions of others is central to emotional competence. Self-conscious emotions, in particular, are thought to facilitate our social interactions and relationships by motivating us to adhere to social norms (guilt) as well as personal standards (pride).
Objectives: Despite the importance of self-conscious emotions, almost all studies have explored basic emotion processing in children with ASD (see Uljarevic & Hamiliton, 2013). Moreover, recognition of emotions is often assessed through facial recognition tasks, with emotions presented at full intensity. The purpose of this research was to assess the recognition of basic and self-conscious emotions from situational contexts that varied in intensity. Relations between emotion recognition, ASD symptomatology, and Theory of Mind (ToM) were also explored.
Methods: Twenty-three children with ASD and 25 neurotypical (NT) children were tested. No significant differences between groups were found for age, male:female ratio, or non-verbal reasoning (Table 1). Children were given a situational emotional test that provided 12 emotional situations for basic (happy, fear, sad) and self-conscious (pride, embarrassment, guilt) emotions. An intense and a less intense version of each emotion were presented. Children were asked to label the emotions (free, cued) and rate the intensity and duration of the emotions (1-5 scale).
Results: Mixed-model ANOVAs and follow-up tests with Bonferroni correction were conducted. In the *cued response* condition, NT children were significantly better than children with ASD at recognizing intense examples of pride, embarrassment and guilt, and non-intense examples of pride and embarrassment (Table 2). NT children were better at recognizing fear from intense and non-intense situations. In the *free response*condition, NT children were better at recognizing intense examples of embarrassment and guilt, and non-intense examples of embarrassment. All children were good at labeling fear in the intense condition (Table 2). No significant group differences were seen in the recognition of happy and sad emotions. All children rated the intensity and duration of "intense" emotions as greater than that for "less intense" emotions. Children with ASD rated situations eliciting pride and embarrassment as being more intense and longer lasting than NT children (Table 2). Significant relations were found between ToM scores and the recognition of emotions in children with ASD, but not in NT children. No other significant relations were found.
Conclusions: The present study shows that children with ASD are generally less accurate than NT children in their recognition of self-conscious emotions from situational contexts. This is important given the significance of self-conscious emotions in terms of emotional competence. These results conflict with a study (Tracy et al., 2011) showing that children with ASD are as accurate as NT children at recognizing pride from facial expressions—suggesting that the measurement of emotions (facial vs. situational) is important. Consistent with facial recognition studies (Tell et al., 2014), some evidence was found that children with ASD were generally less accurate than NT children at recognizing fear. ToM abilities appear to underlie emotion recognition in children with ASD, but not in NT children.

Table 1 ***Comparison of Matching Variables and Participant Characteristics***

	Diagnostic Group	
	ASD (N=23)	***NT (N=25)***
Age	11;09 (2.0)	11;06 (2.1)
Males/Females	19:4	19:6
SRS-2 T-Score***	74.1 (8.4)	47.3 (7.2)
CARS-2 Raw Score	31.3 (4.1)	---
CARS-2 T-Score	46.6 (6.2)	---
WASI-2 FSIQ*	97.0 (16.3)	106.0 (10.7)
Nonverbal Reasoning	49.0 (13.3)	50.1 (6.1)
WASI-2 Vocabulary***	46.4 (10.8)	57.6 (8.0)
Faux Pas Detection Score (out of 10)	5.2 (3.2)	6.08 (2.5)
Strange Stories (out of 16)	9.8 (2.6)	10.7 (2.3)

Note. SRS-2: Social Responsiveness Scale-2, CARS-2: Childhood Autism Rating scale-2, WASI-2: Wechsler Abbreviated Scale of Intelligence-2. * $p < .05$.** $p < .01$. *** $p < .001$.

Table 2 ***Mean Proportion Correct in Recognizing Basic and Self-Conscious Emotions from Situational Contexts in Children with Autism Spectrum Disorders (ASD) and Neurotypical (NT) Children***

			CUED RESPONSE CONDITION			
	Basic Emotions			Self-Conscious Emotions		
	Happy	**Sad**	**Fear**	**Pride**	**Embarrassed**	**Guilt**
Intense						
ASD	.61 (.49)	.89 (.34)	.70 (.47)[a]	.78 (.42)[a]	.74 (.45)[a]	.43 (.51)[a]
NT	.60 (.50)	.83 (.38)	.92 (.28)	.92 (.28)	.92 (.28)	.76 (.44)
Non-Intense						
ASD	.78 (.45)	.83 (.39)	.65 (.49)[a]	.61 (.49)	.52 (.51)	.34 (.49)
NT	.83 (.38)	.80 (.41)	.80 (.41)	.68 (.48)	.64 (.49)	.36 (.49)
			FREE RESPONSE CONDITION			
	Basic Emotions				Self-Conscious Emotions	
	Happy	**Sad**	**Fear**	**Pride**	**Embarrassed**	**Guilt**
Intense						
ASD	.56 (.51)	.91 (.27)	.91 (.28)	.61 (.50)	.69 (.47)[a]	.43 (.51)[a]
NT	.60 (.50)	.92 (.28)	.92 (.28)	.56 (.51)	.92 (.28)	.64 (.49)
Non-Intense						
ASD	.78 (.42)	.73 (.45)	.65 (.43)[a]	.61 (.49)	.43 (.51)[a]	.13 (.34)
NT	.72 (.46)	.76 (.44)	.88 (.33)	.56 (.51)	.68 (.48)	.20 (.41)

Note. [a] Denotes significant group differences. Situations were approximately three to four sentences in length, and had been validated for each emotion and intensity level by adults ($N = 45$) prior to the start of the experiment. Children were asked to identify the emotion of a child protagonist in each situation, and using rating scales, to rate how intensely the protagonist experienced the emotion as well as estimate the duration of the emotion. Children with ASD rated the intensity (M_{ASD} 4.3/5.0; M_{NT} 3.9/5.0) and duration (M_{ASD} 4.2/5.0; M_{NT} 3.3/5.0) of pride situations, as being greater than NT children. A similar pattern was found for the intensity (M_{ASD} 3.78/5.0; M_{NT} 3.40/5.0) and duration ratings (M_{ASD} 2.74/5.0; M_{NT} 2.6/5.0) for embarrassment. For all children, the free response condition was administered before the cued response condition. Standard deviations are in parentheses.

231 **110.231** The Relationship Between Interpersonal Synchrony and Social Attention during Rhythmic Inter-Limb Coordination Tasks in Children with Autism Spectrum Disorder

S. Izadi-Najafabadi[1], *I. Park*[2], *S. Srinivasan*[1], *M. Kaur*[1], *T. Gifford*[2], *K. L. Marsh*[3] *and A. N. Bhat*[1], *(1)University of Delaware, Newark, DE, (2)University of Connecticut, Storrs, CT, (3)Psychology, University of Connecticut, Storrs, CT*

Background:
Children with Autism Spectrum Disorder (ASD) have significant social impairments such as reduced social attention/monitoring and eye contact (American Psychiatric Association, 2013). This will affect their ability to learn everyday activities through observational learning. In addition, motor coordination impairments observed in children with ASD will affect their ability to synchronize and keep up with others subsequently contributing to their social disconnect (Bhat, Landa, Galloway, 2011). To date, no study has examined the relationship between the direction of social gaze and interpersonal synchrony (IPS) in children with ASD.
Objectives:
In this study, we aimed to compare the direction of social gaze and IPS between children with ASD and typically developing (TD) children during various simple (dual-limb, clap, march, alternate drumming) and complex (multilimb, march-clap and asymmetrical drumming) coordinated rhythmic actions performed with a social partner.
Methods:
11 children with ASD and 12 age- and gender-matched TD children between 4 and 12 years of age were observed in a dyadic context during simple and complex rhythmic actions of clapping, marching, and drumming. Children were asked to perform these activities while synchronizing their movements with an adult social partner and a metronome beat. During these activities we recorded the visual field of the child by placing a wide-angle camera on the forehead to record gaze direction. Gaze direction was coded as looking at the upper or lower body of the social partner or away within the central visual field of the child. IPS was coded as the proportion of total time the child was in, opposite, or out of synchrony with the social partner.
Results:
We found that children with ASD spent more time looking away (14.43±15.37) compared to TD children (3.22±6.31) indicating deficits in sustained social monitoring. Moreover, children with ASD (drum: 61.16 ± 38.64, march: 87.83 ± 13.84, clap: 63.95 ± 28.28) were less synchronous in their movements with the social partner compared to the TD children (drum: 97.12 ± 14.5, march: 98.32 ± 5.92, clap: 95.52 ± 6.90). In both groups, leg motions (Complex march: 91.66 ± 13.63, Simple march: 94.62 ± 9.12) were more synchronous than arm motions (Complex clap: 79.65 ± 23.73, Simple clap: 80.33 ± 27.26). Lastly, during the simple actions both groups attended to the task-relevant limbs i.e.; lower-limb during marching or upper limb during clapping. However, during complex multilimb actions, both groups appear to simplify their perceptual information by primarily focusing on the clapping hands than the marching feet.
Conclusions:
Our results show how social monitoring impairments may contribute to the lack of interpersonal synchrony in children with ASD. Movement clinicians such as OTs/PTs must encourage focused social attention as well as socially embedded motor activities in children with ASD to further enhance their interpersonal synchrony with others.

232 **110.232** The Relationship Between Socialization Skills and Externalizing Problems in Autism Spectrum Disorder

N. Shea[1], *J. Kopec*[2], *E. Payne*[1], *E. McKernan*[1] *and N. Russo*[1], *(1)Syracuse University, Syracuse, NY, (2)Psychology, Syracuse University, Syracuse, NY*

Background: Although not a core symptom of Autism Spectrum Disorders (ASD), externalizing symptoms such as aggression and behavior problems are common and have the potential to negatively impact daily functioning and academic achievement (Klin & Volkmar, 2000; Volker et al., 2010). Klin & Volkmar (2010) suggested that externalizing behaviors associated with ASD may be a function of social difficulties (Klin & Volkmar, 2000). Specifically, it has been suggested that individuals with ASD engage in problem behaviors to achieve desired social responses as a result of difficulties adjusting to social demands in socially appropriate ways (Macintosh & Disssanayake, 2006). Despite this suggestion, there has been no empirical assessment of this postulated relationship.
Objectives: The goals of this study were to (a) provide empirical evidence to support the relationship between socialization and behavior problems, (b) and to investigate whether this relationship is unique to individuals with ASD.
Methods: Participants in this study included 20 children with ASD and 34 typically developing (TD) children. Participants with ASD met diagnostic criteria for ASD as determined by the Autism Diagnostic Observation Schedule, Second Edition, Autism Diagnostic Interview-Revised, and clinical judgment based on DSM-5 criteria. All participants were administered the Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II; Wechsler, 2011). Parents of participants completed the Vineland Adaptive Behavior Scales, Second Edition (Vineland-II; Sparrow, Cicchetti, & Balla, 2005) and the Behavioral Assessment System for Children, Second Edition (BASC-2; Reynolds & Kamphaus, 2004). Of interest to the present study were the Externalizing Problems Domain on the BASC-2 and the Socialization domain on the Vineland-II. Participant's ages and IQ scores are presented in Table 1. There was a significant difference in Full Scale and Verbal IQ (but not in the Perceptual Reasoning Index) between the typically developing and ASD groups, however IQ was not significantly correlated with the relevant Vineland or BASC-2 scales for either of the two groups.

Results: Linear regressions were run separately for the ASD group and the TD group to predict Socialization scores on the Vineland-II from the Externalizing Problems scores on the BASC-2. Externalizing problems predicted social functioning in the expected direction for the individuals with an ASD $F(1,18) = 9.96$, $p = .005$, with an R^2 of .356, but not for the TD participants $F(1,32) = 1.745$, $p = .196$, with an $R^2 = .052$.
Conclusions: These findings support the relationship between socialization and behavior problems in ASD, specifically that children with more socialization difficulties have more behavior problems. Further, this relationship might be unique to individuals with an ASD, though this specification requires further study.
(Table 1 is uploaded as an image)

Table 1

	N	Age	FSIQ*	PRI	VCI*
ASD M (SD)	20 (6 female)	11, 10 (2)	102.95 (10.63)	103.45 (11.16)	101.80 (12.91)
TD M (SD)	34 (17 female)	10, 5 (3)	112.29 (11.76)	106.09 (14.26)	115.29 (10.50)

Notes. M = mean, SD = standard deviation, FSIQ = Full Scale Intelligence Quotient, PRI = Perceptual Reasoning Index, VCI = Verbal Comprehension index. Age is represented in years, months. * Indicates significant differences at the p<.05 level.

233 **110.233** The Role of Theory of Mind in the Daily Living Skills of Children with ASD

T. Estrada[1], *R. Bowler*[1], *E. A. Lovell*[1], *K. Duskin*[1] *and B. Wilson*[2], *(1)Seattle Pacific University, Seattle, WA, (2)Clinical Psychology, Seattle Pacific University, Seattle, WA*

Background: Children with autism spectrum disorder (ASD) commonly exhibit deficits in activities of daily living (ADL) skills when compared to typically developing (TD) peers (Bal et al., 2015). Additionally, social deficits are defining characteristics of children with ASD (APA, 2013) and have been shown to predict decreased ADL abilities (Bal et al., 2015). The present study hypothesized that that the ADL deficits seen in children with ASD are related to Theory of Mind (ToM), an indicator of social perception (Kimhi et al., 2014). ToM skills are often impaired in children with ASD (Baron-Cohen, Tager-Flusberg, & Cohen, 1985; Kimhi et al., 2014).
Objectives: This study aimed to develop a greater understanding of how social factors may contribute to decreased ADL skills in children with ASD. Therefore, the purpose of this study was to test our hypothesis that ToM abilities would moderate the association between children's status and their ADL skills.
Methods: Participants included seventy-two children, ages 3:0 to 6:11. Twenty-two children were previously diagnosed with ASD and 50 children were TD. Children completed a ToM battery in a laboratory setting. Parents' ratings from the *BASC-2* (Reynolds & Kamphaus, 2004) were used to evaluate children's ADL skills. Additionally, the *DAS-II* (Elliott, 2007) was used to assess children's language abilities.
Results: A moderation analysis using the SPSS macro PROCESS (Hayes, 2013) tested whether the association between developmental status and ADL skills was moderated by ToM abilities. Controlled variables included children's language abilities and age. The main effect of status on ADL skills was significant ($B = -45.93$, $SE = 14.96$, $p < .001$) but the main effect of ToM skills on ADL skills was not significant ($B = .09$, $SE = .88$, $p = .14$). The contribution of the interaction between status and ToM was significant, $\Delta R^2 = .04$, $F(21, 66) = 4.64$, $p < .05$. Specifically, children with ASD who had low (-1 SD; $B = -20.26$, $SE = 4$, $p < .001$) and mean ($B = -13.82$, $SE = .2.91$, $p < .001$) levels of ToM abilities had lower ADL skills when compared to TD children. However, when children with ASD had greater ToM abilities (+1 SD; $B = -7.38$, $SE = 4.34$, $p = .09$), their ADL scores were not significantly different from TD children. This suggests children with ASD may have comparable ADL skills when they also display higher ToM abilities.
Conclusions: These results supported our hypothesis that the association between status and ADL skills would be moderated by ToM abilities. Specifically, when children with ASD had low or mean levels of ToM abilities, they had greater deficits in ADL skills than TD children. However, this relation was not significant for children with ASD who had ToM abilities above the mean, which suggests that their high ToM skills may buffer them against potential deficits in their daily living skills which are characteristic of ASD. The findings suggest that targeting interventions to increase ToM abilities may play a role in improving ADL skills for children with ASD and, therefore, improve independence.

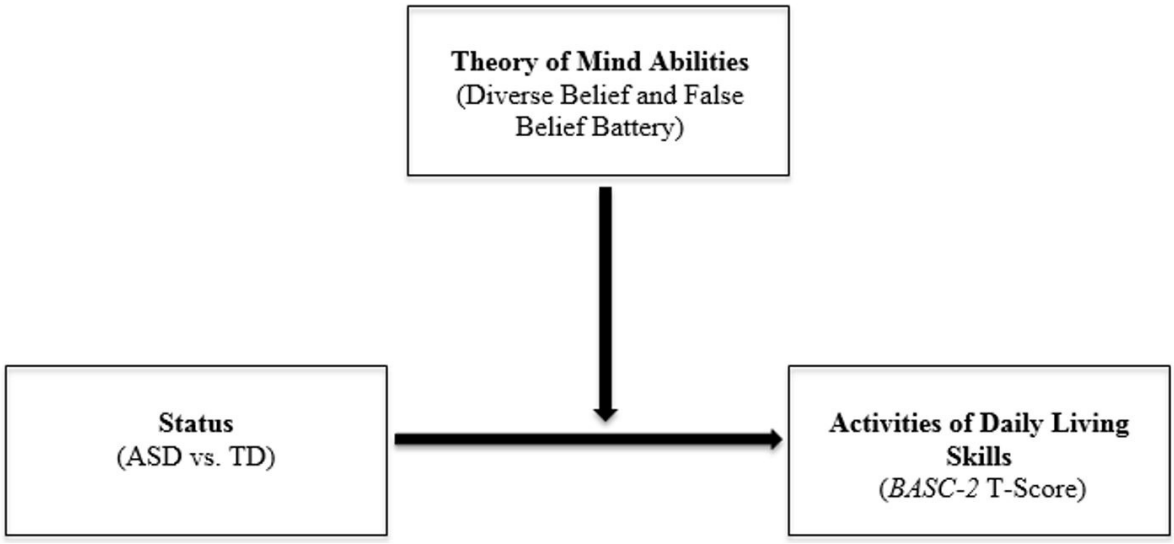


Figure 1. Moderation model

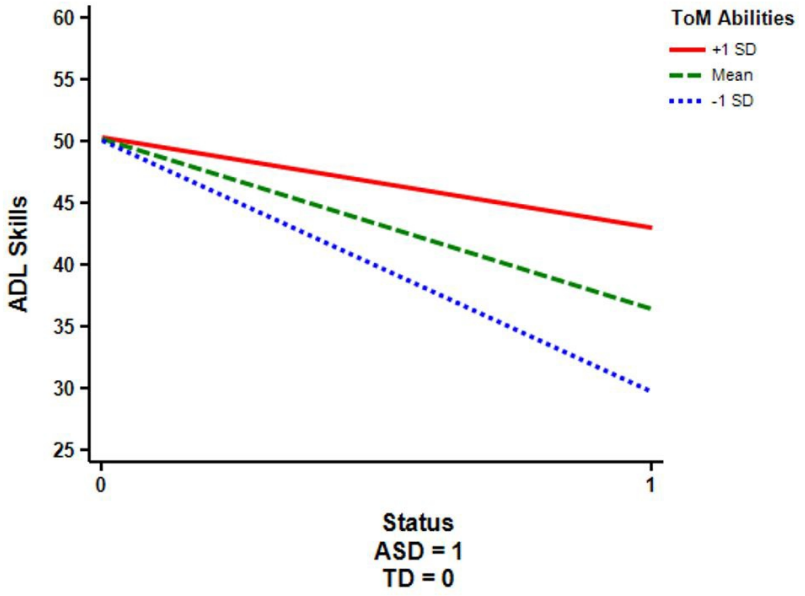


Figure 2. The interaction between status and ADL skills at high, mean, and low levels of ToM abilities

234 **110.234** The Stare-in-the-Crowd Effect: How We Notice When Others Look at Us and How This Is Affected By Psychopathology

E. T. Crehan[1,2], *H. E. Frering*[1], *N. Durand*[1], *C. Pirro*[1], *K. Reeves*[1] *and R. R. Althoff*[3], *(1)Psychology, University of Vermont, Burlington, VT, (2)Psychology, University of Alabama, Birmingham, AL, (3)Psychiatry, Psychology, and Pediatrics, University of Vermont, Burlington, VT*

Background:
Humans are particularly adept at detecting if someone is looking at them in a crowd of other faces. This “stare-in-the-crowd effect” is implicated in numerous moment-to-moment interactions yet relatively little is known about its characteristics. Properly detecting and reacting to gaze informs social interactions; deficits in this perceptual system cause an individual to miss out on large amounts of social information and is a core deficit observed in ASD. A newly validated paradigm was used to study stable gaze detection as well as dynamic (e.g. catching another person staring and getting caught staring) to capture these deficits.
Objectives:
-To determine if different gaze conditions elicit differential eye movements and physiological arousal
-To determine how the stare-in-the-crowd effect presents relative to ASD and related traits
Methods:
A total of 36 young adults (ages 18-35) completed an eye tracking task, heart rate monitoring, a brief cognitive assessment, and three self-report questionnaires, including the Social Responsiveness Scale (SRS), the Theory of Mind Inventory (ToMI), and the Liebowitz Social Anxiety Scale (LSAS). Four eye tracking outcomes (interest area (IA) dwell time, IA fixation count, and IA second fixation duration, and pupil size) and one heart rate outcome (RMSSD) were analyzed in four eye tracking conditions.
Results:
The overall sample included 36 adults (M = 20.53, SD = 2.22; 41.7% female). Of these, 15 were diagnosed with ASD or PDD and 21 were not. There were no significant differences between the two groups by age, sex, or IQ. Two by four ANOVAs yielded a significant interaction of diagnosis and condition on IA dwell time ($F(3,139)=5.67$, $p<.005$); a significant interaction of diagnosis and condition on IA second fixation duration ($F(3,139)= 4.77$, $p<.005$); a non-significant interaction of diagnosis and condition on IA second fixation duration ($F(3,139)=2.18$, $p=.094$); and no significant main effects or interaction of diagnosis and condition on pupil size ($F(3,139)=1.5$, $p=.33$).
Change scores for IA Dwell time, IA Fixation count, IA Second Fixation Duration, Pupil Size, and RMSSD were calculated relative to stable and dynamic conditions (e.g. How many more IA fixations did a person make in the Catching another staring and getting caught staring conditions versus the Stable Averted and stable Mutual conditions?) and relative to amount of self-directed gaze conditions (e.g. What was the difference in RMSSD between the Stable Averted and Catching another staring conditions versus Stable Mutual and Getting caught staring conditions?). Regressions using the SRS and LSAS to predict psychophysiological outcomes were not significant. Advanced theory of mind as measured on the ToMI significantly predicted IA Fixation Count, IA Dwell Time, and RMSSD.
Conclusions:
The pattern of differences in eye tracking outcomes confirms that individuals with ASD are impacted by the stare-in-the-crowd effect but to a lesser extent than typically-developing individuals. Advanced theory of mind is significantly associated with gaze behavior. Both group comparisons and dimensional analyses highlight targets for intervention.

235 **110.235** The Use of Ipads to Enhance Joint Attention Skills in Children with Autism Spectrum Disorder (ASD)

C. Mangafa, *L. Moody, A. Woodcock and A. Woolner, School of Art and Design, Coventry University, Coventry, United Kingdom*

Background: iPads™ are increasingly used in primary schools with reported benefits in communication, independent learning and creativity. Children with autism spectrum disorder have an affinity with mobile technology, which is recognised by the autism research community with many studies emerging in this field. Joint attention (JA) is an essential life skill which can indicate the later development of social communication and language acquisition. It is usually absent or impaired in children with autism, which means that they often find it difficult to share attention with an adult or peer about a toy or activity by keeping eye contact and pointing, but also showing interest to the other person. Research on the use of iPads™ to develop JA skills in autism is still in infancy.
Objectives: This qualitative study aims to explore primary school teachers' and parents' perspectives and experiences of developing JA skills in children with autism using iPads™.
Methods: Semi structured interviews with 16 school staff members and non-obtrusive observations of 12 pupils interacting with their teacher using iPads™ were held in three UK schools. Also, parents of children with autism aged 4-11 years old are currently being interviewed to investigate parents' practice of developing JA beyond school hours and exploring the iPad™'s benefits in promoting JA in different contexts.
Results: All teachers used teaching strategies to promote JA on a daily basis but a few used iPads™ in their classroom. Participants expressed different opinions about the effectiveness of teaching strategies and iPad™ use in developing JA.The observations showed that teachers used a variety of evidence-based strategies to engage their pupils with autism in JA opportunities but that there was little use of iPads™. The iPad™ was mainly used as a reward, a motivator to direct and sustain pupils' attention, to practice turn-taking and waiting skills and to teach the curriculum. Preliminary findings derived from the semi structured interviews with parents have shown that parents use a variety of social activities to boost their child's joint attention skills. Their views though were contradictory regarding the iPad™'s contribution in developing JA skills, with a few parents mentioning that the iPad™ can be a solitary device that can further isolate their child from daily human interactions while other parents have mentioned that the iPad™ is a motivating tool used to grasp their child's attention and teach them JA. Parents have also mentioned that they wish to have stronger links with their child's school.
Conclusions: The research concludes that schools would benefit from teacher training and dissemination of good practice on how to use iPads™ for JA purposes. Parents are also interested in discovering how they can best address their children's needs in cooperation with the schools. To that end, the future steps of this research include creating guidelines about the way to develop JA opportunities at home and school with the use of the iPad™ as an engaging educational device.

236 **110.236** Understanding Social Versus Private Intention: Exploring the Neural Correlates of Intention Understanding Based on Intentional Content

N. I. Berger, *Michigan State University, East Lansing, MI*

Background: Given that children with ASD demonstrate impairment in social-cognition, developing a comprehensive understanding of intention understanding in ASD is important as it is believed to be a foundational skill upon which higher level social-cognition is built. Recent behavioral work in young children with significant ASD symptomatology suggests that while deficits are not present on tasks requiring intent to be inferred from an actor's action on an object (private intention), impairment is evident on tasks in which intent must be inferred from the actor's social-communicative behavior such as eye gaze, vocalizations, or facial expressions (social intention). However, it is unclear whether the neural correlates supporting each type of intention are distinct.
Objectives: The purpose of this study was to validate a novel ERP paradigm to assess the neural correlates of private and social intention understanding that could be used to examine these constructs in children with ASD. As part of this validation process, we examined the relationship between the neural correlates of each type of intention understanding and autistic traits.
Methods: We examined neural indices of attention to social and non-social intention understanding in 35 typically developing young adults, exploring modulation of each type of intention understanding by level of autistic traits. Participants viewed a sequence of pictures depicting either social or private intention with the final picture of the sequence varying such that sometimes the actor completed the intended action and sometimes he performed an unintended action. Participants made a response only if the actor did what he intended to do; no responses were made to unintended actions. Autistic traits in this non-clinical sample were quantified using the Broader Autism Phenotype Questionnaire.
Results: Across participants, there was a main effect of trial type, such that unintended actions resulted in greater allocation of attention — as indexed by larger P3 amplitude — compared to intended actions, and a main effect of intentional content, such that private intention stimuli resulted in greater allocation of attention — as indexed by larger P3 amplitude — compared to social intention stimuli. An interaction between trial type and intentional content was also observed, which indicated that the difference in P3 amplitude between intended and unintended actions was greater for private than for social stimuli. Higher expression of autistic traits, specifically aloofness, was correlated with an attenuated allocation of attention — as indexed by smaller P3 amplitude — for social intention understanding, but was unrelated to private intention understanding.
Conclusions: Neuroelectric indices of attention concord with behavioral findings of a dissociation between social and private intention understanding, and highlight that it is the processing of social intention in particular that is related to ASD traits. Notably, the attenuated allocation of attention for social intention understanding observed at higher levels of autistic traits seems to suggest that social intention stimulus cues (i.e., eye gaze and head turn) fail to induce a strong sense of expectancy for these individuals. This finding demonstrates that attenuated responsiveness to social-communicative cues extends to autistic characteristics within the range of typical functioning.

237 **110.237** Using Facial Expression Analysis Software to Examine the Relationship Between Abnormal Facial Expressions and Alexithymia in Children with and

without Autism

D. A. Trevisan[1], *M. Bowering*[2] *and E. Birmingham*[1], *(1)Faculty of Education, Simon Fraser University, Burnaby, BC, Canada, (2)Linguistics, Simon Fraser University, Burnaby, BC, Canada*

Background: Buck and Powers (2013) argue that the ability to nonverbally express one's emotions is an important developmental skill, because the ways in which caregivers respond to those emotions can help children understand *what* emotion they are experiencing, *why* they are experiencing it, and may subsequently offer strategies on how to regulate that specific emotion. If children are non-expressive or express their emotions in confusing ways, learning opportunities are lost and *alexithymia* (i.e., difficulties identifying and describing one's feelings) could develop over time. Buck and Powers' hypothesis may be especially relevant for children with Autism Spectrum Disorder (ASD), as approximately 50% of this population has high rates of alexithymia compared to 10% in the neurotypical population (Berthoz & Hill, 2005), and because ASD is characterized in part by blunted and/or confusing nonverbal emotional expression (APA, 2013). While Buck and Powers' hypothesis has been supported by several studies using neurotypical adults, to date, no studies have examined the relationship between nonverbal emotional expression and alexithymia in child participants or in the ASD population.
Objectives: The objective of this study was to examine associations between nonverbal expression and alexithymia in children with and without ASD.
Methods: Participants (see Table 1) viewed images and videos extracted from YouTube and Google Images designed to evoke various emotional responses, while being covertly recorded with a webcam. The stimuli were collated into a 15-minute .mp4 video file. Participants were instructed to sit still and watch carefully for the entire video. Subsequently, webcam recordings were analyzed using iMotion's Emotient software (ImotionsGlobal, 2015), which estimates which emotions are being expressed based on Ekman et al.'s (2002) facial action coding system (FACS). In cases where the entire 15-minute recording was not usable (e.g., due to participant distraction), "inattention time" was partialed out. Concurrently, parents completed the parent-report Children's Alexithymia Measure (CAM; Way et al., 2010), with higher scores on the CAM reflecting stronger alexithymic traits.
Results: A significant negative correlation was observed between CAM scores and expression of contempt, $r(32) = -.351$, $p = .021$, as well as an aggregate of all negative emotions (including sadness, contempt, disgust, anger and fear), $r(31) = -.336$, $p = .028$). In addition, higher CAM scores were associated with higher rates of neutral expression $r(32), = .341$, $p = .024$. Thus, children with stronger alexithymic traits produced weaker negative expressions and were more expressively neutral than children with weaker alexithymic traits.
Conclusions: This study is the first to show that less salient facial expressions are associated with higher levels of alexithymia in children with and without ASD, consistent with Buck and Power's (2013) hypothesis. These results support the possibility that blunted or confusing emotional expression may contribute to the high rates of alexithymia in the ASD population, although causation cannot be inferred from this study's design. Future research should use more ecologically valid stimuli, longitudinal designs, and examine facial expressions during interactions between children and caregivers to gain a clearer understanding of how abnormal facial expressions may contribute to the development of alexithymia.

Table 1. *Participant Demographics*

	ASD	Non-ASD
N	17	17
Age range (years)	7-13	7-11
Mean age (years)	9.76	8.47
Gender Distribution	14M:3F	12M:5F

238 **110.238** Using Qualitative Methods to Explore the Subjective Experience of Eye Contact in Autistic Teens and Adults

D. A. Trevisan[1], *C. Lin*[2], *N. K. Roberts*[1] *and E. Birmingham*[1], *(1)Faculty of Education, Simon Fraser University, Burnaby, BC, Canada, (2)Psychology, Simon Fraser University, Burnaby, BC, Canada*

Background:
Several theories attempt to explain why individuals with Autism Spectrum Disorder (ASD) are reluctant to engage in eye contact during social interaction. *Social motivation* accounts suggest that social information is less intrinsically rewarding to individuals with ASD (Chevallier et al., 2012). *Aversion theories* suggest that mutual gaze elicits a hyperarousal response in ASD, possibly mediated by amygdala dysfunction, leading to an aversion to eye contact (e.g., Dalton et al., 2005). Finally, *Sensory processing* accounts suggest individuals with ASD have difficulties coordinating multiple sensory systems (Crane et al., 2009) and therefore avoid eye contact during conversation to avoid sensory overload. Remarkably, no published research to date has utilized qualitative methods to explore the subjective experience of eye contact in individuals with ASD, which could have significant theoretical implications. Objectives:
Objectives:
The purpose of this study was to understand how high-functioning adults and teenagers with ASD experience eye contact in their daily lives. Our research question was "How do people with ASD experience eye contact?"
Methods:
Using keywords "Eye Contact" and "Autism," we searched the Internet for high quality autobiographical accounts of teenagers and adults with ASD describing their lived experiences with eye contact. We accepted videos for analysis when the person in the video spoke in English, reported a diagnosis of ASD, and discussed their *own*experience with eye contact (as opposed to discussing the ASD population generally). Although data collection is still in progress, nine YouTube videos have met the inclusion criteria thus far. Videos were transcribed and entered into NVivo. Using a phenomenological approach (Groenewald, 2004), we coded the transcripts, identified trends and generated themes.
Results: (Preliminary Themes)
1) *Sensory overload*. Two participants described a need to concentrate on the mouth during conversation to aid comprehension. Four described maintaining eye contact as being exhausting, in part due to the overwhelming amount of information provided by the eyes and face. Similarly, three described an inability to simultaneously make eye contact and comprehend words of their conversation partner.
2) *Aversion*. Seven participants described one or more negative feelings including embarrassment, discomfort or anxiety while making eye contact. Three said eye contact feels "unnatural," and four expressed feelings of *invasion* or *violation* from being looked at in the eye.
3) *Cultural norms*. Three participants described a failure to understand the importance of eye contact and why it is an expected social convention. Two participants expressed a desire for society to accept their differences, and to not assume they are being disrespectful for neglecting eye contact. Two recognized the importance of eye contact for the purpose of "fitting in" or appearing "normal."
Conclusions:
In general, data support theories that suggest sensory processing abnormalities and aversion contribute to lack of eye contact in the ASD population, but little evidence for social motivation accounts were observed. Interventions should evaluate the individual with ASD's views on cultural norms surrounding eye contact in designing appropriate solutions for eye contact difficulties. Results of this study should be interpreted with caution due to sampling bias.

239 **110.239** Using the Social Responsiveness Scale to Characterize Social Deficits in Children Referred for Aggressive Behavior

M. Tudor, *K. Ibrahim, E. Bertschinger, A. Sedlack and D. G. Sukhodolsky, Yale Child Study Center, Yale School of Medicine, New Haven, CT*

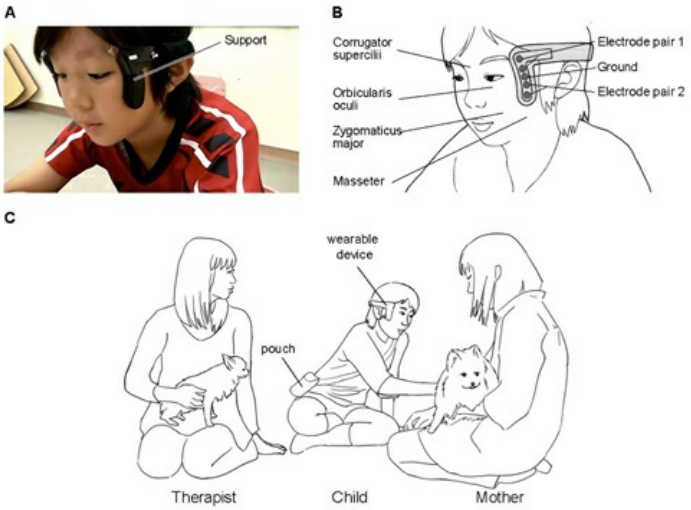
Background: The Social Responsiveness Scale (SRS; Constantino & Gruber, 2003) is a measure of social deficits that has been mostly used in children with autism spectrum disorder (ASD). While the measure reflects social deficits (e.g., awareness, motivation, communication), commonly seen in ASD, there is evidence that it may also reflect dimensions that relate to social behavior in children with other psychiatric diagnoses, such as anxiety (Cholemkery et al., 2014, Settipani et al., 2012). Aggressive behavior and irritability is another phenotypic presentation that may be associated with social deficits (Sukhodolsky and Scahill 2012). However, the associations between social deficits as reflected by the SRS and aggressive or disruptive behavior in children without ASD has yet to be examined.

Objectives: The goal of the current study was to examine the relationships between scores on measures related to aggression and SRS scores in typically developing children referred for aggressive behavior relative to matched typically controls without any psychiatric or developmental psychopathology.
Methods: A total of 87 parents completed a battery of measures of disruptive behavior and social function as part of ongoing research study of anger and aggression in children. Fifty-seven children were referred for disruptive behavior (19 female; age *M*=11.54, *SD*=2.32) and the remaining 30 were recruited as healthy controls (6 female; *M*=12.95, *SD*=2.10). Thus, the sample reflected a wide range of aggression and social behavior profiles. Parents reported on their child's aggression using the Child Behavior Checklist (CBCL), Inventory of Callous Unemotional Traits (ICU), The Home Situations Questionnaire (HSQ), and the Disruptive Behavior Rating Scale (DBRS). Social abilities were reported using the SRS.
Results: As expected, the TD clinic sample demonstrated higher scores on all aggression-related measures. SRS Total scores (*M*=66.47/"Mild" range for corresponding T-score), *SD*=28.40) were also significantly higher within the TD clinic sample than the healthy control subsample (*M*=22.76/"Normal" range for corresponding T-score, SD=15.43; *t*[84]=7.72, p<.00).
When examining the full sample, SRS Total scores were positively correlated with several indicators of aggression and disruptive behavior ($p<.01$): CBCL Aggressive Behavior subscale, $r(84)=.62$, HSQ Total $r(84)=.56$, DBRS Total, $r(85)=.55$, and ICU Total, $r(85)=.48$. Additionally, via hierarchical regression, age ($\beta=.01$, $t=-2.54$, $p=.01$) and Total SRS scores ($\beta=.60$, $t=7.03$, $p<.01$) were shown to significantly predict CBCL Aggressive Behavior; this was not true for gender or SRS subscales.
Conclusions: The results of the current study suggest that typically developing children with aggressive behavior surpass clinical cutoffs on the SRS and that, more generally, SRS scores are correlated with various types of aggression, irritability and noncompliance. This finding indicates that Total SRS scores can be added to clinical evaluation of children who are not on the ASD spectrum in order to characterize social deficits associated with other behavioral problems; as examined in this report, aggression and irritability. SRS subscales may be less useful for such characterization. Past studies have shown some similar relationships in samples of siblings of youth with ASD (Hus et al., 2013) but not ASD samples (Kanne & Mazurek, 2011), further suggesting the utility of differential use of this instrument across populations.

240 **110.240** Wearable Devices for Reading Facial Expression and Detecting Face-to-Face Behavior of Children with ASD

***K. Suzuki**, Center for Cybernics Research, University of Tsukuba, Tsukuba, Japan*

Background:
The social imaging technologies to identify and represent social behaviors is introduced. We reported several wearable devices to measure interactions among people, e.g. physical touch (Iida et al., 2011) and group dynamics (Miura et al. 2013). In this study, a wearable device for detecting smile based on biosignals, and the feasibility study with children with ASD is introduced. Monitoring signals from facial muscles can be a way to measure emotional information (Niedenthal et al. 2009) but children with ASD might show limited observable expression when they are enjoying an activity (Welch 2012). A preliminary study with a child demonstrated that our wearable device effectively correlated positive social behaviors of the child with ASD increased when the smiles increased, and that negative social behaviors decreased when the smiles increased during an AAA (Animal-Assisted Activities) session (Funahashi et al., JADD 2013).
Objectives:
We proposed a wearable device (Gruebler et al. 2014) to detect the smiles of children with ASD using electromyographic signals from the side of the face. We conducted a two-year study to analyze the facial expressions of children and compare data by our device with the evaluation of interventions by a specialized medical examiner while the children experienced AAA with small dogs.
Methods:
The device we designed is compact so the children can wear it during long periods of time, it allows complete mobility of the child in their environment. Independent Component Analysis (ICA) and Artificial Neural Network (ANN) is used to classify the signals from different muscles groups in the face. Thirteen children with ASD (10 boys and 3 girls, mean age = 12.8) and 8 normal healthy children (3 boys and 5 girls, mean age =12.3) were recruited to participate in, which they did voluntarily. Four children with ASD did not want to put on the wearable device during the session, but 9 children with ASD and all 8 control children had no difficulty doing so. Using the typical smiles and the baseline, suitable EMG segments were selected for the training set to perform ICA and to train the ANN. The change in the total duration of each child's smiles in both groups are analyzed.
Results:
The training set was prepared for each participant, and the accuracy of smiling and non-smiling detection was on average 99.84% SD=0.22 and 99.21% SD=0.96, respectively. We found positive correlation between ME and device for threshold levels between 0.65 and 0.95 in all participants through 4 successive sessions and the average number of smiles of each group
Conclusions:
Our findings were consistent with our previous finding using a child with ASD under the same experimental condition. The wearable device can be used to code facial expressions during any other interactions such as face-to-face interactions and quantifying people's facial expressions while on-the-go regardless of context. We have also developed a wearable device using IR sensor for detecting face-to-face time and duration based on head orientations of children. Further investigations include the analysis spontaneous smile and behavior such as with touch, reaching, and face-to-face.



Poster Session
111 - Miscellaneous
11:30 AM - 1:30 PM - Hall A

241 **111.241** Home-Based Parent-Implemented Early Intervention for Young Children with Autism Spectrum Disorders: A Systematic Review and Meta-Analysis

***D. A. Prykanowski**, B. Reichow, J. R. Martinez and K. Marsh, University of Florida, Gainesville, FL*

Background: Family-centered practices are part of a developing literature base in early intervention to help parents/caregivers to support the positive development of their young children with autism spectrum disorders (ASD). One way in which these practices are being implemented is through parent training of early intervention strategies so they will be able to implement interventions with their children in the natural home setting. While there are a variety of parent training programs, many are conducted in clinical or group settings with the expectation the parent will generalize those strategies to the home setting. It is important to investigate the research that examines training a parent within a natural setting and determine the effect on child outcomes, as well as overall parent/family outcomes.
Objectives: The objective of this systematic review is to explore the effects of parent-implemented interventions on communication and behavioral outcomes of young children with ASD, as well as parent skills to conduct the intervention following training and implementation based primarily in the home. A secondary objective is to examine additional outcomes related to the child (i.e. ASD symptomology) and those related to parent/family well being due to the home-based training.
Methods: Studies included in this review were conducted using a randomized control trial design comparing the home-based parent implemented intervention to community

services, and/or waitlist interventions. Studies were located through an extensive search of multiple electronic databases, as well as utilizing a snowball method identifying other possible inclusions. All studies were by two authors independently and discrepancies were resolved. After data extraction, the components of these studies, as well as the effects on child and family outcomes were synthesized using descriptive narratives; visual displays using harvest plots, and other meta-analytic techniques.
Results: The search yielded an initial result of 17,528 articles and following initial screening, 135 full-text articles were assessed for eligibility resulting in the inclusion of 15 studies. Table 1 provides a descriptive summary of the included studies. The studies included 448 child participants in treatment, and 430 in control groups. Overall, the primary outcome assessed most often across these studies was responsive interactions between parent and child, followed by child communication. Eight different types of interventions were used across studies with focused play being the most used intervention. Results were limited in reporting of implementation fidelity and maintenance data.
Conclusions: While effects on the interaction between parent and child were positive, demonstrating that parents can act as primary interventionists in this setting, this poster will discuss the limitations of the studies including the study quality, use of fidelity measures, as well as the varied, inconsistent training strategies that have been used across these interventions. Intervention packages often consistent of multiple training strategies which make it difficult to parcel out the most effective way to teach parent to implement interventions. Additionally, measures used in these studies were not sensitive enough to capture the change over time needed. These results will be used to suggest areas for future research involving parent training and young children with ASD.

Study	Type of Manuscript	Participants Child age in months, N	Intervention	Comparison	Outcomes
Drew et al. 2002	Journal article	Mean (SD) age of Treatment= 21.4(2.7), n=12; Mean (SD) of Control= 23.6(3.8), n=12	Training parents to increase their child's joint attention and joint action skills	Community Services	Primary: Communication Secondary: Parent Stress
Gonzalez, 2006	Dissertation	Treatment n = 5; Control n=3	Developmental, Individual-based, Relationship-based (DIR) program	Option to receive services after experiment	Primary: Child repetitive behaviors
Kasari et al. 2014	Journal article	Mean (SD) age of Treatment= 42.8 (10.21), n=60; Mean (SD) of Control= 41.9 (10),n=52	Joint attention Symbolic Play Engagement and Regulation (JASPER) training	Caregiver education group	Primary: Responsive interactions Secondary: Communication, Behavior, Parent involvement & adherence
Kasari et al. 2014	Journal article	Mean (SD) age of Treatment= 22.18(4.18), n=32; Mean (SD) of Control= 22.56(3.47), n=34	Focused Playtime Intervention (FPI) to promote toy play with child	One of two treatment groups: FPI or monitoring group intervention	Primary: Responsive Interactions. Parent/child relationship Secondary: Communication
Nefdt, 2007	Dissertation	Mean (SD) age of Treatment = 38.92 (14.57), n=13, 38.43(11.2), n=14	Self-directed video instruction in Pivotal Response Treatment	Waitlist Control	Primary: Parent skills Secondary: Communication, responsive interaction, Parent confidence
Nefdt et al. 2010	Journal article	Mean (SD) age of Treatment = 38.92 (14.57), n=13, 38.43(11.2), n=14	Self-directed video instruction in Pivotal Response Treatment	Waitlist Control	Primary: Parent skills Secondary: Communication, responsive interaction, Parent confidence
Oosterling et al. 2010	Journal article	Mean(SD) age of Treatment= 35.3 (5.5) n=36,Mean (SD) age of Control= 33.3 (6.4), n=31	Focus Parent Training program to increase joint attention, mutual enjoyment and compliance	Treatment-as-usual	Primary: Communication Secondary: Behavior (engagement), Parenting Skills
Pajareva et al. 2011	Journal article	Mean (SD) age of Treatment= 56.6 (10.1), n=16,Mean (SD) age of Control=58.3 (12.7) n=16	Developmental, Individual-based, Relationship-based (DIR) and Floortime	Treatment-as-usual	Primary: Functional developmental Secondary: ASD symptomology
Siller et al. 2013	Journal article	Mean (SD) age of Treatment= 58.3(12.7), n=36; Mean(SD) age of control= 55.9(11.9), n=34	Focused Playtime Intervention (FPI) to promote toy play with child	Parent Advocacy Coaching Only	Primary: Responsive interactions/parent child relationships Secondary: Communication
Solomon et al. 2014	Journal article	Mean (SD) age of Treatment = 49.85(10.43), n=64; Mean(SD) of Control = 50.53(10.07), n=64	Play and Language for Autistic Learners (PLAY) Project home consultation program	Community Services	Primary: Responsive Interaction Secondary: Communication, Parent Stress
Vattuone, 2013	Masters Thesis	Mean (SD) age of Treatment = 22.39(4.44) n=23; Mean(SD) of Control = 23.36 (3.39) Control n=22	Focused Playtime Intervention (FPI) to examine working alliance and parent stress	One of two treatment groups: FPI or monitoring group intervention	Primary: Parent Stress, Working Alliance
Wetherby et al. 2014	Journal article	Mean(SD) age of Treatment= 19.64(1.93),n=42; Mean(SD) age of Control= 22.39(4.44), ,n=40	Social Communication, Emotional Regulation, & Transactional Supports (SCERTS)	Group training in a clinic	Primary: Communication Secondary: ASD symptomology, Developmental, Adaptive behaviors
Elder, 2011	Dissertation	Mean age of total participants = 21 months; Treatment: n=49,Control: n=48	Early Start Denver Model to increase child attention and initiations	Community Services	Primary: Parent/Child relationships Secondary: Developmental, adaptive, ASD symptomology
Siller et al. 2014	Journal article	Mean(SD) age of Treatment =58.3 (12.7), n=36, Mean (SD) age of Control= 55.9(11.9), n=34	Focused Playtime Intervention (FPI) to increase parental responsive communication	Parent Advocacy Coaching Only	Primary: Attachment behaviors in children Secondary: Developmental, Communication
Schertz et al. 2013	Journal article	Mean(SD) age of Treatment= 24.6(4), n=11, Mean(SD) of Control= 27.5(3.4),n=12	Joint Attention Mediated Learning (JAML)	Community Services	Primary: Joint Attention Secondary: Developmental

Oral Session - 1A

112 - Gene-Environment Interactions that Contribute to ASD

1:45 PM - 2:35 PM - Hall B

1:45 **112.001** Gene-Environment Interactions in ASD: PBDE Exposures and DNA Methylation in the Early Autism Risk Longitudinal Investigation

K. M. Bakulski[1], *A. P. Feinberg*[2], *J. Feinberg*[2], *E. Schriver*[3], *S. C. Brown*[4], *L. A. Croen*[5], *I. Hertz-Picciotto*[6], *C. J. Newschaffer*[3] *and M. D. Fallin*[7], *(1)Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (2)Johns Hopkins University, Baltimore, MD, (3)A.J. Drexel Autism Institute, Philadelphia, PA, (4)Mental Health, Johns Hopkins University Bloomberg School of Public Health, Baltimore, MD, (5)Division of Research, Kaiser Permanente, Oakland, CA, (6)Dept of Public Health Sciences, School of Medicine, UC Davis MIND Institute, Davis, CA, (7)Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD*

Background: The environment and genetics both contribute to the etiology of autism spectrum disorder (ASD), but few studies have investigated risks from both sources jointly. *In utero* exposure to polybrominated diphenyl ethers (PBDEs) has known neurodevelopmental effects and is suggested to be an ASD risk factor. DNA methylation plays a complex role in ASD etiology, and we tested whether epigenetic state at birth may be associated with exposure to PBDEs during pregnancy.
Objectives: The goal of this analysis is to determine whether DNA methylation measured in cord blood mediates the association, if any, between prenatal exposure to PBDEs and risk of ASD.
Methods: In the Early Autism Risk Longitudinal Investigation (EARLI) enriched-risk ASD pregnancy cohort, 11 PBDE congeners were measured in maternal blood samples during pregnancy. Genome-wide DNA methylation was assessed in cord blood samples using the Illumina Infinium Humanmethylation 450k array. ASD risk was estimated at 12-months using the clinician administered Autism Observation Scale for Infants (AOSI) scale. We tested pairwise associations between PBDE concentration and DNA methylation as well as DNA methylation and AOSI score. We will use causal inference testing to assess mediation of the potential PBDE-ASD relationship via DNA methylation.
Results: Paired maternal PBDE, cord DNAm, and offspring AOSI were available for 201 families. AOSI scores ranged from 0-20 (mean(SD) 5.4(4.8)). PBDE-28 concentration ranged from 0-69.1 pg/g (mean(SD): 7.6(10.2)) and PBDE-99 concentration ranged from 0-365.1 pg/g (mean(SD): 29.9(52.0)). DNA methylation was modestly associated with specific PBDE congener concentrations and DNA methylation was also associated with AOSI score at specific locations. Results of the mediation analysis will be presented.
Conclusions: This is a proof-of-concept study using PBDEs as an example for testing mediation of an exposure-ASD relationship via DNA methylation. DNA methylation represents an intersection of environmental exposures and underlying genetic architecture, and may be an effective tool for estimating gene-environment interaction in ASD risk.

1:57 **112.002** Polygene – By – Prenatal Environment Interaction in Autism Spectrum Disorder Using Copy Number Variant Burden

B. Sheppard[1], *K. Benke*[2], *A. B. Singer*[3], *L. A. Croen*[4], *J. L. Daniels*[3], *C. J. Newschaffer*[5], *A. M. Reynolds*[6], *D. E. Schendel*[7], *L. A. Schieve*[8], *C. Ladd-Acosta*[9] *and M. D.*

Fallin[10,11], (1)Epidemiology, Johns Hopkins School of Public Health, Baltimore, MD, (2)Mental Health, Johns Hopkins School of Public Health, Baltimore, MD, (3)University of North Carolina, Chapel Hill, NC, (4)Division of Research, Kaiser Permanente, Oakland, CA, (5)A.J. Drexel Autism Institute, Philadelphia, PA, (6)University of Colorado - Denver, Aurora, CO, (7)Aarhus University, Aarhus, Denmark, (8)National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention, Atlanta, GA, (9)Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (10)Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD, (11)Johns Hopkins Bloomberg School of Public Health (JHBSPH), Baltimore, MD

Background: Autism Spectrum Disorder (ASD) is a complex disease with both genetic and environmental risk factors. Increased copy number variation (CNV) burden has previously been associated with (ASD). The prenatal period is also of increasing importance towards understanding the environmental risk factors contributing to ASD etiology. However, evidence for specific environmental risk factors has been inconclusive. A joint approach allowing for the possibility that environmental effect may be modified by polygenic risk, as measured by CNV burden, may increase the ability to detect environmental effects.
Objectives: The purpose of this work is to evaluate the association between four prenatal self-reported environmental exposures – smoking, alcohol, beta-2 adrenergic receptor (B2AR) agonists, and selective serotonin reuptake inhibitors (SSRI) – and ASD, while allowing for potential effect modification by CNV burden in the Study to Explore Early Development (SEED).
Methods: SEED is a multi-site case-control study of children aged 3-5 years with ASD and a control group drawn from the general population. All children were born between September 2003 and August 2006. Prenatal exposure to environmental risk factors was ascertained through a detailed maternal interview that occurred 3-5 years after pregnancy. A Hidden Markov Model approach (PennCNV) was used to call CNVs from Illumina genotype array data. Measures of CNV burden were assessed on both a genome-wide scale and restricted to ASD candidate regions determined by the SFARI gene online database. Associations with environmental exposures were first assessed by likelihood ratio test (LRT) comparing the likelihood of a full model with environmental exposure plus covariate terms to a null model constraining environmental exposure term to zero (H_0: $\beta_E = 0$). Interactions were then tested by a 2-degree-of-freedom LRT comparison of a full model with CNV burden, environmental exposure, and interaction terms to a null model where environment and interaction terms are jointly constrained to zero (H_0: $\beta_{CNVxE} = \beta_E = 0$). All models contained sex and the first five ancestral principal components derived from principal component analysis on measured single nucleotide polymorphisms (SNPs) as covariates.
Results: Allowing for effect modification by copy number burden revealed a significant association between prenatal SSRI use and ASD in the presence of large (>400kb) CNVs (LRT p = 0.033), where the CNV-free SSRI association was not statistically significant. Additionally, a negative association between prenatal alcohol exposure and ASD was revealed among those with high CNV kb burden in SFARI candidate genes (LRT p = 0.011). Prenatal smoking exposure was associated with ASD risk with and without consideration of CNV burden, although adjustment for potential SES confounders was not yet considered.
Conclusions: To our knowledge, this is the first effort to evaluate genome-wide CNV burden by environment interaction in an ASD case and population-derived control sample. Allowing for the presence of effect modification by CNV burden permitted us to detect associations of ASD with self-reported prenatal alcohol and SSRI exposure where the marginal testing failed to do so. Accounting for genetic risk may potentially elucidate mechanisms of environmental risk for ASD.

2:09 **112.003** Dysregulation of RORA, a Risk Gene for ASD, By "Low-Dose" Exposure to the Herbicide Atrazine, an Endocrine Disrupting Compound

***K. Kocher**, K. Janczura and V. Hu, Dept. of Biochemistry and Molecular Medicine, The George Washington University, Washington, DC*

Background: We have previously shown that retinoic acid-related orphan receptor alpha (*RORA*) is deficient in a subgroup of individuals with ASD and that it potentially regulates the transcription of hundreds of ASD-associated genes. Because *RORA* is in turn regulated in opposite directions by male and female sex hormones, we hypothesize that *RORA* may be dysregulated by endocrine disrupting compounds (EDCs), like the herbicide atrazine, which may result in downstream or genome-wide changes in the expression of genes relevant to the pathobiology of ASD.
Objectives: The goals of this study were to: 1) investigate changes in *RORA* expression induced by low-dose exposure to atrazine; 2) investigate the potential for genome-wide alterations of biochemical pathways relevant to ASD; and 3) develop a high-throughput assay for screening other EDCs that may elevate risk for ASD based on dysregulation of *RORA* expression.
Methods:
Treatment of neuronal cells with low-dose atrazine. The human neuronal cell model (SH-SY5Y) was exposed to 10-fold dilutions of atrazine solubilized in DMSO (range 0.1nM-1000nM) for 2 hours.
RORA expression and transcriptome analyses. *RORA* expression as a function of atrazine concentration was determined by RT-qPCR analyses. Transcriptome analyses of atrazine-treated SH-SY5Y samples at selected doses were also performed using the Affymetrix GeneChip Human Transcriptome Array 2.0. Genome-wide expression changes were analyzed using Transcriptome Array Console (TAC) and Expression Console software, as well as Partek Genomics Suite. Functional and network prediction analyses were performed using QIAGEN Ingenuity Pathway Analysis (IPA).
Development of a high-throughput screening assay. SH-SY5Y cells were co-transfected with a construct containing the *RORA* promoter-driven Firefly luciferase reporter gene and a separate construct containing the *Renilla reniformis* luciferase gene under the control of a constitutive promoter. Following transfection, the cells were exposed to varying levels of atrazine for 2 hours. Firefly luciferase activity was normalized to that of *Renilla* luciferase in each well to determine the relative levels of *RORA* promoter activity in each sample.
Results: Preliminary results show that *RORA* is dysregulated biphasically in a neuronal cell model by low-dose exposure to atrazine. Additionally, using microarrays for expression profiling, we were able to observe that exposure to subnanomolar and nanomolar concentrations of atrazine induce differential gene expression at the whole genome level, notably affecting genes with ASD-associated neurological functions. Furthermore, a number of genes impacted by atrazine exposure are among the annotated genes within the SFARI database of ASD risk genes. The high-throughput dual-luciferase reporter assay replicates in part the atrazine-induced changes in *RORA* expression seen by RT-qPCR analyses.
Conclusions: Low, subtoxic doses of EDCs, such as atrazine, may increase risk for ASD by dysregulating *RORA*, a gene that we have validated as a transcriptional regulator of multiple genes associated with the pathobiology of autism. We anticipate that our high-throughput screen will provide additional insight into gene-environment interactions that impact neurodevelopment as well as increased awareness of the biological consequences of low-dose levels of EDCs that are below current EPA-approved limits.

2:21 **112.004** Maternal Immune Activation Dysregulation of the Fetal Brain Transcriptome and Relevance to the Pathophysiology of Autism

*M. V. Lombardo[1,2], E. Courchesne[3] and **T. Pramparo**[4], (1)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (2)Department of Psychology and Center for Applied Neuroscience, University of Cyprus, Nikosia, Cyprus, (3)Neuroscience, UCSD Autism Center of Excellence, La Jolla, CA, (4)Autism Center of Excellence, UCSD, La Jolla, CA*

Background: Maternal immune activation (MIA) has emerged as a useful model to study how maternal infections during pregnancy might confer prenatal environmental risk for atypical neurodevelopmental phenotypes such as autism spectrum disorders (ASD). However, the molecular cascade of events due to MIA that lead to transcriptome dysregulation that is shared with ASD is less well understood.
Objectives: We tested the hypothesis that MIA-induced gene expression dysregulation would hit ASD-associated genes. These genes have been prioritized based on highly penetrant and recurrent "likely gene-disrupting" variants as well as missense mutations found in large genomic ASD studies. We also aimed to identify the transcriptional changes, both at the single gene level and at the network level, characteristic of the ASD postmortem brain that are shared in the MIA rat fetal brain.
Methods: We employed differential expression (DE) analyses to identify genes and networks dysregulation in ASD and MIA cortical transcriptomes. We used two publicly available datasets, Voineagu and colleagues (2011; GEO: GSE28521) and Oskvig and colleagues (2012; GEO: GSE34058). DE analyses were performed using the sva and limma packages. Network analyses were performed using the WGCNA package. Functional enrichment analyses were performed using the MetaCore GeneGO software.
Results: We show that MIA-dysregulated midgestational fetal brain gene expression is substantially enriched in highly penetrant ASD-associated genetic mechanisms. MIA downregulates pathways involved in synaptic processes, but upregulates translation initiation processes and both sets of processes are similarly dysregulated in the postnatal ASD cortical transcriptome. Upregulated translation initiation co-expression modules are highly preserved across MIA and ASD. The cap-dependent translation initiation gene *EIF4E* is the most affected ASD-associated gene (Cohen's d = 8.27) and targeted analyses demonstrate prominent MIA-dysregulation of *EIF4E*-dependent networks and mechanisms.
Conclusions: This work identifies several routes through which MIA can dysregulate fetal brain gene expression that are highly relevant to ASD.

Oral Session - 1B

113 - Mouse Models of Environmental and Genetic Risk Factors in Autism Spectrum Disorder

2:40 PM - 3:30 PM - Hall B

2:40 **113.001** Autism-Relevant Behaviors in the Antigen-Driven Mouse Model of Maternal Autoantibody Related Autism

***K. L. Jones**[1], J. L. Silverman[2], M. Yang[3], E. Edmiston[2], J. N. Crawley[4] and J. Van de Water[5], (1)University of California at Davis, Sacramento, CA, (2)UC Davis, Sacramento, CA, (3)UC Davis School of Medicine, Sacramento, CA, (4)Psychiatry and Behavioral Sciences, MIND Institute, Sacramento, CA, (5)University of California at Davis MIND Institute, Davis, CA*

Background: Maternal autoantibodies reactive to fetal brain proteins have been described in a subset of mothers of children with autism spectrum disorder (ASD), but not in mothers of typically developing children, by numerous researchers. Additionally, several animal models have demonstrated the pathological significance of these autoantibodies using passive transfer of human IgG, further supporting their role in the development of ASD. Our lab identified the seven protein antigens for maternal autoantibody related (MAR) ASD, finding antibody reactivity to these proteins in 23% of mothers of children with ASD versus less than 1% in women with typically developing children. Most recently, we have mapped the antigenic epitope sequences recognized by these ASD-specific maternal autoantibodies. Previous animal models have all utilized passive transfer of human IgG yielding promising results but did not reflect a constant exposure to the salient autoantibodies throughout gestation, as would be the case in the clinical setting.
Objectives: This study aimed to generate the first biologically relevant animal model of MAR ASD in order to directly assess the pathologic significance of prenatal exposure to epitope-specific autoantibodies in generating autism-relevant behaviors in offspring.
Methods: Prior to breeding, female C57BL/6J dams were randomly assigned to either MAR-ASD or control treatment. In order to generate epitope-specific autoantibodies that mimic those found in the mothers of children with ASD, the MAR-ASD females received a series of immunizations containing peptide epitope sequences of the four primary target proteins of MAR ASD (lactate dehydrogenase A and B, collapsin response mediator protein 1, and stress-induced phosphoprotein 1) conjugated via Multiple Antigenetic Peptide (MAP) system technologies in addition to adjuvant. Control females were injected with saline only. Following confirmation of autoantibody production in immunized animals by ELISA, females were then paired with male breeders to produce the experimental offspring of interest. Subsequent male and female offspring were tested for a variety of autism-relevant behaviors and developmental milestones (MAR-ASD offspring = 24; Control offspring = 22).
Results: MAR-ASD offspring had significant alterations in development, with significant increases in body weight on postnatal days (PD) 4-14 and head width on PD 12 relative to control offspring ($p<0.01$). During juvenile reciprocal social interactions on PD 25, MAR-ASD offspring displayed robust deficits in social interactions as compared to control offspring, with significant decreases in the number of front approach, nose-to-nose sniffing, nose-to-anogenital sniffing, push/crawl, and following bouts ($p<0.045$). Furthermore, significantly more rearing and self-grooming ($p<0.0001$) bouts were observed in MAR-ASD offspring compared to controls ($p<0.0001$).
Conclusions: Our results suggest that the presence of autism-specific maternal autoantibodies to fetal brain protein during gestation produce alterations in development and behaviors that are highly relevant to ASD. By generating the MAR ASD-specific epitope antibodies in female mice prior to breeding, our antigen-driven model demonstrates for the first time that these ASD-specific maternal autoantibodies are directly responsible for alterations in behaviors. These findings contribute to the ongoing efforts toward identification of biological markers specific to sub-phenotypes of autism, and the establishment of a highly translatable animal model of ASD.

2:52 **113.002** Prenatal Immune Activation Alters the Adult Neural Epigenome but Can be Partly Stabilized By a n-3 Polyunsaturated Fatty Acid Diet

ABSTRACT WITHDRAWN

Background:
Prenatal exposure to Maternal Immune Activation (MIA) increases the risk of autism. The MIA rodent model permits direct experimental evaluation of the biological mechanisms driving this vulnerability. It also provides an opportunity to screen novel prevention strategies.
Objectives:
In this study we tested the hypotheses that MIA in the mouse model has wide-spread effects on the epigenome; and that these can be prevented by a post-weaning diet enriched with *n-3* polyunsaturated fatty acids (PUFA).
Methods:
Pregnant mice were exposed to intravenous Polyl:C (a viral analogue) or saline (control) on gestation day 9. Half the offspring were weaned using a conventional lab diet (*n-6* PUFA); half had a *n-3* PUFA enriched diet. Genome-wide DNA methylation in hypothalamic brain tissue was examined using Next Generation Sequencing techniques.
Results:
Adult offspring exposed to MIA prenatally had significant global DNA hypomethylation. Pathway analyses revealed that genes regulating synaptic plasticity were differentially methylated following MIA. Moreover, DNA methylation differences were concentrated at risk loci linked to neurodevelopmental disorders. More than 80% of genes affected by MIA were 'stabilized' by the n-3 PUFA intervention.
Conclusions:
Thus, MIA during prenatal life causes persistent widespread epigenetic changes in the postnatal brain that can be limited by early dietary intervention with n-3 PUFA. These effects on the epigenome may have functional consequences. For example, we have previously reported that the brain biochemical and behavioural consequences of MIA can also be prevented by n-3 PUFA diet. That the developmental impact of early life immune activation can be modified - especially by a relatively simple and low cost intervention – is a critical observation and deserves further study.

3:04 **113.003** Maternal Stress Causes Behavioral Changes in C57BL/6J Mice

K. K. Chadman[1] *and L. Leone*[2]*, (1)Developmental Neurobiology, NYS Institute for Basic Research in Developmental Disabilities, Staten Island, NY, (2)Developmental Neuroscience, College of Staten Island, City University of New York, Staten Island, NY*

Background: The etiology for most cases of autism spectrum disorder (ASD) is unknown at this time. There is strong evidence for the genetic role in ASD but environmental factors also have a modifying role. One potential environmental factor is maternal stress during pregnancy. Stress during prenatal development increases the vulnerability of affective disorders including schizophrenia and ASD. Prenatal stress has been shown to lead to postnatal behaviors that resemble the defining symptoms of ASD as well as other behaviors that occur frequently in ASD (Kinney et al., 2008).
Objectives: The objective of these experiments was to determine if restraint stress during pregnancy results in autistic-like behavioral alterations in the offspring. A commonly used inbred mouse strain, C57BL/6J was used because these mice to not typically have behaviors resembling the ASD phenotype.
Methods: Timed pregnant C57BL/6J mice were subject to restraint stress three times a day for 30 minutes, at least 2 hours apart for 9 days starting on GD11. The control pregnant mice were left undisturbed during gestation. Both male and female offspring from both stressed and control dams were behaviorally phenotyped as adults. One female and male per litter were used in up to four tests, each test at least 2 days apart. The tests included the social approach test, elevated plus maze, light <--> dark box, marble burying, rotarod, open field and cued and contextual fear conditioning.
Results: In general there were few differences between the male and female offspring. There were no significant effects of maternal stress in the offspring on tests of anxiety such as the elevated plus maze and light <--> dark box, obsessive-compulsive like behavior in the marble burying and spontaneous grooming tests, motor ability and learning on the accelerating rotarod, or learning and memory assessed by the cued and contextual fear conditioning test. However, there were differences in social behavior and acute exploratory activity between the stressed and control mice. The offspring from the stressed dams were less social, spending less time sniffing the stranger mouse in the social approach test compared to the novel object. The stressed mice were also less active at the beginning of the open field exploration test, as shown by travelling a significantly smaller distance, having a reduced speed and spending more time immobile than the control mice.
Conclusions: Prenatal restraint stress affected the behavior of these mice in ways that resemble one of the defining symptoms of ASD, decreased social behavior. Future testing with other inbred strains, including ones that are already considered mouse models of ASD will hopefully shed light on the contribution of prenatal stress to the etiology of ASD. This will provide information on a potentially preventable environmental factor associated with ASD.

3:16 **113.004** Aberrant Sensory Processing in Mice Lacking Autism Associated Met Receptor Function: A Role for Insulin?

F. S. Lo, R. Erzurumlu and ***E. M. Powell****, Anatomy & Neurobiology, University of Maryland - Medicine, Baltimore, MD*

Background: *MET*, the gene encoding the tyrosine kinase receptor for hepatocyte growth factor/scatter factor (HGF/SF), has been identified as a common susceptibility allele for autism spectrum disorders (ASD). Both Met and HGF are expressed in the cerebral cortex during development, and HGF-Met signaling has been implicated in a number of cellular processes, including proliferation, migration, survival, and process formation. Alterations in HGF-Met signaling may therefore affect cortical development, potentially leading to neuroanatomical changes such as those thought to play a role in neurodevelopmental disorders such as ASD. We have previously found an expansion of the cerebral cortex at rostral levels in transgenic mice expressing a kinase-dead Met in the *Emx1* lineage. Earlier studies imply defects in cortical connectivity after loss of Met signaling in the *Met-Emx1* mice. Behavioral observations indicate potential altered sensory processing in *Met-Emx1* mice.
Objectives: We investigated sensory processing in mice lacking functional Met receptor in the cerebral cortex (*Met-Emx1*). The study focused on the rodent whisker system and the inhibitory response in the barrel cortex to reveal underlying cellular mechanisms of decreased or absent Met signaling.
Methods: We used in vitro recordings from thalamocortical slices to test our hypotheses that loss of Met altered the balance of excitation to inhibition (AMPA/GABA ratio). We also measured the multiple input index and paired pulse ratios of EPSCs and IPSCs. Immunohistochemistry and immunoblots were used to confirm expression levels and anatomical alterations.
Results: Our data show altered excitation/inhibition (E/I) balance at the thalamocortical synapse. In addition, treatment with insulin, which recruits GABA-A receptors to restore inhibition in control slices, failed to change the E/I balance in slices lacking a single copy of functional *Met*.
Conclusions: Our results suggest that the sensory circuitry in the *Met-Emx1* cortex exhibits impaired E/I balance and is resistant to insulin. These data suggest the approved therapies for diabetes may be helpful in the prevention or amelioration of the symptoms associated with ASD, especially in the individuals who have the common autism associated *MET* alleles.

Oral Session - 2A

114 - Sensory and Motor Phenotypes Useful for Biomarkers and Parsing Heterogeneity

1:45 PM - 2:35 PM - Room 307

1:45 **114.001** Common Sensory Endophenotypes Spanning Sensory Processing Disorder and the Autism Spectrum

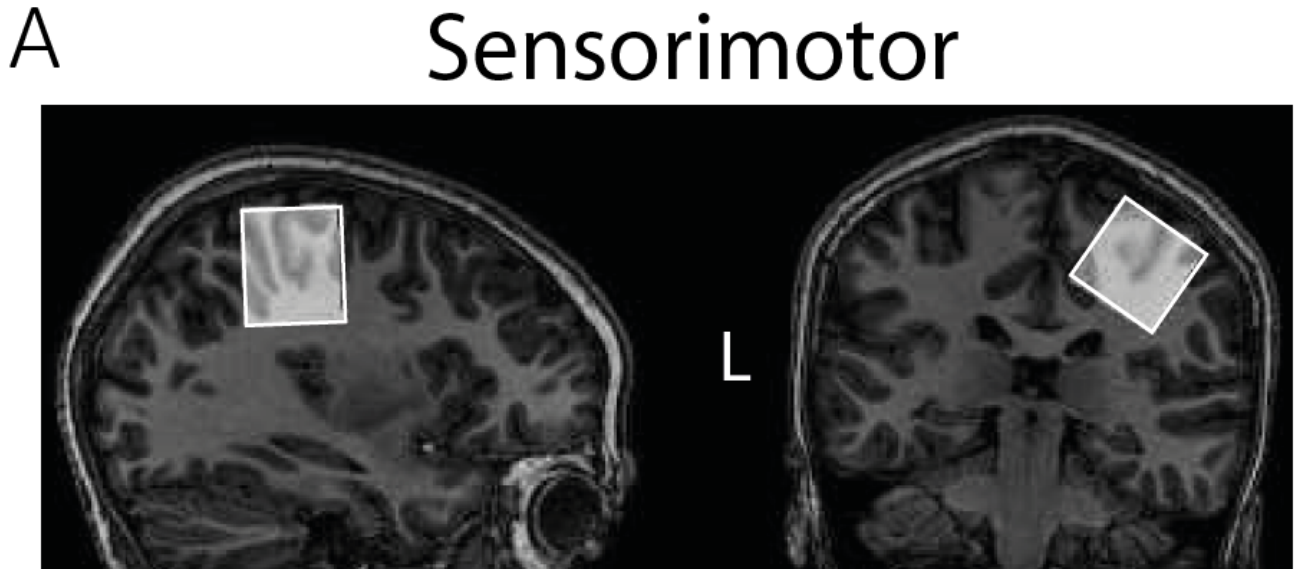
J. J. Foxe[1,2] *and S. Molholm*[3]*, (1)Albert Einstein College of Medicine, Bronx, NY, (2)Department of Neurobiology and Anatomy, University of Rochester Medical Center, Rochester, NY, (3)Neuroscience and Pediatrics, Albert Einstein College of Medicine, Bronx, NY*

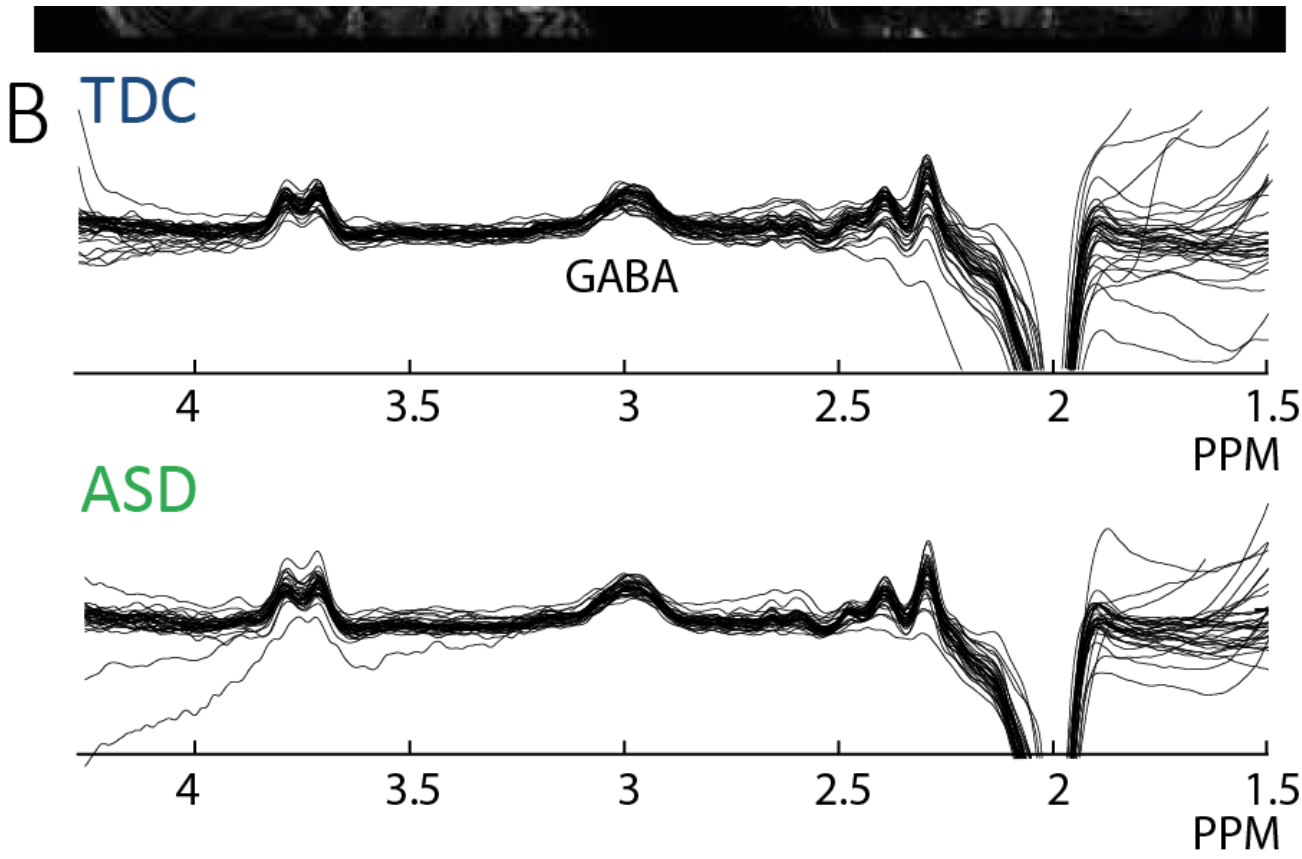
Background:
Sensory-processing anomalies constitute a hallmark symptom domain of the ASDs, but similar sensory symptoms are often observed in other neurodevelopmental disorders (e.g. Obsessive Compulsive Disorder, Attention Deficit Hyperactivity Disorder), suggesting some shared genetic liability and the possibility of common endophenotypes. There is also emerging recognition amongst clinicians and researchers that there exists a substantial cohort of children who do not meet diagnostic criteria for a categorical neurodevelopmental disorder, but nonetheless manifest clinical levels of hypo- or hyper-sensitivity to sensory inputs. These otherwise typical children with sensory processing disorder (SPD) are of specific interest to the research community in that the restriction of their pathology to the sensory processing domain allows for study of a relatively "purified" phenotype.
Objectives:
To assess both basic unisensory and multisensory processing in SPD with the use of psychophysics and high-density electrophysiological recordings of brain activity, and compare with unisensory and multisensory processing in neurotypical controls and individuals with ASD.
Methods: N/A
Results:
Study 1: Somatosensory evoked potentials (SEPs) to trains of stimuli delivered at varying presentation rates (ISIs ranging from 150ms to 1050ms) were examined to determine whether differences in the initial registration and processing of tactile inputs might account, in part, for aberrant reactions to the sensory environment. Thirteen children with SPD (5.3 - 15.2 years) and 13 matched neurotypicals produced SEPs that were similar in their temporal and spatial properties. Clear between-group differences in SEP amplitude as a function of stimulation rate were observed, and these were most apparent in later phases of sensory processing (130-195ms). Response slopes as a function of ISI suggested a steeper slope for the SPD group, due to greater increase in response amplitude as ISI increased. These findings suggest a potential neural mechanism for the increased reactivity to tactile inputs observed in SPD.
Study 2: High-density ERPs interrogated multisensory integration (MSI) in three groups of fourteen age- and IQ-matched children: those with ASD, those with SPD, and neurotypical individuals. Participants responded as quickly as possible to unisensory-visual, unisensory-auditory or bisensory-audiovisual stimuli. Probing the behavioral data for evidence of MSI (i.e., race model violation) indicated clear separation between the two clinical groups and the TD children, and analysis of the electrophysiological data subtly distinguished children in the ASD group from their peers in the TD and SPD groups.
Study 3: It is now well-established that children with an ASD show severe deficits in their ability to integrate seen and heard speech. Children with SPD do not show the social communication deficits that are part of the diagnostic criteria for an ASD. Here we asked whether they would also show deficits in multisensory speech integration under noisy environmental conditions. Monosyllabic words were presented in different levels of noise, which were sometimes accompanied by videos of the person articulating the word. Comparing performance measures of 12 SPD children to 12 matched neurotypical controls, we find a clear deficit in multisensory speech integration.
Conclusions:
Collectively, these studies point to clear anomalies in sensory processing across three modalities in SPD children.

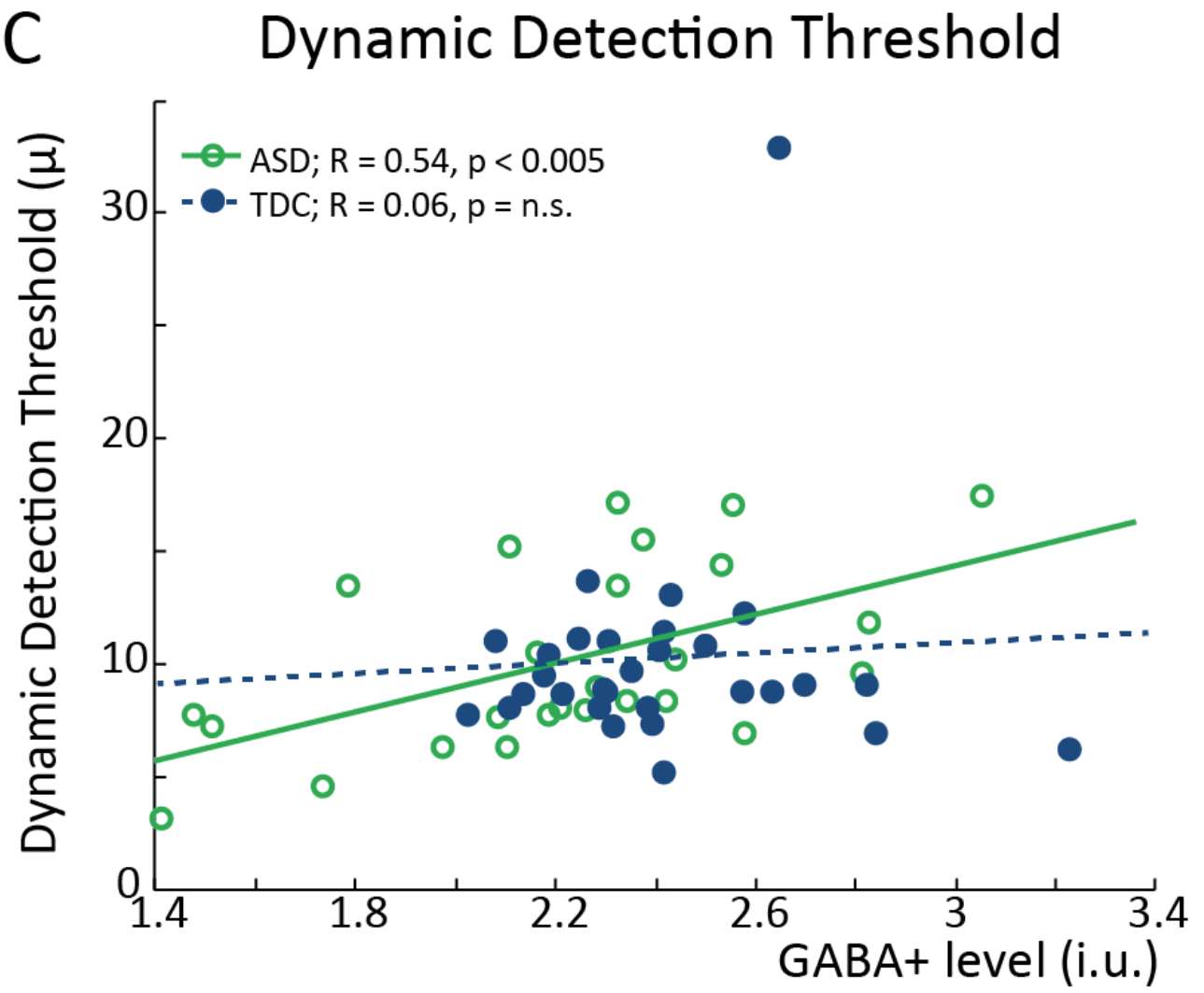
1:57 **114.002** Reduced GABA Levels Predict Altered Sensory Function in Children with Autism Spectrum Disorder

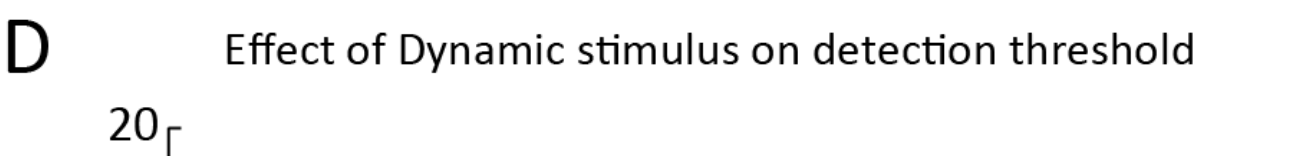
N. A. Puts[1,2]*, E. L. Wodka*[3]*, A. D. Harris*[4]*, D. Crocetti*[3]*, M. Tommerdahl*[5]*, R. A. Edden*[6] *and S. H. Mostofsky*[7]*, (1)Radiology and Radiological Science, Johns Hopkins University, Baltimore, MD, (2)FM Kirby Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, (3)Kennedy Krieger Institute, Baltimore, MD, (4)Department of Radiology, University of Calgary, Calgary, AB, Canada, (5)University of North Carolina, Chapel Hill, NC, (6)Johns Hopkins University School of Medicine, Baltimore, MD, (7)Johns Hopkins School of Medicine, Baltimore, MD*

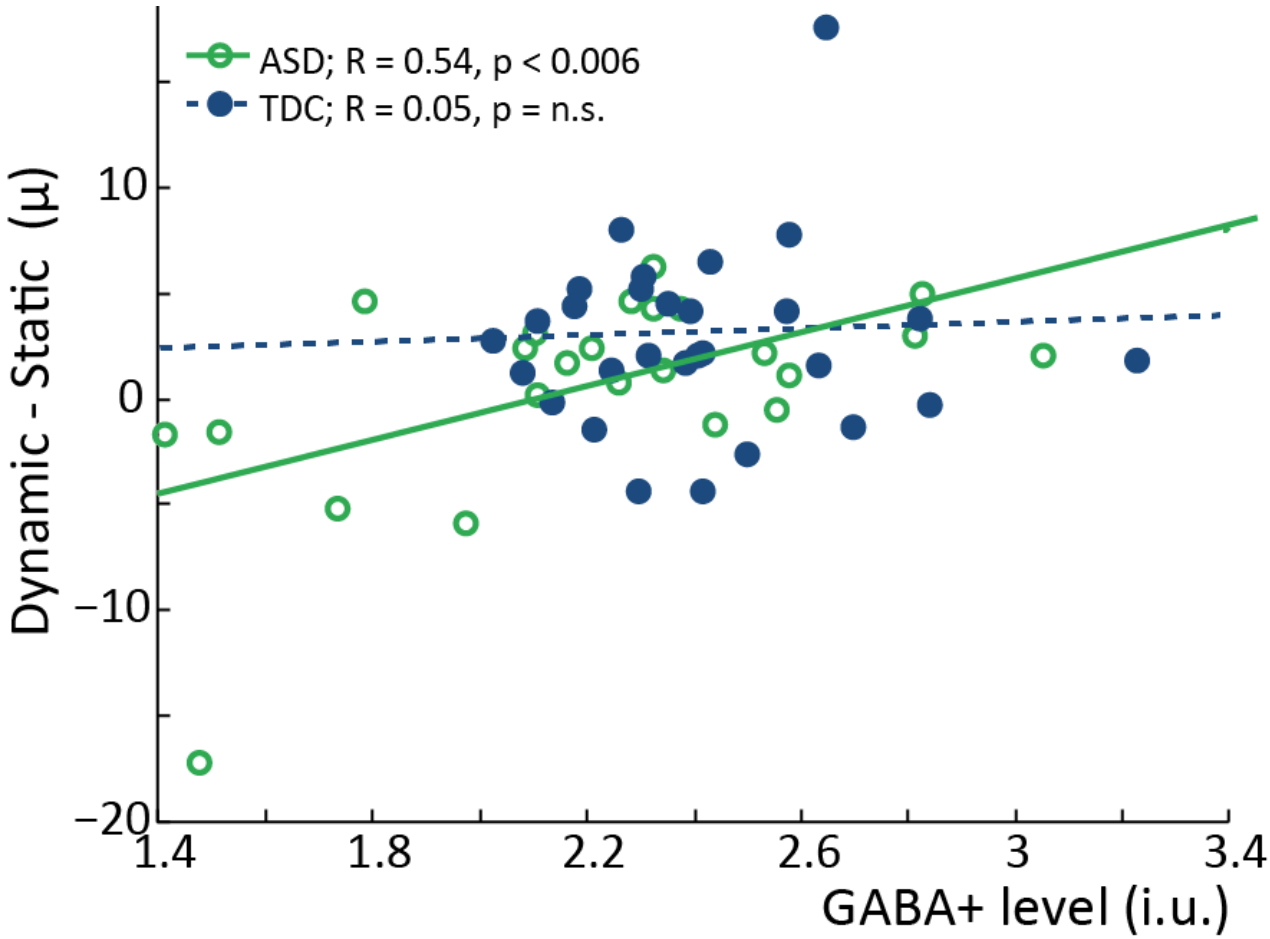
Background: Difficulties with sensory stimuli have been increasingly recognized and are now included as a diagnostic feature of ASD. Multiple lines of evidence suggest that GABA, the main inhibitory neurotransmitter in the brain, plays a role in the pathophysiology of ASD. It is well known that GABA plays a key role in regulating tactile processing. However, the link between GABA and autism-associated impairments in vibrotactile processing remains unclear.
Objectives: GABA can be measured using edited Magnetic Resonance Spectroscopy (MRS) and we developed a technique to measure tactile sensitivity in children objectively, in tasks linked to inhibition[6]. In this study, in a large cohort, we aimed to investigate whether 1) children with ASD have reduced GABA levels, 2) children with ASD show altered vibrotactile processing, and 3) whether altered GABA levels are associated with abnormal tactile processing in ASD.
Methods: Subject and parental consent were obtained under local IRB approval. Data were acquired in 37 children with ASD (10.69 ± 1.4 years, 6F) and 35 TDC (10.09 ± 1.25 years; 8F). Children had normal IQ. GABA-edited MR spectra were acquired from $(3\ cm)^3$ voxels over right primary sensorimotor (Fig 1A&B) and occipital cortices. GABA levels were calculated against the unsuppressed water signal from the same voxel and tissue corrected. *Behavioral*: Children performed: 1) Static and Dynamic detection tasks (DT; where the increasing (dynamic) sub-threshold stimulus is thought to act through feed-forward inhibition); 2) Amplitude discrimination with- and without an adapting stimulus (AD; linked to lateral inhibition); and 3) Frequency discrimination (FD; encoded through GABAergic inhibition).
Results:
Sensorimotor GABA levels were significantly reduced in children with ASD compared to TDC (2.20 ± 0.44 i.u. and 2.40 ± 0.25 i.u. respectively, $p = 0.016$). There were no group differences in occipital GABA levels. For children with ASD, sensorimotor GABA levels correlated positively with dynamic DT, with higher GABA levels indicating a higher DT (Fig 1C). The difference between a static and dynamic DT (Figure 1D) were significantly correlated with GABA levels within the entire cohort; this finding was driven by children with ASD, such that those with lower GABA levels showed a reduced effect of sub-threshold stimulation. AD performance after single-site adaptation correlated with GABA levels in TDC but not in ASD (Fig 1E) adaptation was absent in ASD. Tactile FD is correlated with GABA in TDC, which has been previously reported (Fig 1F); this association was not observed in ASD.
Conclusions: Sensorimotor GABA levels were reduced in children with ASD compared to TDC, while occipital levels are normal, consistent with previous work. Tactile abnormalities in ASD were consistent with previous work, and consistent with reduced GABA-mediated inhibition. Our correlative results are consistent with the prediction for children with ASD; reduced GABA level was associated with stronger effect of modulating stimuli. Children with ASD show reduced GABA levels, and are associated with abnormalities in tactile performance. Altered in vivo GABA levels might explain abnormal tactile information processing in ASD. The GABA system may be a future and novel target for therapies in ASD.




B
TDC
GABA
4
3.5
3
2.5
2
1.5
PPM
ASD
4
3.5
3
2.5
2
1.5
PPM

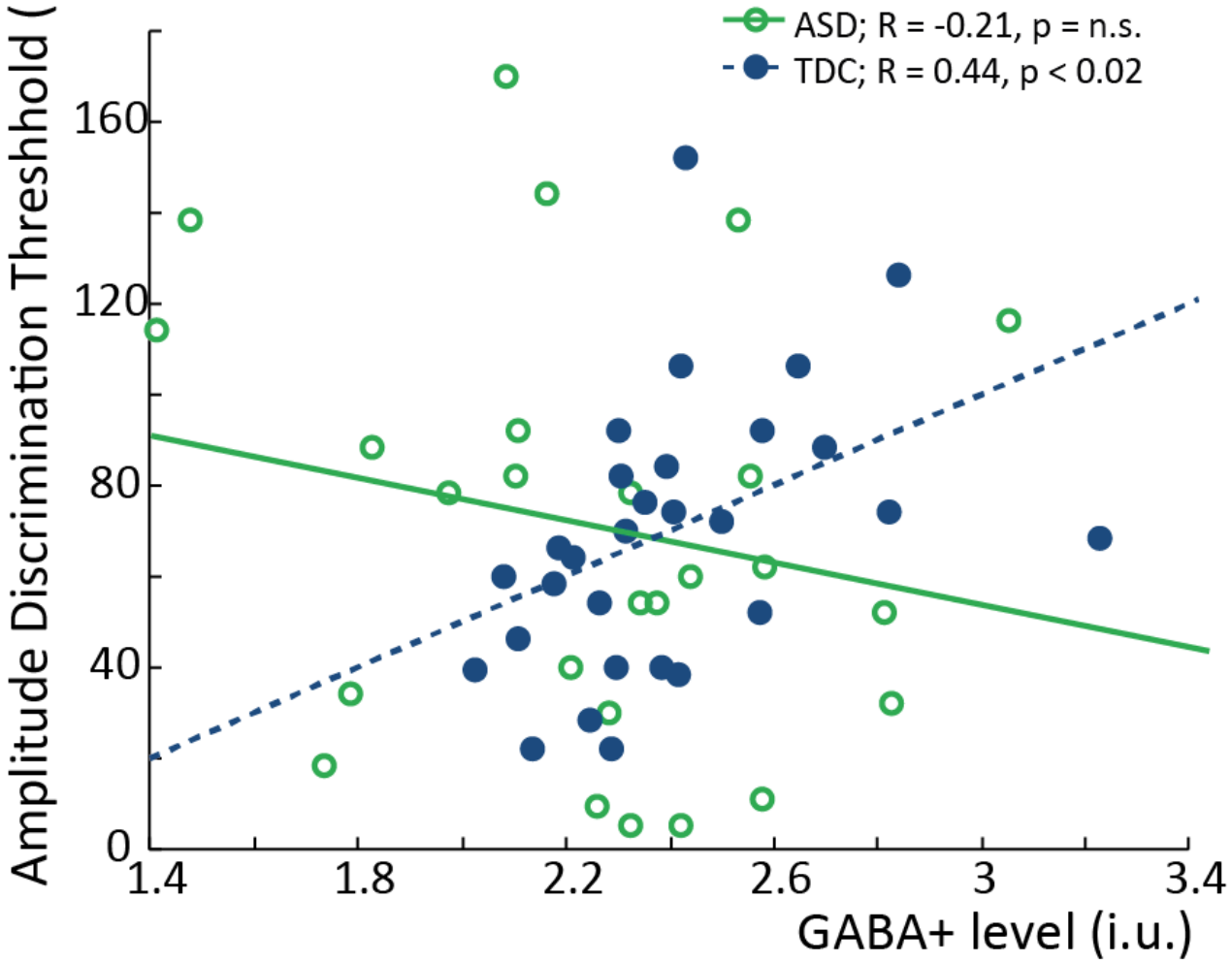

C
Dynamic Detection Threshold
ASD; R = 0.54, p < 0.005
TDC; R = 0.06, p = n.s.
Dynamic Detection Threshold (μ)
30
20
10
0
1.4
1.8
2.2
2.6
3
3.4
GABA+ level (i.u.)

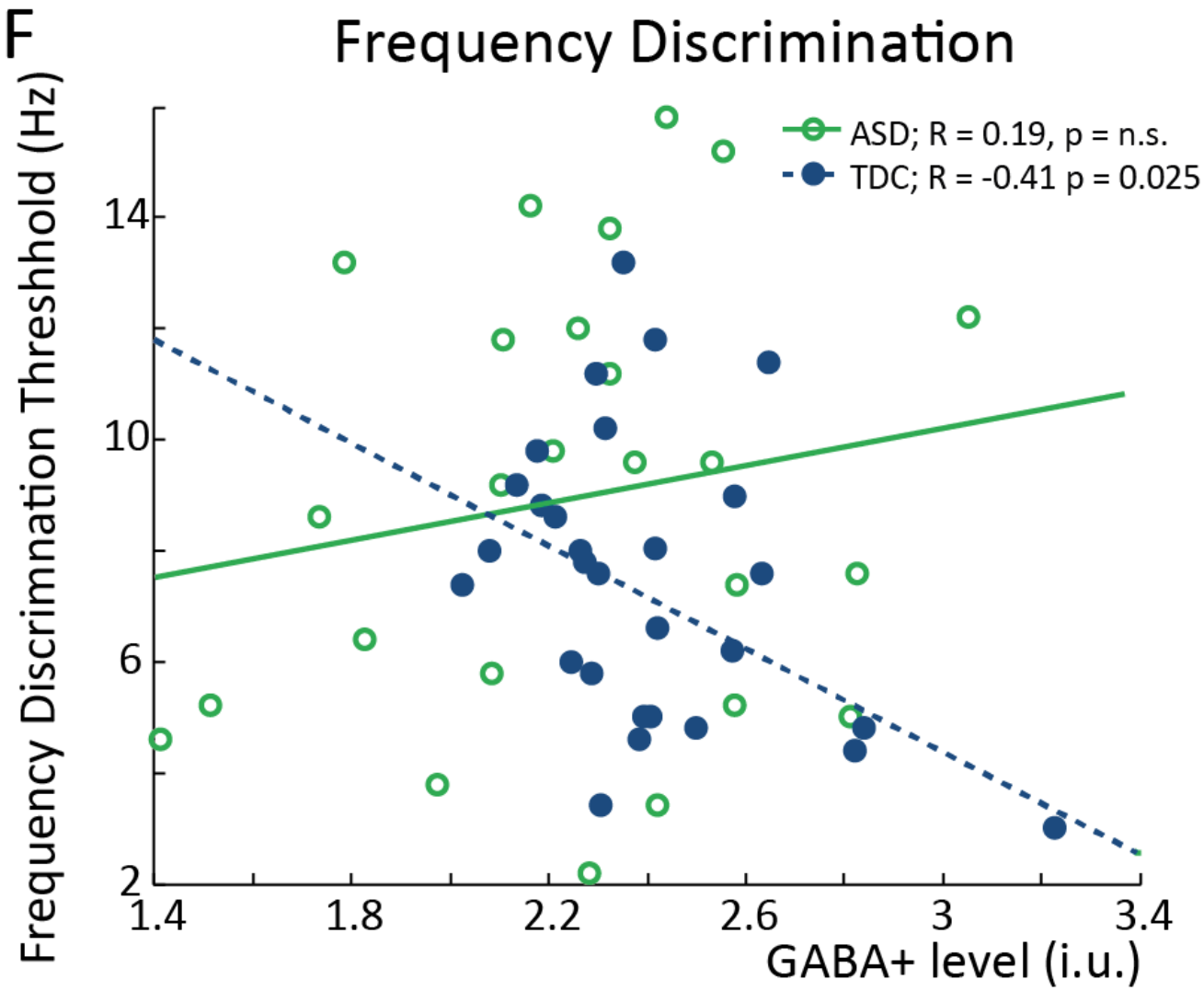

D
Effect of Dynamic stimulus on detection threshold
20



E

Amplitude Discrimination with single site adaptation





2:09 **114.003** The Variability of Restricted Repetitive Behavior in Neurodevelopmental and Neuropsychiatric Disorders

D. W. Evans, *Geisinger Health System, Lewisburg, PA*

Background:
Restricted, repetitive behavior (RRB) appears in a wide variety of neurodevelopmental and neuropsychiatric disorders including intellectual disability (ID), autism spectrum disorders (ASD), obsessive-compulsive disorder (OCD), Tourette syndrome (TS) and schizophrenia (Sz), among others. Within each diagnosis there is substantial individual variability in the severity of RRB; the source of this variability has been the subject of considerable debate. Our recent work on genetic copy number variation syndromes (CNVs) indicates that probands' phenotypic variability on a range of quantitative traits is influenced by family background factors. Thus the degree of impairment exhibited by patients/probands may be influenced by the performance of non-carrier/non-patient family relatives.
Objectives: This study aims to explore sources of variability of RRBs across neurodevelopmental and neuropsychiatric disorders. We examine parental RRB as a contributing factor explaining the variability of children's RRB in a range of disorders.
Methods: Three thousand twenty-nine families with at least one child ranging in age from 1 to 18 years of age participated in an online assessment of RRB. These families were recruited through Scientific Sampling International, and were demographically representative of the general U.S. population in terms of race/ethnicity, geographic region, income, and mental health status. Seven hundred forty seven of these children had been diagnosed with at least one neurodevelopmental/neuropsychiatric disorder, including developmental delay, developmental coordination disorder, intellectual disability, ASD, specific language impairment, OCD, TS, depression, anxiety, bi-polar disorder, and schizophrenia. Parents completed the Childhood Routines Inventory-Revised (CRI-R) a 63-item parent report measure of repetitive behavior and restricted interests. Parents also self-reported on the newly developed Adult Routines Inventory (ARI).
Results:
Factor analysis revealed a two-factor solution for both the CRI-R and the ARI: Motor Behavior and Compulsions (MBC) and Restricted Interests/Insistence on Sameness (RIS). Next we created "clusters" based on children's diagnoses. These included: ADHD, depression/anxiety, developmental delay/intellectual disability, ASD, conduct disorder/oppositional defiant disorder, obsessive-compulsive disorder/Tourette syndrome, bi-polar/schizophrenia. Analysis of Variance compared the total CRI-R, MBC and RIS t-scores between the diagnostic cluster groups. The groups differed significantly for total CRI-R ($F(8,2852)= 59.24$); MBC ($F(8,2852)=41.20$) and RIS ($F(8,2852)=59.86$ (all $p< 0.00001$). Post hoc tests revealed that the ASD and OCD/TS groups had higher total CRI-R scores and for MBC than all other diagnostic groups. For the RIS factor, bi-polar/schizophrenia and OCD/TS were higher than all other groups, with ASD similar to all other diagnostic groups (and greater than children with no diagnosis). Further analyses revealed that a) parent- child intraclass correlations on all scales of the ARI and CRI-R were significant; b) the parents of children with a diagnosis had elevated ARI scores – even when the parents themselves had no history of a clinical diagnosis.
Conclusions:
The findings reported here provide further clarification of the nature of RRB across a variety of neurodevelopmental and neuropsychiatric disorders. We discuss the relevance of these findings for quantitative approaches to clinical assessment and diagnosis. We also discuss the importance of considering family background when determining clinical morbidity, particularly in studies of genomic copy number variation syndromes.

2:21 **114.004** Sensorimotor Abnormalities in Biological Mothers and Fathers of Individuals with ASD

L. M. Schmitt[1,2], *S. P. White*[2,3], *K. C. Conroy*[2], *J. A. Sweeney*[2,3] *and M. W. Mosconi*[4], *(1)UT Southwestern Medical Center, Dallas, TX, (2)Center for Autism and Developmental Disabilities, Dallas, TX, (3)Center for Autism and Developmental Disabilities, University of Texas Southwestern, Dallas, TX, (4)Dole Human Development Center, University of Kansas, Lawrence, KS*

Background: Eye movement studies provide a precisely quantifiable and translational method for examining sensorimotor impairments in autism spectrum disorder (ASD). Individuals with ASD show reduced accuracy and increased accuracy variability of saccadic eye movements. We have demonstrated that unaffected first-degree relatives of individuals with ASD also show reduced saccade accuracy and increased saccade variability suggesting that eye movement abnormalities may be familial. Here, we used a family trio design to determine the extent to which eye movement abnormalities are familial, and to examine whether they are differentially expressed in mothers versus fathers.
Objectives: To assess the familiality of eye movement abnormalities in individuals with ASD and their unaffected parents.

Methods: Thirty-five family trios (proband with ASD, biological mother, biological father) and 70 age-, IQ- and gender-matched healthy controls (42 proband controls, 28 parent controls) completed eye movement testing. Participants with ASD were between ages 6-20 years, 89% male, and had a Performance IQ >70. Parents of probands were <55 years old and completed the Broad Autism Phenotype-Questionnaire (BAP-Q). Participants completed 60 trials of a visually-guided saccade task during which they made saccades to peripheral targets that appeared with equal probability at 12 or 24 deg to the left or right of center**.** Saccade accuracy, accuracy variability, peak velocity, and peak acceleration were measured for each trial.
Results: During the visually-guided saccade task, individuals with ASD demonstrated reduced saccade accuracy and increased accuracy variability compared to age-matched controls**.** Mothers of individuals with ASD also demonstrated reduced saccade accuracy compared to adult female controls. Fathers of individuals with ASD did not show any differences in the accuracy or variability of their saccades relative to male controls. Deficits in saccade accuracy, peak velocity, and peak acceleration were found to be highly familial, co-varying more strongly in mother-child versus father-child dyads. However, their saccade accuracy and accuracy variability were associated with BAP-Q rated social aloofness, pragmatic language deficits, and behavioral rigidity for fathers of individuals with ASD. This was not observed for mothers, and no other cognitive or demographic characteristics related to their oculomotor deficits.
Conclusions:
Our findings provide further support that sensorimotor impairments in ASD are familial, with novel evidence suggesting primarily maternal influences. Fathers did not show sensorimotor deficits compared to controls, but their ability to make accurate saccades was related to broader autism phenotypic characteristics suggesting that sensorimotor processes among unaffected fathers may be one component of a broader constellation of sub-clinical features that confer risk onto their offspring. In contrast, mothers in our sample appear to have relatively isolated sensorimotor deficits that may be directly related to the deficits observed in their offspring, yet have factors protecting them from exhibiting broader phenotypic characteristics. Future studies should be aimed at better understanding maternal versus paternal contributions to risk susceptibility in ASD, identifying potential protective factors in mothers, and determining how maternal and paternal influences affect sensorimotor functioning in female probands.

Oral Session - 2B

115 - Early Dysmaturation of Sensory and Motor Systems as Critical Predictors of Symptom Severity

2:40 PM - 3:30 PM - Room 307

2:40 **115.001** Cataloguing and Characterizing Interests in Typically Developing Toddlers and Toddlers Who Develop ASD

*J. T. Elison[1], J. J. Wolff[2], **E. P. Teska**[1], K. Botteron[3], A. M. Estes[4], H. C. Hazlett[5], J. Pandey[6], R. T. Schultz[7], L. Zwaigenbaum[8], J. Piven[9] and .. The IBIS Network[9], (1)Institute of Child Development, University of Minnesota, Minneapolis, MN, (2)University of Minnesota, Minneapolis, MN, (3)Psychiatry and Radiology, Washington University School of Medicine, St. Louis, MO, (4)University of Washington Autism Center, Seattle, WA, (5)Carolina Institute for Developmental Disabilities, University of North Carolina at Chapel Hill, Chapel Hill, NC, (6)Children's Hospital of Philadelphia, Philadelphia, PA, (7)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (8)University of Alberta, Edmonton, AB, Canada, (9)University of North Carolina at Chapel Hill, Chapel Hill, NC*

Background: Little is known about the prospective emergence of restricted interests in autism spectrum disorder (ASD).
Objectives: Our aims were three-fold: 1) attempt a replication and extension of DeLoache et al. (2007) findings that indicate a greater proportion of typically developing toddler/preschool-aged males show extremely intense interests as compared to similar aged females; 2) examine whether the intensity and/or peculiarity of interests reported at 18 or 24 months differentiated children at high-familial-risk who later met diagnostic criteria for ASD at 24 months as compared to high and low risk children who did not meet diagnostic criteria at 24 months; and 3) test a feature of the "extreme male brain theory" by examining whether females at high-familial risk for developing ASD show a greater proportion of male sex-typed interests as compared to low-risk females.
Methods: The *Intense Interests Inventory* (Elison & Bodfish, 2009) was conducted in a semi-structured interview format. Parents reported their child's primary interests at 18 and 24 months of age in the context of the IBIS study. Interests were rated by clinical examiners on a 5-point scale with respect to the intensity and peculiarity of each interest listed. The sample consisted of 95 low-risk infants (53 males), 157 high-risk infants who did not meet diagnostic criteria for ASD at 24 months (86 males), and 38 high-risk infants who met diagnostic criteria for ASD at 24 months (33 males).
Results: 1) Among children not meeting diagnostic criteria for ASD at 24 months, a Mann-Whitney U test revealed that the distribution of intensity ratings varied across sex ($p = 0.029$) at 18 months of age, with a greater proportion of males showing moderate or intense interests as compared to females. The effect of sex was not significant at 24 months. 2) Interests of high-risk infants who met diagnostic criteria for ASD at 24 months were rated as more peculiar at 18 months (Mann-Whitney U test, $p = 0.006$) and 24 months (Mann-Whitney U test, $p = 0.030$) as compared to those children not meeting diagnostic criteria. The intensity of interests did not differentiate these two groups. 3) The proportion of females, who do not meet diagnostic criteria for ASD at 24 months and whose primary interest was classified as masculine, feminine, or indeterminate did not depend on familial risk status (18 months, $p = 0.325$; 24 months, $p = 0.572$).
Conclusions: We report evidence partially consistent with DeLoache et al. (2007) that a greater proportion of males show intense interests at 18 months as compared to females, but this finding may be transient or specific to this age. We also report evidence consistent with ADI-R conventions that peculiarity of interests and not the intensity of interests differentiate children who meet diagnostic criteria at 24 months of age. Finally, our finding that females at high-risk for ASD do not show a greater proportion of male sex-typed interests as compared to low-risk females does not support the extreme male brain theory.

2:52 **115.002** Infant Motor Skill and ASD

***E. S. LeBarton**[1] and R. Landa[2], (1)Kennedy Krieger Institute & Johns Hopkins School of Medicine, Baltimore, MD, (2)The Kennedy Krieger Institute, Baltimore, MD*

Background: Emerging theoretical and empirical work suggests that infant motor skill is a characteristic of a prodromal period for autism spectrum disorder (ASD) and developmental vulnerability in infants with an older sibling with ASD (High-risk, HR infants). However, few studies have focused on the first year of life—when delays are proposed to be first evident. Further, little research has addressed this question for HR infants for whom developmental delays have been observed.
Objectives: (1) Examine the presence of motor delays in HR infants relative to infants with no family history of ASD (Low-risk, LR infants). (2) Examine the presence of motor delays in infants later identified with ASD. (3) Examine the relation between infant motor skill and concurrent ASD symptomatology.
Methods: Our sample included 104 HR infants and 55 LR infants assessed at 6 months of age as part of an ongoing longitudinal study. Older sibling's ASD was confirmed using the Autism Diagnostic Observation Schedule (ADOS) and clinical judgment. We assessed infant motor skill using the standardized Peabody Developmental Motor Scales (PDMS). Motivated by previous work, we used the Stationary gross motor subscale and two fine motor subscales (Grasping and Visual-motor Integration, VMI). To assess autism symptomatology at 6 months, we administered the Autism Observation Scale for infants (AOSI). To date, a subset of 74 infants (49 HR, 25 LR) have reached a 24-month follow-up session and these infants were divided into one of two groups based on whether they met our ASD criteria (ADOS score for ASD and clinical judgment). This resulted in 11 infants with ASD (all from HR group) and 63 infants without ASD (No Diagnosis, ND group). Due to unequal sample sizes, we performed non-parametric tests for all analyses (the pattern of results is unchanged using parametric alternatives).
Results: We found that the HR infants scored lower than LR infants on the Stationary scale (z=2.76, p=.006) and both fine motor scales (Grasping: z=2.52, p=.012; VMI: z=2.03, p=.043) (Figure 1). A subset of infants had AOSI scores available (HR: n=74, HR: n=45) to test relations between infant motor skill and concurrent autism symptomatology. Overall, the HR group had higher AOSI scores (mean = 7.80, SD = 3.76) than the LR group (mean = 5.67, SD = 3.02), indicating greater ASD symptomatology in the HR group (z=3.13, p=.002). Within the HR group, AOSI scores significantly related to PDMS stationary (rho=-.333, p=.004) and grasping scores (rho=-.284, p=.014). Finally, we found motor delays in infants later identified with ASD relative to those without ASD. The ASD group scored lower than the ND group on the PDMS stationary scale (z=2.62, p=.009) and both fine motor scales (Grasping: z=2.97, p=.003; VMI: z=2.42, p=.016)(Figure 2).
Conclusions: Our findings provide evidence supporting infant motor skill as an area of developmental vulnerability in HR infants and an early indicator of ASD. In combination this points to the importance of considering motor skill when characterizing a putative prodromal period for ASD and developmental monitoring of HR infants.

Figure 1. Raw PDMS Scores for HR and LR Groups

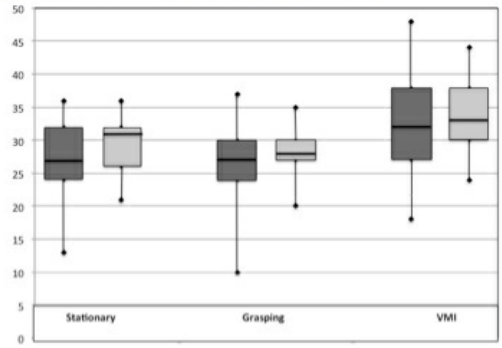


Figure 1. Boxplots of PDMS raw scores at 6 months. HR group is in dark grey and LR group is in light grey. Box indicates interquartile range, line = Median, tails = minimum and maximum.

Figure 2. PDMS raw scores for ASD group and group without ASD (ND)

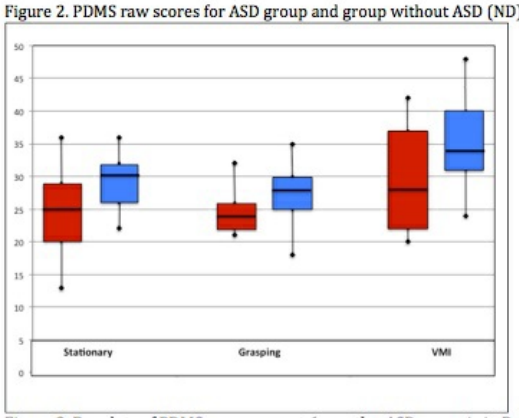


Figure 2. Boxplots of PDMS raw scores at 6 months. ASD group is in Red and ND group is in Blue. Box indicates interquartile range, line = Median, tails = minimum and maximum.

3:04 **115.003** Posture Development from 6 to 14 Months in Infants with Vs. without Risk for ASD

N. B. Leezenbaum *and J. M. Iverson, University of Pittsburgh, Pittsburgh, PA*

Background: During the first 14 months, TD infants progress from postures in which the body is supported by a surface (lying) to postures that require greater strength, muscle coordination, and balance (unsupported sitting, all fours, standing). Although it is well established that individuals with ASD demonstrate difficulties with postural control (Fournier et al., 2010), relatively little is known about the emergence and course of posture development in infants eventually diagnosed with ASD.
Objectives: 1) Describe trajectories of posture development in infants at heightened ASD risk (later-born siblings of children with ASD; HR) and infants with low ASD risk (infants with a negative family history of ASD; LR); and 2) Evaluate the extent to which delays or impairments predict a later ASD diagnosis at 36 months.
Methods: Twenty-five LR and 59 HR infants were observed at home for 25 minutes at 6, 8, 10, 12, and 14 months. Durations of lying, supported sitting, unsupported sitting, all-4, supported standing, and unsupported standing were coded from 6 to 14 months. At 36 months, HR infants received language and ASD diagnostic evaluations using the ADOS-G (Lord et al., 2000) and Mullen Scales of Early Learning (Mullen, 1995). Fourteen HR infants were diagnosed with ASD (HR-ASD), 17 HR infants were classified as language delayed (HR-LD), and 28 HR infants received no diagnosis (HR-ND).
Results: Hierarchical Linear Modeling was used to compare posture development across groups. All groups declined in Lying, but the HR-ASD group spent more time than the LR, HR-ND, and HR-LD groups in Lying at 10 (p=.005; .011; .022) and 12 months (p=.011; .030; .045). With regard to Sitting, HR-ASD and HR-LD groups spent more time than the LR group in Supported Sitting (p=.016; .035) and less time in Unsupported Sitting (p=.002; .042) at 6 months. In terms of All-4, the HR-ASD group did not exhibit the decelerating pattern of growth characteristic of the LR, HR-ND, and HR-LD groups (p < .001). The HR-ASD group spent less time in All-4 than LR, HR-ND, and HR-LD groups at 8 (p=.002; .006; 025) and 10 months (p = .009; .038; 017), however, they caught up the other groups by 12 months, and at 14 months spent more time in All-4 than the other three groups (p = .001; .023; 010). For Supported Sitting, the HR-ASD and HR-LD groups exhibited slower growth than the LR group (p=.002; .024), diverging from the LR group by 8 months (p=.001; .009). The HR-ASD group also exhibited slower acceleration than the LR group in Unsupported Standing (p=.005) and spent less time in this posture by 14 months (p=.006).
Conclusions: Relative to LR infants, HR-LD and HR-ASD infants exhibited delays in Unsupported Sitting and Supported Standing. Delays in All-4 were specific to ASD, and from 10 months on, the HR-ASD infants spent more time than all three groups in less developmentally advanced postures (i.e., Lying: 10-12 months and All-4: 14 months). Taken together, these findings indicate that posture delays are likely among the earliest identifiable disruptions in the unfolding of ASD.

3:16 **115.004** Do Restricted and Repetitive Behaviors during Early Childhood Predict School-Age Executive Functioning Among Children with Autism Spectrum Disorders?

E. Troyb[1], *K. Knoch*[2], *L. Herlihy*[3] *and D. A. Fein*[4], *(1)Brown University, Providence, RI, (2)University of Connecticut, Storrs, CT, (3)Hospital For Special Care, New Britain, CT, (4)Psychology, University of Connecticut, Storrs, CT*

Background: Restricted and Repetitive Behaviors (RRBs) are core features of Autism Spectrum Disorders (ASDs) and include motor stereotypies, preoccupation with parts of objects, restricted interests, insistence on sameness, and sensory interests. One theory proposed to explain the purpose of RRBs points to executive dysfunction and argues that RRBs result from a tendency to perseverate, as well as from deficits in planning, self-monitoring, inhibition of ongoing behaviors, and initiation of new behavior (Russell, 1997). However, because RRBs emerge earlier in development than functions usually grouped under executive functioning (EF), it is important to consider the alternate causation, namely, the effect that RRBs may have on the development of EF. Studies examining the relationship between EF and RRBs are limited and have not examined the impact that early RRBs have on the development of EF (see Leekham et al., 2011).
Objectives: The current study used a longitudinal design to examine the extent to which RRBs at two points in early childhood predict school-aged executive functioning.
Methods: Participants included 40 children diagnosed with ASD at age 1-2 years and again at age 3-5 years. Participants were recruited from a study examining the effectiveness of the Modified Checklist for Autism in Toddler (M-CHAT), a screening instrument designed to identify children at risk for developing ASDs. RRBs were examined at age 1-2 years (M=2.2, SD=0.3; M(Mullen ELC)=58.7, SD=8.5) and 3-5 years (M=4.3 years, SD=0.4; M(Mullen ELC)=63.1, SD=19.5), and were assessed using both direct observation and parent report. RRBs were used to predict EF at age 8-10 years (M=9.9, SD=0.8; M(VIQ)=70.8, SD=31.5; M(NVIQ)=81.4, SD=27.4). EF was examined using the Behavior Rating Inventory of Executive Function (BRIEF), a parent report questionnaire designed to assess EF in daily settings.
Results: Linear regression indicated that RRBs observed at age 1-2 are significant predictors of school-age EF as measured by the Global Executive Composite (GEC) of the BRIEF (F(6, 25)=2.52, p<.05, *Adjusted* R^2=.23). Specifically, RRBs at age 1-2 significantly predicted difficulties with cognitive flexibility and initiation of new behaviors (Shift: F(6, 25)=2.51, p<.05, *Adjusted* R^2=.23; Initiation: F(6, 25)=2.75, p<.05, *Adjusted* R^2=.25). According to these models, increased self injurious behaviors predicted

greater difficulty with cognitive flexibility (*beta*=0.47, *p*<.05). In contrast, reduced repetitive motor mannerisms predicted more difficulty with initiation of new behaviors (*beta*=–0.36, *p*<.05). When RRBs were assessed at age 3-5 years, they did not predict the GEC ($F(6, 25)=1.59$, $p=.19$, *Adjusted* $R^2=.11$), but RRBs were significant in predicting reduced cognitive flexibility ($F(6, 24)=3.01$, $p<.05$, *Adjusted* $R^2=.29$). At age 3-5, more severe adherence to rituals or routines (*beta*=0.42, *p*<.05*)* and greater preoccupations with parts of objects (*beta*=0.41, *p*<.05) predicted increased difficulty with cognitive flexibility.
Conclusions: This study found a predictive relationship between RRBs in early childhood and school-aged EF. Because RRBs emerge earlier in development than classically defined EF, these findings raise two possibilities: first, that RRBs may impact neurocognitive development and the development of EF, and second, that precursors of EF, such as early manifesting inflexibility and perseveration, impact the development of both RRB's and later developing EF.

Oral Session - 3A
116 - Variation in Early Trajectories of ASD
1:45 PM - 2:35 PM - Room 308

1:45 **116.001** Different Developmental Trajectories of ASD: Slow and Rapid Onset of Symptoms in Toddlers from the General Population

E. C. Bacon[1], *L. Schreibman*[2], *A. C. Stahmer*[3], *C. Carter*[1], *E. Courchesne*[1] *and K. Pierce*[1], *(1)Neuroscience, UCSD Autism Center of Excellence, La Jolla, CA, (2)University of California San Diego, La Jolla, CA, (3)University of California at Davis MIND Institute, Sacramento, CA*

Background:
The heterogeneity of ASD is widely documented, however there is little documentation regarding variability in *onset* of ASD symptoms. This question is particularly difficult to answer as it requires the prospective study of ASD. A recent study by Ozonoff et al. (2015) examined the onset of ASD in a baby-sibling population, and found over half the sample that eventually received an ASD diagnosis at age three, did not initially meet criteria for ASD between 1-2 years.
Objectives:
This study aimed to analyze differential developmental trajectories of toddlers with ASD, and specifically compare toddlers initially identified as ASD that retained a diagnosis (*Rapid-Onset*) versus children initially identified as non-ASD who were identified as ASD at a later evaluation (*Slow-Onset*) in the general population.
Methods:
ASD and contrast toddlers were primarily identified using the One-Year Well-Baby Check-Up Approach (Pierce et al., 2011). Children were evaluated using the Mullen, Vineland, ADOS, and the Geometric Preference Test, a preferential looking eye-tracking test designed to quantify a toddlers' preference for geometric or social stimuli (Pierce et al. 2011; 2015). Toddlers were included if initially evaluated ≤24 months (M=17.1) and diagnosis was confirmed at three. Children were reassessed every 9-12 months (M= 3.14 evaluations). Seventy-four language delayed (LD) and 132 typically developing (TD) toddlers were included for comparison. Growth curve analysis was used to examine longitudinal trajectories. Visual preference patterns based on eye-tracking were also compared at intake.
Results:
Within our sample 86 toddlers were considered Rapid-Onset ASD (RO-ASD; i.e., initially identified as ASD and retained that diagnosis over time) and 41 toddlers were identified as Slow-Onset ASD (SO-ASD; i.e., were initially identified as non-spectrum or having a delay such as language delay, but were identified as ASD at a subsequent evaluation). See figure 1 for trajectories of ADOS scores. An ANOVA showed a significant difference in looking times for geometric stimuli across groups ($F_{(3, 127)}=11.406$, $p < .001$). The RO-ASD group showed the highest preference for geometric images (M=42.1 sec), followed by SO-ASD (M=30.3), LD (M=24.9), and TD group (M=18.2; see figure 2). Eleven RO-ASD and 2 SO-ASD cases looked at geometric images at very elevated levels (≥69%) which has been demonstrated to be highly associated with diagnosis of ASD (Pierce et al., 2011).
Conclusions:
Our study showed strikingly different symptom onset patterns within ASD toddlers from the general population. For language and ADOS scores, the RO-ASD group initially showed more impairment than the SO-ASD group, but both groups showed similar performance at age three. Importantly, the SO-ASD group was not initially identified as ASD based on their behavioral presentation, and instead were often identified as having some other delay (i.e. LD). Interestingly, a small subset of SO-ASD children showed elevated preference for geometric images at intake. This finding highlights the need for robust biological markers of autism as they may be able to identify children before behavioral symptoms become clear. These results also emphasize the necessity of repeated screening and follow-up for children showing any delay, as ASD symptoms emerge differently across children.

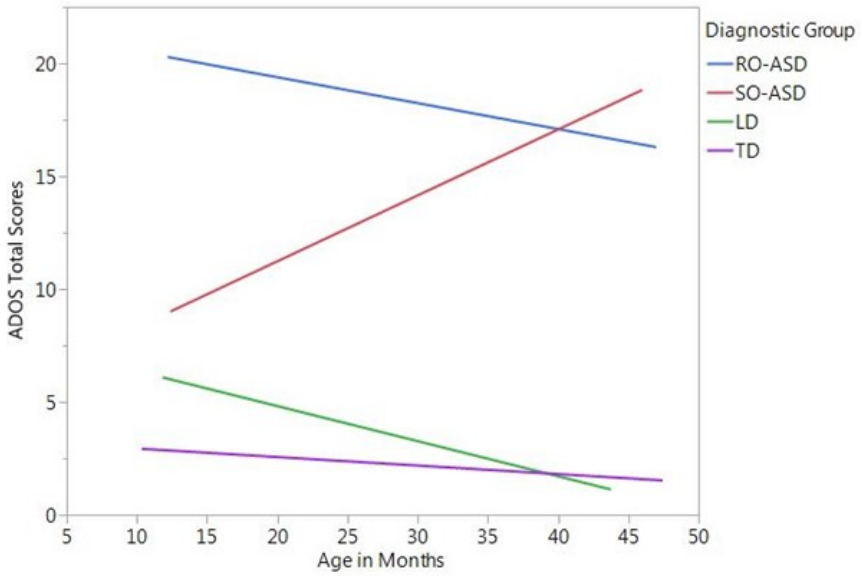


Figure 1. ADOS total scores across time across diagnostic groups.

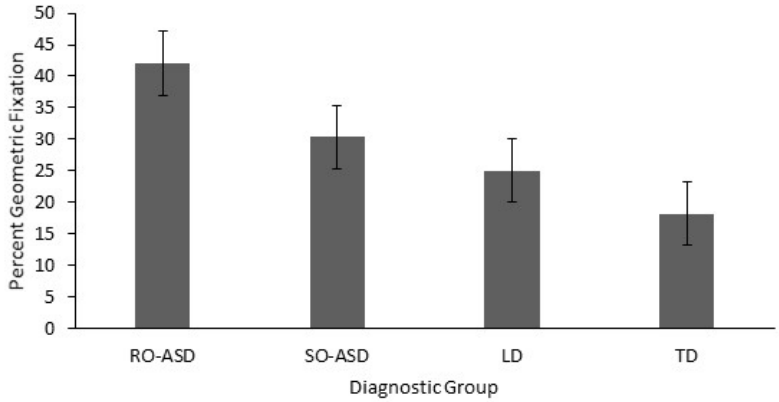


Figure 2. Percent fixation on geometric stimuli across diagnostic groups. Even though the SO-ASD group were not identified as ASD at this early age, percent geometric fixation were already elevated relative to the TD and LD groups.

1:57 **116.002** Characterizing Early Developmental Trajectories in Tuberous Sclerosis Complex

K. J. Varcin[1], *D. Senturk*[2], *M. Sahin*[3], *J. Y. Wu*[4] *and C. A. Nelson*[5], *(1)Harvard Medical School, Boston Children's Hospital, Cambridge, MA, (2)Biostatistics, University of California, Los Angeles, Los Angeles, CA, (3)Department of Neurology, Boston Children's Hospital, Boston, MA, (4)UCLA, Los Angeles, CA, (5)Boston Children's Hospital/Harvard Medical School, Boston, MA*

Background: Tuberous Sclerosis Complex (TSC) is one of the most commonly occurring genetic disorders associated with autism spectrum disorder (ASD). Up to 60% of children with TSC will meet criteria for ASD and up to 80% will experience cognitive delay. Importantly, cognitive delays and ASD often co-occur in this population, posing challenges for diagnosis, intervention targets and treatment selection. Despite hypotheses about the role of epilepsy, cortical pathology, and co-occurring genetic mutations in predicting neurodevelopmental outcomes in TSC, no single clinical factor has been identified as a consistent predictor of atypical neurodevelopment. As TSC is often diagnosed very early in life, often prenatally, allows for prospective investigation of developmental trajectories and early markers of ASD in this population.
Objectives: Modeling the approach taken in our work with infant siblings at high-risk for ASD, we conducted the first, prospective, longitudinal study of infants with TSC, mapping development from 3-6 months through to 36 months of age. Within the context of this prospective study design, we aimed to characterize early delays in cognitive development that precede, and possibly predict, the development of ASD in this high-risk population.
Methods: Infants with TSC (n = 40) and typically developing infants (n = 34) were recruited as early as 3-6 months of age and followed longitudinally until 36 months of age. For all infants, we assessed developmental functioning using the Mullen Scales of Early Learning. Social communication was assessed using the Autism Observation Scale for Infants (AOSI). At 18, 24 and 36 months a diagnostic evaluation of ASD was performed using the Autism Diagnostic Observation Schedule (ADOS). For TSC infants, detailed clinical and seizure history information was obtained at each time point.
Results: Infants with TSC show delays in cognitive development (especially in fine motor [p = .01] and visual receptions skills [p = .03]) and social communication skills (especially in visual tracking [p < .01], disengagement of attention [p < .01] and anticipatory responses [p = .02]) as early as 6 months of age, with more global delays from 9 months (all ps < .05). Infants with TSC who develop ASD (n = 22 of 40 infants with TSC) show more cognitive impairment from 12 months of age (ps < .05) and a slowing of non-verbal skills development between 12 to 36 months of age compared to infants with TSC without ASD, even after controlling for seizure severity (slope estimate -0.80, p = .01).
Conclusions: This research has unveiled a developmental profile in TSC that is marked by prominent and early delays in non-verbal skills, regardless of ASD outcome. Declines in non-verbal skills development between 12 and 36 months in infants with TSC and ASD suggest a domain-specific pathway to ASD in this population. These findings have contributed to the development of a targeted, early intervention trial for this high-risk population.

2:09 **116.003** Longitudinal Development of Social Visual Engagement in Infants Later Diagnosed with ASD

L. A. Olson[1], *A. Klin*[2], *S. Shultz*[2] *and W. Jones*[2], *(1)Marcus Autism Center, Children's Healthcare of Atlanta & Emory University School of Medicine, Decatur, GA, (2)Department of Pediatrics, Emory University School of Medicine, Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, GA*

Background: From birth, typically-developing infants preferentially attend to the social signals, such as eye gaze, of their caregivers (Haith et al., 1977). Recent findings from

our laboratory revealed that infants later diagnosed with autism spectrum disorder (ASD) exhibit decline in eye fixation from 2 until 24 months of age and that the decline is already underway within the first 6 months after birth. In contrast, typically-developing infants show an increase in eye fixation from 2 to 6 months (Jones & Klin, 2013). These findings represent the earliest known indicators of social disability in infancy. If confirmed in larger samples, these findings have the potential to inform efforts at early identification and intervention prior to the emergence of overt symptoms of social disability in ASD.

Objectives: Measure growth charts of social visual engagement from 2-24 months in TD infants and infants later diagnosed with ASD.

Methods: 106 infants were enrolled as risk-based cohorts: N = 40 at low risk (22 males) and N = 66 at high risk for ASD (41 males). Risk status was based on having either a full biological sibling with ASD (high) or on not having ASD among 1st, 2nd, or 3rd degree relatives (low). Diagnostic status was ascertained at 36 months. Of the HR sample, at outcome 13 received a diagnosis of ASD (9 male); 13 showed symptoms of the Broader Autism Phenotype (BAP, 11 male), and 40 (20 male) were confirmed non-ASD. Infants were shown scenes of naturalistic caregiver interaction as in Jones & Klin (2013). Eye-tracking data were collected at 10 time points (months 2, 3, 4, 5, 6, 9, 12, 15, 18, and 24). Longitudinal looking profiles for this cohort were compared with those of the earlier sample (2013) for eyes, mouth, body, and object regions within and between diagnostic group categories. Cohorts 1 and 2 were also combined for larger sample analyses.

Results: Analyses of the ASD replication cohort by functional ANOVA are consistent with earlier results: longitudinal looking profiles for eyes, mouth, body, and object were not significantly different between cohorts 1 and 2 (all $F < 2.4$, $P > 0.14$) (Fig.1). Analyses of the TD replication cohort showed no significant differences from cohort 1 in eye or object fixation (all $P > 0.5$), but did differ from cohort 1 in mouth ($F = 4.95$ $P = 0.032$) and body ($F = 5.55$, $P = 0.024$) fixation. Across outcome groups, typically-developing children show increasing eye fixation; non-ASD siblings show increasing eye fixation; siblings with subthreshold (BAP) symptoms show neither increasing nor decreasing eye fixation, and infants later diagnosed with ASD show declining eye fixation. Similar spectrum effects are observed for body fixation (Fig. 2).

Conclusions: Our results replicate earlier findings showing that infants later diagnosed with ASD show decline in eye fixation from 2-to-24 months. Spectrum effects emerging in the first 6 months give early indication of social disability in infants later diagnosed ASD. Future analyses will include longitudinal looking profiles for female infants with TD (35) and ASD (7) outcomes.

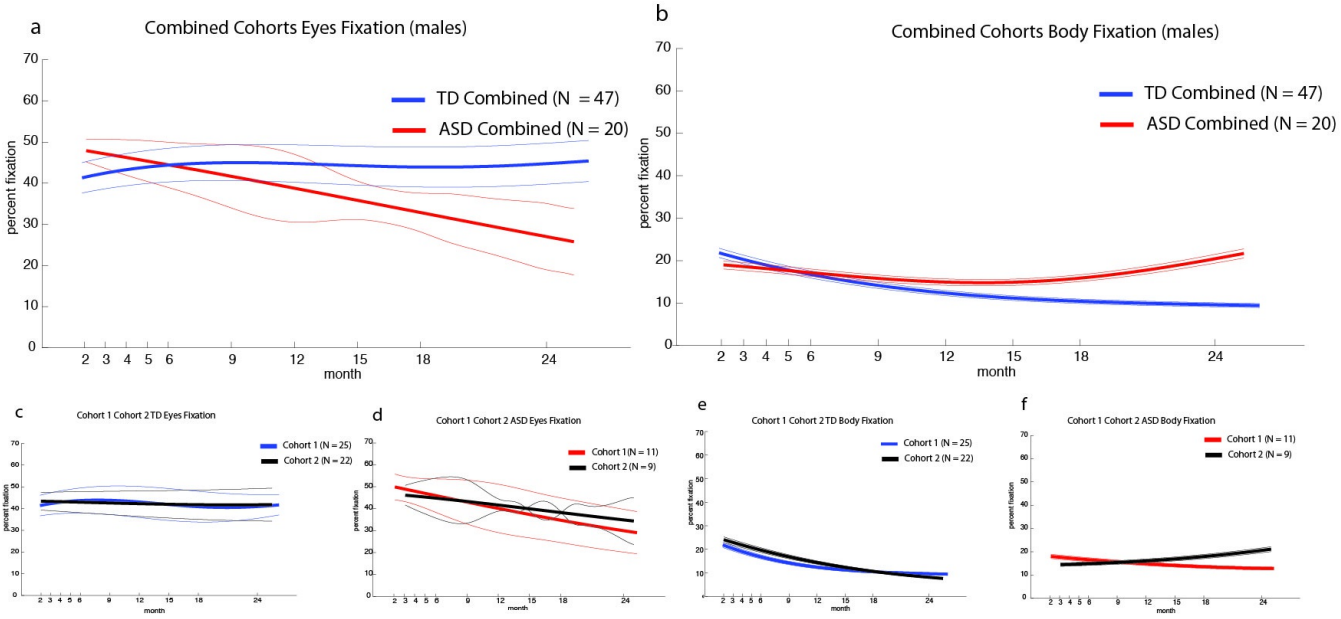
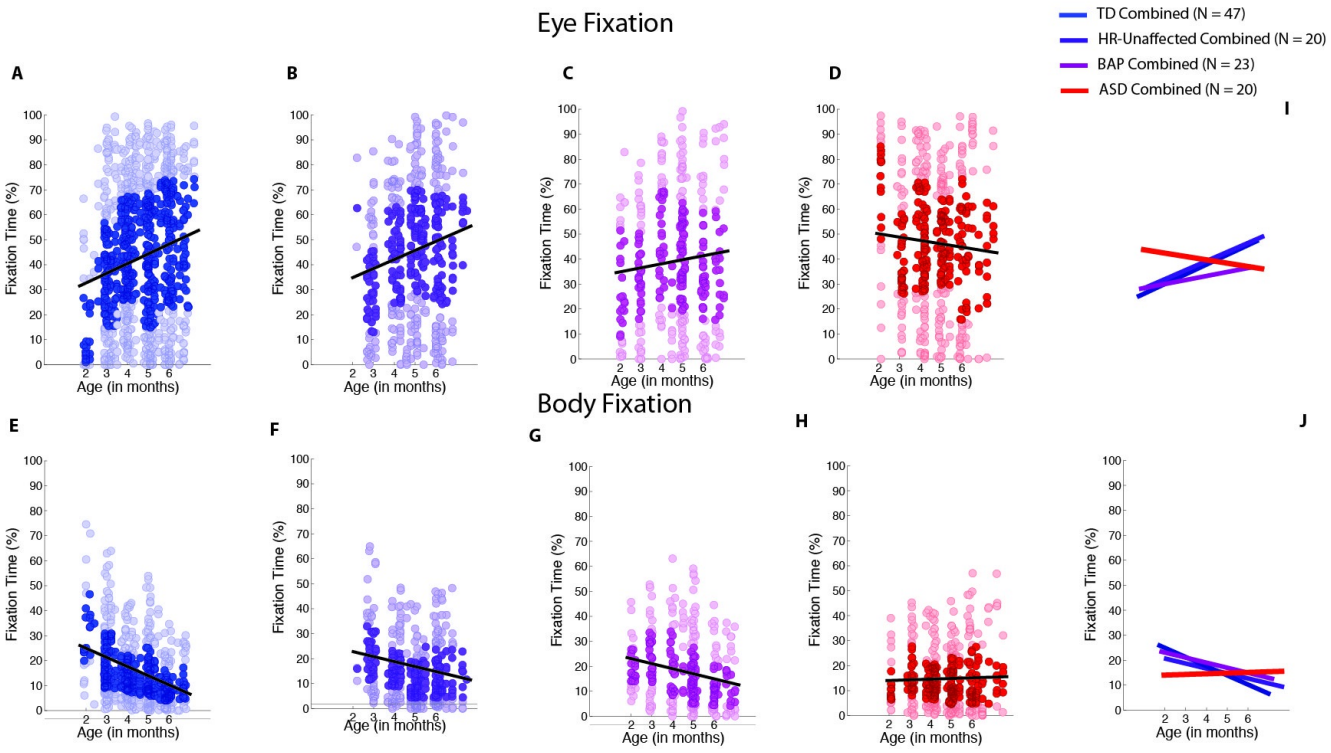


Figure 1 | Growth charts of social visual engagement for typically developing children and children diagnosed with ASD. a, b, Percent visual fixation to eyes (a) and body (b) regions from 2-24 months for TD (blue) and infants later diagnosed with ASD (red). c-f, Comparisons to cohort 1 (Jones & Klin 2013) for visual fixation to eyes (c, d) and body (e, f) regions from 2-to-24 months for TD infants (cohort 1: blue; cohort 2: black) and infants later diagnosed with ASD (cohort 1: red; cohort 2: black). Thick lines indicate mean growth curves, thin lines indicate 95% conficence intervals.



Visual Fixation between 2 and 6 months of age for combined cohorts 1 and 2. A-D: Plots show raw data for percent eyes fixation (interquartile range in bold). E-H: Raw data for body fixation. Plots in J and I show mean trend lines for eyes and body fixation by outcome.

2:21 **116.004** Longitudinal Stability of Quantitative Autistic Traits in Toddler Twins

N. Marrus[1], *Y. Zhang*[2], *A. Glowinski*[3], *T. Jacob*[4], *S. Kennon-McGill*[3], *S. Sant*[5], *T. Gray*[5], *A. Haider*[2] *and J. N. Constantino*[2], *(1)Washington University School of Medicine, Webster Groves, MO, (2)Washington University School of Medicine, Saint Louis, MO, (3)Washington University in St. Louis, St. Louis, MO, (4)Family Research Center, VA Palo Alto Health Care System, Menlo Park, CA, (5)Washington University School of Medicine, St. Louis, MO*

Background:
The ability to measure the early trajectory of core autistic traits has significant implications for elucidating developmental mechanisms of heterogeneity in ASD and tracking incremental responses to early interventions. Previously (Marrus et al., *J Child Psychol Psychiatry* 2015), we demonstrated that a video-referenced rating of Reciprocal Social Behavior (vr-RSB), a novel toddler measure in which caregivers rate their child's level of RSB compared to a typically developing video anchor, shows strong psychometric properties including a continuous, unimodal distribution of autistic trait severity (as indexed through levels of RSB), high heritability, excellent test-retest reliability, and marked impairments in RSB in toddlers with ASD.
Objectives:
To investigate in a general population sample whether quantitative autistic traits (QAT) measured using the vr-RSB at age 18 months predict variation in QAT at age 36 months, the latter measured using the preschool version of the Social Responsiveness Scale (SRS), which has been extensively validated in prior autism research (Baranek et al., *Autism 2013*; Duku et al., *J Autism Dev Disord* 2013).
Methods:
Parents of 252 epidemiologically representative toddler twins [monozygotic (MZ)=31 pairs, dizygotic (DZ)=95 pairs] participated in the Early Reciprocal Social Behavior Study (ERSB), a longitudinal study of early social development. Parents rated their 18-month-old twins on the vr-RSB, and subsequently completed the preschool SRS on their children at age 36 months. Pearson's correlations were performed for total RSB scores at 18 and 36 month time points, as well as sub scale scores for social communication

(SC) and restricted, repetitive behavior (RRB). Comparisons of intraclass correlations (ICCs) for MZ vs. DZ twins provided estimates of heritability at each developmental juncture. An exploratory principal components analysis (PCA) using a varimax rotation was conducted at each time point, based on common items across the vr-RSB and SRS-2.

Results:

Total RSB scores were strongly correlated between 18 and 36 months, r=.666, p<.01 (Fig. 1). Similarly high correlations were observed for SCI and RRB scores across the two time points as well. ICCs for MZ twins were greater than DZ twins for total RSB scores, SC, and RRB scores at 36 months (Table 2). PCA of 18 month data demonstrated a first principal factor accounting for 19% of the variance which mapped well to the principal factor derived from PCA of 36 month data.

Conclusions:

Levels of RSB, and by extension autistic traits, demonstrated strong longitudinal stability in a general population sample over the critical period from 18 to 36 months, when interventions typically begin for children affected by ASD. The ability to serially implement reliable quantitative trait measurements during this period offers the opportunity to track nuanced changes in core features of the autistic syndrome over time and in response to intervention.

Figure 1. Pearson Correlations for Reciprocal Social Behavior, Social Communication, and Restricted, Repetitive Behavior Scores Between 18 and 36 months

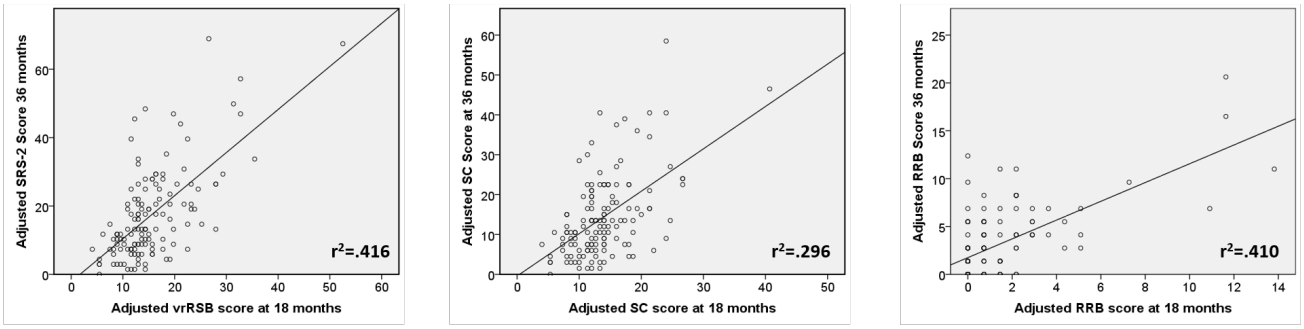


Fig. 1 Quantitative autistic trait scores at 18 months strongly predict those at 36 months for total RSB score as well as SC and RRB scores.

Table. 2 Twin-Twin Intraclass Correlations for Early RSB and Related Traits at 36 months

Twin type (pairs)	Age in Months (Mean, SD)	RSB Total Score	Social Communication Items	Restrictive Repetitive Behavior Items
MZ (n=18)	36.1 (.59)	.944 (p<.01)	.930 (p<.01)	.843 (p<.01)
DZ (n=51)	36.2 (.58)	.280 (p<.05)	.300 (p<.05)	.225 (p>.05)

Oral Session - 3B

117 - Early Markers of ASD: Laboratory and Community Studies

2:40 PM - 3:30 PM - Room 308

2:40 **117.001** Combining Multiple Eye Tracking Measures at 6 Months in Infant Siblings: Associations with Outcomes

***F. Shic**, Q. Wang, S. Macari and K. Chawarska, Yale Child Study Center, Yale University School of Medicine, New Haven, CT*

Background: Atypical scanning patterns towards social information are evident by 6-7 months in infant siblings of children with ASD who later develop ASD themselves (Chawarska, Macari, & Shic, 2013; Elison et al., 2013; Jones & Klin, 2013; Shic, Macari, & Chawarska, 2014). However, it is not yet clear how different variables uncovered by eye tracking can be related to one another and to developmental outcomes.

Objectives: To use data reduction techniques to develop more compact representations of the latent structure associated with visual scanning strategies evidenced by high risk infant siblings of children with ASD at 6 months of age. To associate this structure with later outcomes, both directly and via clustering.

Methods: Eye-tracking data were collected from 6-month-old high-risk infant siblings (*N*=85). Primary eye tracking tasks included the Dyadic Bid (DB) Probe (Chawarska, Macari, & Shic, 2012) and the Speaking Face (SF) Task (Shic, Macari, & Chawarska, 2014). Region of interest variables reflecting time looking towards the Scene, Faces, and Eye-Mouth ratio were dependent measures. Missing dependent measures caused by movement or inattention were imputed with bootstrap methods using augmented data from up to 6 other experimental conditions. This reconstructed dataset was subject to principal component analysis (PCA) using parallel analysis to identify number of components followed by hierarchical clustering with the number of clusters determined via majority vote via NbClust (Charrad & Ghazzali, 2014). Outcomes included diagnoses of ASD (*N*=12), atypical development (ATYP, *N*=34, e.g. language delay), or typical development (TYP, *N*=39) at 24 or 36 months of age. Pearson's correlation analysis was used to explore phenotypic relationships between 6-month eye tracking variables and clinical outcomes at 24 months.

Results: Two principal components (PCs) were identified, with the first PC reflecting decreased looking at the scene and at faces in both the DB and SF tasks and decreased looking at the eyes in SF task and increased looking at eyes in the DB task. This PC correlated with ADOS 1 composite and total scores (*r*=.32 to .36, *p*<.01). Hierarchical clustering on the two PCs revealed 3 clusters. One cluster showed poor overall attention (non-lookers, NON, *N*=35), another showed greater looking at eyes (EYE, *N*=20), and the last more looking at mouths (MOU, *N*=30). The MOU group was predominantly female (62% female) and showed the fewest autism symptoms (ADOS 1 TOT = 5.1), whereas the NON and EYE groups were more male (80% and 75% male) and showed more symptoms (TOT=7.2, 9.2). Children with outcomes of ASD were primarily in the NON cluster (58.3%); children with TYP outcomes were more often in the MOU cluster (46.2%).

Conclusions:

6-month old eye tracking phenotypic data combined using data reduction techniques and augmented with clustering can provide insight into the developmental relationships between visual scanning strategies early in development and the heterogeneous outcomes associated with ASD. Results suggest that gender as well specific looking patterns to the mouth or eyes in differing contexts may provide clues regarding developmental trajectories.

2:52 **117.002** Computer Vision Detects Delayed Social Orienting in Toddlers with Autism

***K. Campbell**[1], K. L. Carpenter[1], J. Hashemi[2], S. Espinosa[2], S. Marsan[1], J. Schaich Borg[3], A. Harris[1], Z. Chang[2], Q. Qiu[2], M. Tepper[2], R. Calderbank[2], J. P. Baker[4], G. Sapiro[2], H. Egger[3] and G. Dawson[1], (1)Duke Center for Autism and Brain Development, Duke University School of Medicine, Durham, NC, (2)Duke University Pratt School of Engineering, Durham, NC, (3)Department of Psychiatry and Behavioral Sciences, Duke University School of Medicine, Durham, NC, (4)Duke University School of Medicine, Department of Pediatrics, Durham, NC*

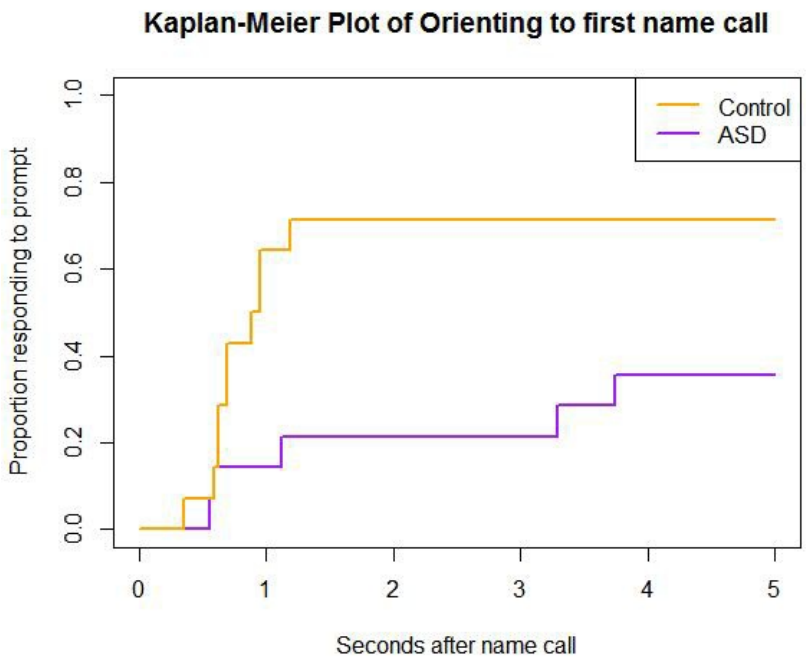
Background: A failure to orient when a child's name is called has been identified as a potential risk marker for autism spectrum disorder (ASD) in young children.[1,2] Although screening and diagnostic measures use failure to orient to name as a sign of risk for ASD, delayed orienting is not generally noted on clinical assessment. However, Dawson et al. found that, when young children with ASD do orient to their name, they are more likely to exhibit delayed responses, as compared to children with typical development.[2]Such delayed responses might be difficult to detect during a clinical observation, and require frame-by-frame rating of videos. Novel and scalable approaches that can automatically detect relevant autism risk behaviors, such as delayed orienting, are needed.

Objectives: To apply computer vision technology to precisely characterize presence and timing of orienting to name in 16-30 month olds with and without risk for ASD.

Methods: Interim analyses were conducted on 14 toddlers who met criteria for ASD on the ADOS-T and 14 age and gender-matched children with typical development who participated in an experimental assessment. Children watched videos on an iPad while an examiner standing behind the child administered 3 opportunities for the child to orient to their name. The front-facing camera within the iPad recorded video. Orienting to name was assessed using algorithms to detect movement of facial landmarks toward the examiner. Automated scoring was compared to rating by a human coder. Precise measurement of initiation of head movement (sampling rate: 30 frames/sec) allowed for analysis of latency to response. Frequencies of orienting and Kaplan-Meier curves were derived to compare the two groups of toddlers.

Results: Computer vision analysis of orienting showed moderate reliability with human rating and excellent agreement on timing of head turn (kappa= 0.52, ICC=.80). On the first name call, 71% of the typically-developing toddlers oriented to name, whereas only 36% of toddlers with ASD oriented. In the typical group, mean latency to orienting on the first name call was 0.83 seconds (sd 0.68), whereas mean latency in the ASD group was 1.53 seconds (sd 1.17). Kaplan-Meier curves were found to be statistically

different on log-rank test (p=0.04; hazard ratio 3.03; 95% CI [1.02,9.02]) (Figure 1).
Conclusions: We demonstrated that typically-developing toddlers tend to orient to their name within 1 second, whereas toddlers with ASD orient inconsistently and with longer latency. Computer vision analysis allowed for automated and precise characterization of the social orienting response in toddlers. Development of computerized behavioral assessments of autism risk behaviors may aid in developing automated, scalable methods of early detection of ASD. Future analyses will be conducted with a larger sample in this ongoing study.
References:
1. Baranek, G.T., et al. (2013). Hyporesponsiveness to Social and Nonsocial Sensory Stimuli in Children with Autism, Children with Developmental Delays, and Typically Developing Children. Dev Psychopathol, *25*, 307–320.
2. Dawson et al. (1998). Children with autism fail to orient to naturally occurring social stimuli. JADD, *25*, 479-485.



3:04 **117.003** Attention Capture By Faces within a Naturalistic Scene in Toddlers with ASD

***L. DiNicola**, F. Shic, S. F. Fontenelle, K. K. Powell, S. Macari and K. Chawarska, Yale Child Study Center, Yale University School of Medicine, New Haven, CT*

Background: Eye-tracking studies have documented atypical attention toward facial stimuli in children with autism spectrum disorder (ASD), including both diminished attentional bias (Chawarska, Macari & Shic, 2013) and atypical scanning patterns (Chawarska, Volkmar & Klin, 2010; Chawarska & Shic, 2009). Such results raise the question of whether or not faces capture the attention of individuals with ASD to the same extent as typically developing (TD) peers. Although adolescents with ASD have been shown to take longer than those with TD to fixate faces in naturalistic images (Freeth et al., 2010), the degree to which faces within naturalistic scenes capture the attention of toddlers with ASD has yet to be investigated.
Objectives: To investigate the attentional capture of faces within naturalistic scenes for TD toddlers and those with ASD.
Methods: 135 toddlers (ASD, *n*=80; TD, *n*=55) between 15 and 40 months of age (M_{ASD}=25.76 months, M_{TD}=23.16 months) viewed an eye-tracking task testing spontaneous attention toward eight static images. Each image appeared for five seconds and contained a different woman smiling and facing forward within a naturalistic scene (e.g., sitting at an office desk or preparing food in a kitchen). Faces appeared in locations equidistant from a central fixation point that preceded each trial. Primary outcome variables were the average time it took for a child to orient toward the face within a scene (Latency_Face), the average number of discrete gaze shifts toward a face (Shift_Face), and the average percentage of valid scene-viewing time spent attending to a face (%Face). All participants received the Mullen Scales of Early Learning (MSEL; Mullen, 1995), and all toddlers diagnosed with ASD received the Autism Diagnostic Observation Schedule (ADOS-G; Lord et al., 2000).
Results: ANOVA analysis revealed no significant differences between diagnostic groups concerning the total time spent attending to the scenes (*p*=0.2). Linear mixed effects modeling was employed to examine the effect of diagnostic group on Latency_Face, Shift_Face and %Face, controlling for age and Mullen nonverbal developmental quotient (DQ). No significant differences were observed between toddlers with TD and ASD on Latency_Face, %Face, or Shift_Face. Effect sizes were small for all variables (Cohen's *d*s<0.3). Within the ASD group, Pearson's *r* correlations revealed no significant relationships between any of the three variables of interest and Mullen verbal or non-verbal DQs or ADOS total scores.
Conclusions: Toddlers with ASD exhibited no differences from TD peers in attention capture by faces within complex naturalistic scenes. The number of gaze shifts toward faces and percent of viewing time spent attending to faces during the eye-tracking session also did not differ between groups. These results add to a growing body of work indicating that social stimuli capture the attention of young children with ASD (e.g., Johnson, 2013; Elsabbagh et al., 2012). The ability to detect and orient toward faces, even within complex visual environments, appears unimpaired in toddlers with ASD. Mechanisms contributing to the documented attentional atypicalities in these toddlers, as well as relationships to attentional differences later in life, merit further exploration.

3:16 **117.004** Social Communication Screening and Parent Concern at 9-21 Months of Age: Comparison of a Large Primary Care Sample and Children Later Diagnosed with ASD

***A. M. Wetherby**[1], D. Dow[2], E. A. Allgood[3], E. Slate[3], A. Delehanty[4], T. N. Day[2] and C. E. Rice[5], (1)Florida State University Autism Institute, Tallahassee, FL, (2)Psychology, Florida State University, Tallahassee, FL, (3)Statistics, Florida State University, Tallahassee, FL, (4)Communication Science & Disorders, Florida State University, Tallahassee, FL, (5)Emory Autism Center, Decatur, GA*

Background: The American Academy of Pediatrics recommends screening all children for ASD at 18 and 24 months. However, there is limited evidence of well-validated autism-specific screening tools in primary care settings. Unlike families referred for suspected ASD or high-risk siblings who may have heightened concern, families in the primary-care population may receive positive screening results before raising concerns about their child. In a review of current evidence for ASD screening, examining how broadband and autism-specific screening tools can be used together to improve accuracy was a priority for future research (Zwaigenbaum et al., 2015).
Objectives: To compare the results of a broadband screen for social communication (SC) delay and parent concern from a large sample screened in primary care by the FIRST WORDS®Project with a subgroup of children later diagnosed with ASD.
Methods: Children were first screened for SC delay based on parent-report with the *Infant-Toddler Checklist* (ITC; Wetherby & Prizant, 2002) through primary care providers at 9-21 months of age and negative screens were invited for re-screening. Two autism-specific screening tools were used for children with a positive SC screen— the *Early Screening for Autism and Communication Disorders* (ESAC) based on parent-report and the *Systematic Observation of Red Flags of ASD*(SORF) based on video-recorded observation. Children with a positive autism screen were invited for a diagnostic evaluation to confirm or rule out ASD between 24-36 months of age. Parent concern reported on the ITC was coded into 16 types of concern. This sample represented the region with 57.6% white, 30.6% black, 8.4% multiracial; 7.6% Hispanic; 47.2% first-born, 32.1% second-born, 20.5% later-born; 15.4% bilingual. The results were grouped into 3-month age intervals from 9-21 months and analyzed.
Results: Based on screening of 8,161 children, the percent of positive SC screen ranged from 15-20%, indicating selection bias of the sample based on the tenth-percentile screening cutoff. There were 194 children diagnosed with ASD by 3 years. The percent of parents with concern in the full sample increased from 6% at 9-11 months to 15% at 18-21 months. For the ASD subgroup, the percent of positive screen ranged from 53% at 9-11 months to 78% at 18-21 months. The percent of parent concern in the ASD

subgroup was 22% at 9-11 months, 33% at 12-14 months, 50% at 15-17 months, and 67% at 18-21 months. Most concerns were initially expressive language and motor skills, and predominantly expressive language by 18-21 months. Patterns of screening outcome and parent concern will be examined by age and race/ethnicity.
Conclusions: These findings document the effectiveness of a developmental surveillance system to screen for ASD in a general population sample of toddlers using a broadband SC screener followed by two autism-specific screeners. There was an increase in parent concern from 9-21 months, but the broadband SC screening outcome was more sensitive than parent concern across this age range. These findings illustrate that parents are fairly accurate at reporting social communication milestones but less accurate at knowing whether to be concerned about delays in these milestones.

Oral Session - 4A
118 - Sociodemographic Diversity and Screening, Diagnosis, and Clinical Presentation
1:45 PM - 2:35 PM - Room 309

1:45 **118.001** Parental Satisfaction with Diagnostic Evaluations: The Effects of Diagnosis, Race, and Education

M. Khowaja[1], *R. K. Ramsey*[2] *and D. L. Robins*[3], *(1)Georgia State University, Atlanta, GA, (2)Psychology, Georgia State University, Atlanta, GA, (3)Drexel University, Philadelphia, PA*

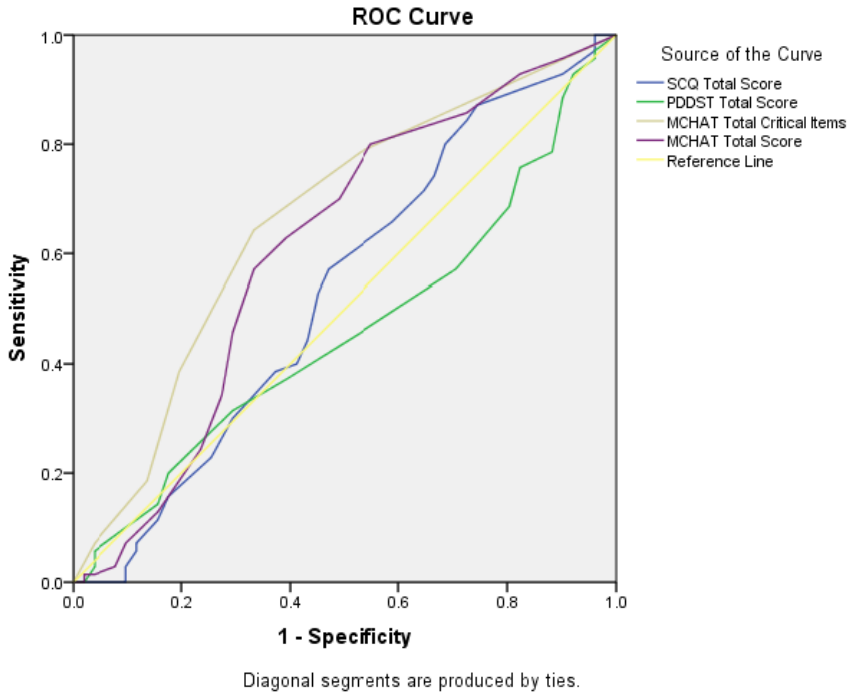
Background: Parents receiving a diagnosis of developmental disability for their child have noted a substantial amount of dissatisfaction or negative appraisals with the diagnostic evaluation process (Goin-Kechel et al., 2006; Stuart & McGrew, 2009). Criticisms relate to timeliness, professionalism, clarity of results, and thoroughness of recommendations (Keenan et al., 2010). Moreover, health-related disparities for minorities and low-income families have been identified across a range of childhood disorders, including autism, regarding early identification, access to intervention, and prognosis (Fountain et al., 2012; Kuo et al., 2012; Tregnago & Cheak-Zamora, 2012). However, research on sociodemographic disparities regarding parents' perception of screening and evaluation is limited.
Objectives: The goal of this study is to identify factors that affect parental satisfaction with the autism screening and evaluation process, to pinpoint strengths and areas of improvement in clinical practice. Given disparities in healthcare utilization and access, this study specifically explores sociodemographic factors.
Methods: Toddlers demonstrating risk on autism screening during routine pediatric visits were referred for diagnostic evaluation. Families received comprehensive assessment and oral and written feedback, which included test results, diagnosis, and specific recommendations. Parents completed and mailed back Post Evaluation Satisfaction Questionnaires after receiving the written report. Using MANOVA and independent samples *t*-tests, the effects of parental race, education, income, and diagnostic outcome were measured on satisfaction outcomes.
Results: The sample of parents (n=68) was 32.4% racial/ethnic minorities, 41.7% with bachelor's degree, and 92.6% mothers; mean age of toddlers was 25.9 months, with 55.9% diagnosed with ASD. Racial/ethnic minorities identified screening and evaluation services as more helpful than Whites, $t(52)=-2.230$, $p=.030$. Parents who earned less than a bachelor's degree demonstrated greater agreement with evaluation results compared to bachelor's degree holders, $F(2, 56)=3.227$, $p=.047$. Additionally, parents of children diagnosed with ASD reported lower clarity of information and quality of staff interactions compared to those who had a non-ASD delay (ps <.05). However, when accounting for parental race, income, and education this effect of diagnosis was no longer apparent.
Conclusions: Results suggest that minority status and lower education were associated with higher agreement with findings and ratings of helpfulness. One might hypothesize that minorities and/or parents with lower education experienced power differentials in the evaluation process, which contributed to social desirability bias, or that increased helpfulness may have been due to reduced baseline knowledge regarding child development. Also, receiving a diagnosis of ASD is related to lower perceived clarity of information and quality of interaction compared to other developmental delays. This may be due to the complex nature of autism symptomatology. However, sociodemographic variables also seem to differentiate parent satisfaction outcomes. Because parental education, race, and income are interrelated, further examination of these factors may be of value in understanding gaps in service provision. One study limitation was the use of a convenience sample, which may yield sampling bias. Researchers and practitioners are encouraged to seek parental feedback to help inform the shift in healthcare for individuals with developmental disabilities to a more comprehensive, family-centered care model.

1:57 **118.002** Examining the Cross-Cultural Accuracy of Three Early Autism Screening Instruments

J. McDonough[1], ***J. M. Campbell***[2], *L. Gardner*[3] *and L. Murphy*[3], *(1)Irving Independent School District, Irving, TX, (2)University of Kentucky, Lexington, KY, (3)Boling Center for Developmental Disabilities and Department of Psychiatry - University of Tennessee Health Science Center, Memphis, TN*

Background: Autism Spectrum Disorder (ASD) is often diagnosed later than the time at which it can be reliably identified. Differences exist between minority racial and SES groups with regard to age at first diagnosis of ASD. Population-wide screening for ASD has been recommended to aid in early identification as well as to reduce disparities in timing of diagnosis, particularly for underserved groups. Although findings related to the psychometric properties of ASD assessment instruments are fairly well established, little information is available regarding use of ASD assessment instruments with culturally diverse populations.
Objectives: Investigators documented accuracy of three commonly used screening instruments to detect ASD within a referred sample. Investigators compared scores across three screeners as well as compared their accuracy in correctly detecting ASD. The overall goal of the investigation was to compare the validity of three early ASD screening instruments across cultural groups to inform clinical use of the instruments with diverse populations.
Methods: *Social Communication Questionnaire* (SCQ), *Modified Checklist for Autism in Toddler* (M-CHAT; Total Score and Critical Item Score), and *Pervasive Developmental Disorders Screening Test-II* (PDDST-II) parent ratings were collected for 121 children (M age = 3.74 years, SD = 1.14) completing a comprehensive diagnostic evaluation between 2010 and 2012. Comprehensive diagnostic evaluation included use of the *Autism Diagnostic Observation Schedule (ADOS) and ADOS-Second Edition* (ADOS-2) and *Childhood Autism Rating Scale-Second Edition* (CARS-2); final clinical diagnosis was established via team consensus. A total of 70 children met criteria for ASD (57.9%); 51 children met criteria for another disorder (42.1%). Screeners were completed in counterbalanced order and clinicians were blind to the results of the screeners. Correlations between test scores were calculated and test accuracy was calculated via area under the curves (AUCs) derived from receiver operating characteristic analysis. AUCs were compared for the entire sample and across race groups (i.e., Caucasian, African-American, Other) and maternal education (i.e., No High School Graduate, High School Graduate, Some College or Higher) or each screener via z tests.
Results: All screeners were positively correlated at the $p < .01$ level with Pearson correlations ranging from .42 to .85. For the entire sample, AUCs ranged from .46 (PDDST-II) to .66 (M-CHAT-Critical Items; see Figure 1). M-CHAT-Total and M-CHAT-Critical Item AUCs were significantly greater than the SCQ AUC ($z = 2.29$, $p = .02$ and $z = 3.08$, $p = .002$). The M-CHAT-Critical Item AUC was significantly greater than the PDDST-II AUC ($z = 2.14$, $p = .03$). For African-American children, the M-CHAT-Total was more accurate when compared to children of Other races ($z = 2.14$, $p = .03$). No differences in accuracy were found across maternal education groups.
Conclusions: In general, screeners showed poor accuracy (i.e., AUCs = .46 - .66) for discriminating between children with and without ASD in a referred sample. The M-CHAT performed significantly better than the SCQ and PDDST-II screeners. Few differences were noted across race and SES groups. The findings should be extended to population-based screening as the present sample consisted of a referred group of children.

Figure 1. *ROC Curves for M-CHAT, M-CHAT Critical Items, SCQ, and PDDST-II Total Scores, Total Sample*



2:09 **118.003** Disparities in the Clinical Characterization Profiles of African American Vs Caucasian Individuals with Autism

C. A. Saulnier[1], *J. M. Moriuchi*[2], *J. Berman*[3], *M. Reid*[4] *and A. Klin*[5], *(1)Marcus Autism Center, Children's Healthcare of Atlanta and Emory University School of Medicine, Atlanta, GA, (2)Psychology, Emory University, Atlanta, GA, (3)Children's Healthcare of Atlanta, Atlanta, GA, (4)Pediatrics, Marcus Autism Center, Children's Healthcare of Atlanta and Emory University School of Medicine, Atlanta, GA, (5)Department of Pediatrics, Emory University School of Medicine, Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, GA*

Background:
Studies examining differences between African-American and Caucasian individuals with autism have yielded equivocal findings. African-American individuals are more likely to have developmental delays (e.g., Cuccaro et al., 2007), but are less impaired on measures of adaptive behavior and executive functioning and exhibit less externalizing and stereotypical behavior compared to Caucasian peers (Ratto et al., 2015; Sell et al., 2012). Factors underlying this discrepancy remain unclear, but likely contribute to previous findings of delays in diagnosis, misdiagnosis of disruptive behavior disorders, and less access to care for African-American individuals with autism (e.g., Mandell et al., 2009).
Objectives:
This study compares phenotypic profiles of African-American and Caucasian school-age individuals with ASD on measures of cognition, adaptive functioning, and diagnostic symptomatology.
Methods:
Participants included 184 individuals (93 African-American, 91 Caucasian) with Autism Spectrum Disorder ranging in age from 3 to 18 years (mean=99.62 months; SD=46.81) who received a clinical evaluation through research studies at the Marcus Autism Center. Measures included the *Differential Ability Scales, 2nd Edition* (DAS-II);

the Autism Diagnostic Observation Schedule, 2nd Edition (ADOS-2)*; the Autism Diagnostic Interview, Revised* (ADI-R)*, and the Vineland Adaptive Behavior Scales, 2nd Edition, Survey Form* (Vineland-II).
Results:
ANOVA analyses on a preliminary sample (93 African-American, 21 Caucasian) revealed significant racial differences; African-American individuals scored significantly lower than Caucasian individuals across measures of verbal, nonverbal, and overall cognitive ability [DAS-II GCA: F(1,63)=24.56, p<.001], and adaptive communication [Vineland-II Communication: F(1,106)=5.25, p<.05], and exhibited significantly greater restricted and repetitive behavior [ADOS-2 RRB: F(1,99)=12.49, p<.01]. Adaptive communication differences disappeared when controlling for cognition.
Given the significant difference in cognitive ability, analyses were repeated in a subset of participants without cognitive impairment (i.e., DAS-II GCA>70; 21 African-American, 19 Caucasian). Within this sample, significant differences remained across measures of cognitive ability. Differences in ADOS RRB were no longer significant. However, African-American individuals without cognitive impairment had significantly lower adaptive socialization scores, even after controlling for cognitive ability [Vineland-II Socialization: F(1,31)=13.12, p<.01]. Across analyses, no differences were found on Vineland Internalizing or Externalizing scales or on ADI-R scores.
Conclusions:
In summary, we found that African-American individuals exhibited significantly lower levels of cognition and higher levels of restricted and repetitive behaviors than Caucasian individuals. Only 5% of the Caucasian sample had cognitive scores below 70 compared to 47% of the African-American sample. When limiting the sample to the "cognitively-able" range, African-American individuals still exhibited lower cognition in addition to adaptive socialization deficits, but no differences in stereotypical behaviors, suggesting that the higher RRB levels noted in the total sample were likely influenced more by cognitive impairment than autism symptomatology. In contrast, African-American individuals' adaptive socialization deficits remained even after controlling for cognitive functioning and even in the absence of differences in autism symptomatology. These findings help clarify the discrepancy in clinical profiles of African-American and Caucasian individuals with autism, highlight areas for targeted intervention, and raise questions about how to most appropriately conceptualize "level of functioning."

2:21 **118.004** Do Domains of Developmental Risk Identified By Parents during ASD Screening and Areas of Risk Identified during ASD Diagnostic Assessment Differ: Findings from a Case Series of Ethnically Diverse, Low-Income Toddlers

S. J. Jerome[1]*, J. Sandler*[1]*, S. broder-Fingert*[2]*, K. Devlin*[1] *and E. Feinberg*[1]*, (1)Community Health Sciences, Boston University School of Public Health, Boston, MA, (2)Division of General Pediatrics, Boston University School of Medicine, Boston, MA*

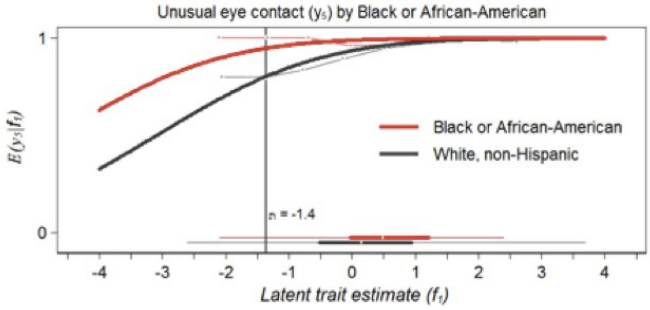
Background: Universal screening for Autism Spectrum Disorder (ASD) is a recommended strategy to address disparities in age of ASD diagnosis. The M-CHAT is the most widely used instrument to screen children primary care settings. Recent studies suggest that M-CHAT performs differently based on family demographic characteristics. However, few studies have explored how such differences correspond to performance on ASD diagnostic assessments.
Objectives: To explore the relationship between domains of developmental risk identified by low-income families during ASD screening and areas of risk identified during ASD diagnostic assessment.
Methods: Screening (MCHAT-R/F) and diagnostic (ADOS-2) data were collected from 44 children who were referred for an ASD diagnostic evaluation and were participants in randomized control trials studying methods to improve early identification of ASD. All met ASD risk criteria based on the MCHAT-R/F initial screen and follow-up interview. MCHAT-R/F items were categorized based on the four ADOS-2 domains: communication, reciprocal social interaction, play, and restricted and repetitive behaviors. For each domain, we assessed whether areas of risk identified in the MCHAT-R/F and ADOS-2 were concordant or discordant. For discordant results, we assessed patterns of risk identified by parents compared to the child's performance on the ADOS-2.
Results: Twenty-four of 44 children meet ASD diagnostic criteria, yielding a PPV of 55%, consistent with published MCHAT-R/F performance characteristics. Twenty children were not diagnosed with ASD. In this low-income (91%), majority minority sample (84%), children who were not diagnosed with ASD were significantly more likely to come from larger, single- parent households. Based on responses to items on the MCHAT-R/F, 80% of parents endorsed risks in the domain of communication; 79% in reciprocal social interaction; 15% in play, and 20% in restricted and repetitive behaviors. Based on performance on the ADOS-2, 75% of children met diagnostic criteria related to communication; 35% of children related to reciprocal social interaction; 21% of children related to play, and 39% related to restricted and repetitive behaviors. The most common discordant pattern was related to reciprocal social interaction, which was identified as an area of risk by 80% of parents and was confirmed during diagnostic assessment in only 35% of children. The most discriminatory item on the MCHAT-R/F for ASD was item one, "If you point at something across the room, does your child look at it?"; 80% of children who failed this item were diagnosed with ASD. The most discordant item was item eighteen, "Does your child understand when you tell him or her to do something?"; 79% of children who failed this item did not receive an ASD diagnosis.
Conclusions: This study identified two areas that may play a role in classifying low-income, largely minority children who do not meet diagnostic criteria for ASD as having elevated risk. The first is parental appraisal of children's social interaction skills and the second is parental expectation of children's response to parent-initiated communication. Further research that explores parental understanding of developmental norms is needed and could lead to more accurate assessment of ASD risk in this population.

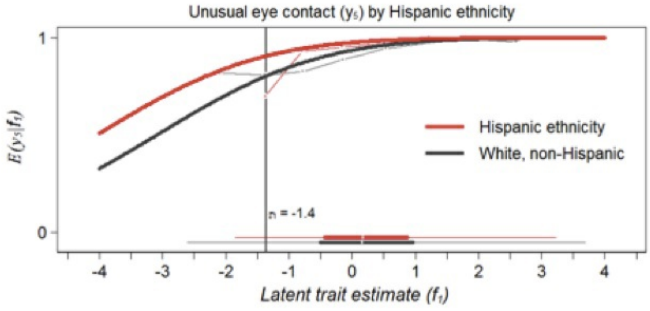
Oral Session - 4B
119 - International and Cross-cultural Perspectives on Screening and Diagnosis
2:40 PM - 3:30 PM - Room 309

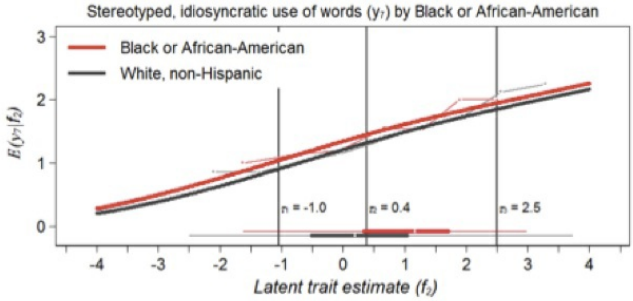
2:40 **119.001** Examining Potential Measurement Biases in the Autism Diagnostic Observation Schedule for Race, Ethnicity and Gender

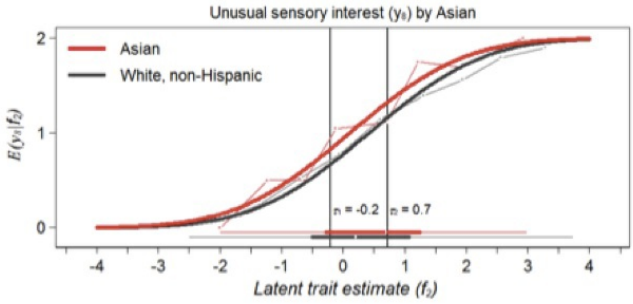
A. J. Harrison[1]*, M. R. Naughton*[1] *and R. N. Jones*[2]*, (1)University of Georgia, Athens, GA, (2)Warren Alpert Medical School, Brown University, Providence, RI*

Background:
The Autism Diagnostic Observation Schedule (ADOS) is widely used across cultural contexts to assess symptoms of autism spectrum disorders (ASD; Blacher et al, 2014). Little research has examined whether demographic characteristics such as race, ethnicity, and gender contribute to differential variability on ADOS score profiles, in spite of known cultural differences in social norms and variability in ASD symptom presentation across demographic groups (Bernier, Mao, & Yen, 2010). For example, cross-cultural variability exists regarding amount and type of social eye contact (e.g., Fugita, 1973; McCarthy, Lee, Itakura, & Mur, 2006) and facial expression (Vrana & Rollock, 2002), which may directly result in symptom variability in an assessment context depending on the diagnostic tests used. In potential support of this point, research shows variability exists with regard to ASD symptom presentation (Tek & Landa, 2012) and identified symptom profiles (Kharod, Giarelli, Blum, Hanlon, & Levy, 2012) across different demographic groups.
Objectives:
The objective of this study is to examine the ADOS to determine if item-level biases exist among distinct sociodemographic groups including race (Caucasian, African American, or Asian), ethnicity (Hispanic or non-Hispanic), and gender.
Methods:
Participants included in this study (n = 2459) were part of the Simons Simplex Collection (SSC), had complete data and fell within one of the racial categories identified as sufficiently powered for analysis: White (n = 2245), Black/African American (n = 103), or Asian (n = 111). The majority participants classified their ethnicity as not Hispanic or Latino (n = 2165) rather than Hispanic or Latino (n = 294) and were male (n = 2129). We examined a subset of ten items from the ADOS that were included in at least three of the four ADOS modules and were worded the same in both the item description and the coding categories across all modules.
Results:
A measurement noninvariance analysis was used, and approached using a Multiple Causes analytic framework. The focus was limited to differences in item location. All analyses controlled for age and IQ. Holding level of overall ADOS score constant, we found significant item level bias for three items. We observed Black children we more likely have higher ratings on the ADOS items assessing levels of usual eye contact and stereotyped or idiosyncratic word use. Asian children were more likely to have elevated ratings on the unusual sensory interests ADOS item. In terms of ethnicity, Hispanic children were also more likely to have higher ratings on the ADOS item assessing levels of usual eye contact. No item level biases were observed for gender.
Conclusions: This study revealed that of the ten ADOS items examined, item level biases existed for race among three specific items. In a diagnostic assessment context, this variability within ADOS items may result in overestimation of impairment for specific racial groups. These findings speak to the need for more research assessing the need for specific norms for different racial and ethnic groups to aid in more accurate diagnosis.









2:52 **119.002** The Diagnosis of Autism Spectrum Disorder in Low and Middle Income Countries: Concordance of Assessment Instruments in Jamaica

M. E. Samms-Vaughan[1], *M. H. Rahbar*[2], *A. S. Dickerson*[3], *K. A. Loveland*[4], *D. A. Pearson*[4], *J. Bressler*[2], *S. Shakespeare-Pellington*[1], *M. L. Grove*[5], *C. Coore-Desai*[1], *J. A. T. Reece*[1], *E. Boerwinkle*[2] and *M. Hessabi*[3], *(1)Department of Child and Adolescent Health, The University of the West Indies, Mona Campus, Kingston 7, Jamaica, (2)Division of Epidemiology, Human Genetics, and Environmental Sciences (EHGES), University of Texas School of Public Health at Houston, Houston, TX, (3)Biostatistics/Epidemiology/Research Design (BERD) Component, Center for Clinical and Translational Sciences (CCTS), University of Texas Health Science Center at Houston, Houston, TX, (4)Psychiatry & Behavioral Sciences, University of Texas Medical School at Houston, Houston, TX, (5)University of Texas School of Public Health at Houston, Houston, TX*

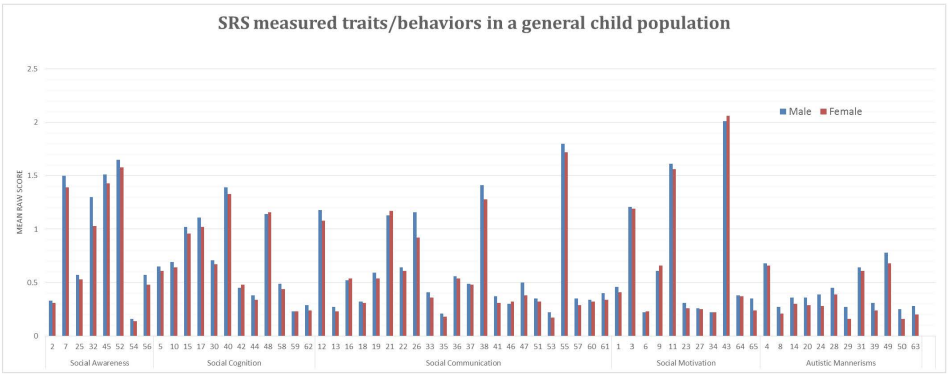
Background:
The high prevalence of ASD has encouraged development of new valid and reliable diagnostic tools. While the ADOS and ADI-R are widely used in diagnosis in High Income Countries (HIC), their administration requirements, including costly in person training, expensive test booklets and lengthy administration time, make them less suitable for Low and Middle Income Countries (LMIC). Yet, it is important that ASD be diagnosed accurately so that children with and without ASD receive appropriate interventions. The cost-efficiency and flexible administration requirements of the Childhood Autism Rating Scale (CARS) has made it an instrument of choice for ASD assessment in HIC, as well as LMIC countries, like Jamaica. There has been limited assessment of its diagnostic accuracy in LMIC.
Objectives:
The objective of this paper is to determine the concordance of the CARS, ADOS and ADI-R in Jamaica, a LMIC, to identify the most feasible instrument for use in this setting.

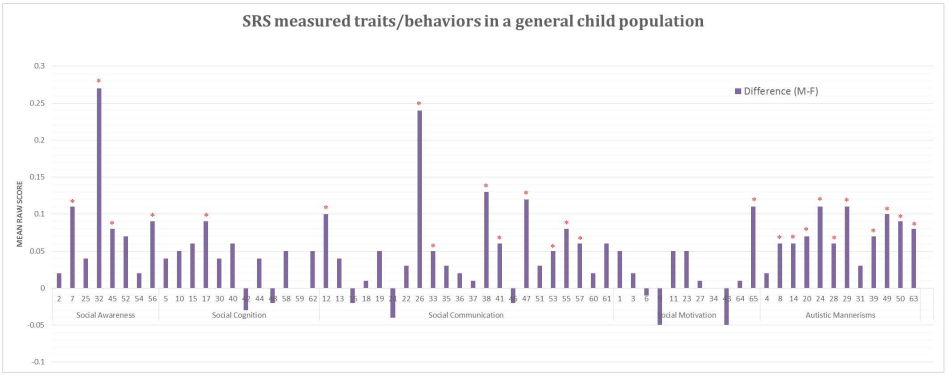
Methods:
149 children, aged 2-8 years, previously diagnosed with ASD by an experienced clinician using the CARS were re-evaluated using the ADOS and ADI-R. The proportion of children confirmed as having ASD by ADOS, ADOS-2 and ADI-R was determined and mean CARS, ADI-R and ADOS scores compared using ANOVA, with significance at a 5% level.
Results:
The mean age of the sample was 64.4 (SD=21.6) months; the male female ratio was 6:1. All children (100%) were confirmed as having ASD using the ADOS, 98.7% (147/149) using ADOS 2 and 94.6% (141/149) using the ADI-R. Of the ten children whose ASD status was not confirmed by ADI-R or ADOS-2, seven did not reach the threshold in at least two domains of the ADI-R, two did not reach the threshold for the ADOS-2, and only one did not reach the threshold scores for either the ADOS-2 or ADI-R. Concordance between the ADI-R and ADOS and ADOS2 was 94.6% and 93.3% respectively. Total ADI-R ADOS and ADOS-2 domain scores were significantly higher for children classified with autism than for those classified autism spectrum ($P<0.01$, $P<0.05$).
Conclusions:
The CARS, used by an experienced clinician, was shown to have high concordance in Jamaica. Use of this easily administered, economical and time efficient instrument by a clinician experienced in ASD, may be appropriate in other LMIC settings. The use of the CARS by clinicians of varying levels of experience with ASD should be evaluated before general recommendations for its use in these settings are made.

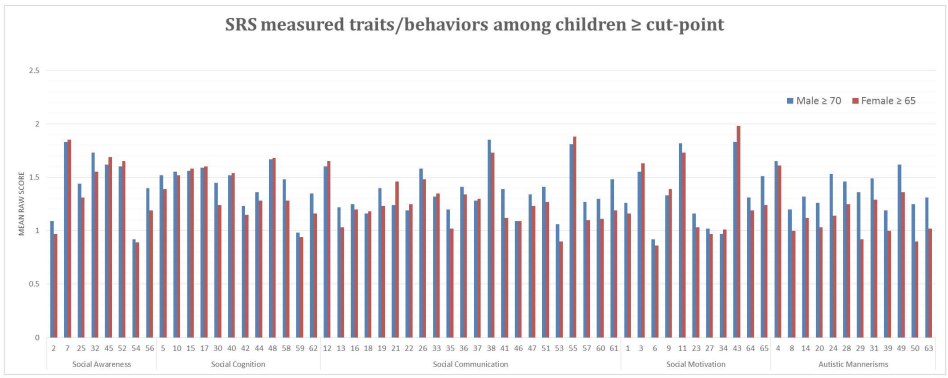
3:04 **119.003** Distributions of SRS-Measured Autistic Traits in a Taiwanese Population of Children Aged 6-8 Years

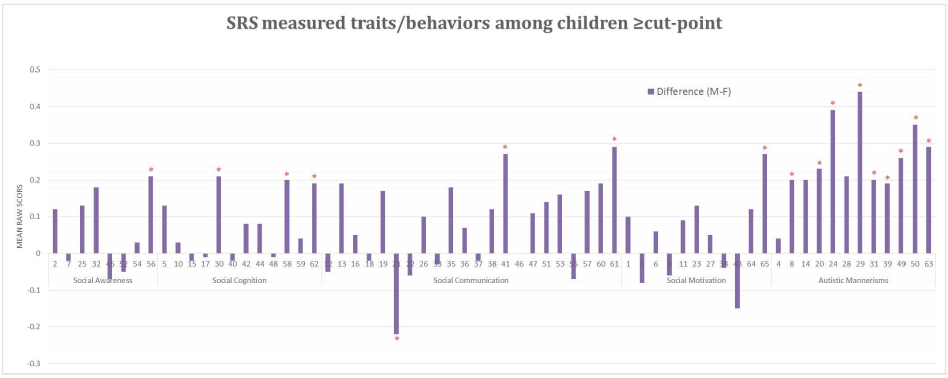
P. C. Tsai[1], *L. C. Lee*[2], *R. A. Harrington*[3] *and F. W. Lung*[4], *(1)Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (2)Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (3)Johns Hopkins University, Baltimore, MD, (4)Calo Psychiatric Center, Pingtung, Taiwan*

Background: It is well accepted that Autism Spectrum Disorder (ASD) represents one end of a larger spectrum of quantitative impairment that is continuously distributed in the general population. The Social Responsiveness Scale (SRS) is an instrument that characterizes quantitative impairments in social awareness, cognition, communication, motivation, and repetitive behavior/restricted interests that define ASD, and provides a subtler characterization of individual symptoms than using traditional classification systems. This tool is particularly feasible for assessing autistic traits in large, population-based studies because it can quantify the spectrum of dimensional impairments of ASD. Implementing the SRS in a large population will allow it to be utilized across different settings and against different norms and subgroups such as gender, age, or racial/ethnical background.
Objectives: To examine the distributions and sex difference of SRS item scores by its five dimensions in a Taiwanese population of children aged 6-8 years.
Methods: Caregiver-reported SRS data were collected by an epidemiologic autism study conducted in Pingtung Taiwan. A total of 2891 primary caregivers completed the SRS for 1428 males and 1546 females. Children whose sex was not reported were excluded from this analysis. Distributions of mean item raw scores were examined by SRS domains and by child sex to describe the population-baseline, and those whose total raw scores were above the cut-point. As recommended in the literature, a raw score of >=70 in males and >=65 in females is a cut-point that provides evidence for the presence of an ASD in Western countries. Of all the included participants, 172 males and 185 females met these recommended cut-points. T-tests were conducted to compare the mean item raw scores between males and females.
Results: As expected, males were rated with higher raw scores on the majority of SRS items (55 out of 65) compared to females in the general population. Significant sex differences were observed for the majority of items in the domains of Social Awareness, Social Communication, and Autistic Mannerisms (AM). Similar score distribution patterns were shown among children who met the recommended cut-points. Notably, the magnitude of item score differences between males and females who met the cut-point is particularly paramount in the AM domain, being between 3 to 4 times that of sex differences in the general population.
Conclusions: Our findings indicate male children in this Taiwanese population have higher item SRS scores than female children, in the general population and in those at high risk of ASD. Higher SRS scores in males have been reported in clinical-based studies, our findings are the first to confirm such a distribution in the general population. We found that sex differences particularly stand out in the AM domain, in both the general population and in children at high risk of ASD. AM may play a key role in interpreting the sex disparity of ASD diagnoses. As there are no autism epidemiologic studies of this kind, our study provides first insights on how autistic traits are distributed in general populations (population baseline) and in those at high risk of ASD.









3:16 **119.004** Counting without the Numbers: Venezuelan Attempts at Prevalence Studies

C. Montiel-Nava[1,2]*, Z. Gonzalez*[1] *and J. A. Chacin*[3]*, (1)Psychology, La Universidad del Zulia, Maracaibo, Venezuela, (2)Center for Graduate Studies, Universidad Latina, Panama, Panama, (3)La Universidad del Zulia, Maracaibo, Venezuela*

B**ackground:** Diagnostic studies involving the Spanish-speaking population are scarce. Although there is no evidence that the clinical presentation of ASD varies across cultures, ethnicities, or races, there are disparities in prevalence and age of diagnosis for the different countries and ethnic groups. Globally, ASD prevalence has increased and the age of diagnosis has decreased, but not for the Latino population. Prevalence studies in LAMI countries serve many purposes: They offer data for health and educational planning, allow international comparisons for the study of risk factors, protective factors, and cultural influences, and, finally, permit the cultural adaptation of assessment tools.

Objectives: The aim of this manuscript is: (1) to discuss the results of epidemiological research in Venezuela in light of methodological features and (2) to offer conclusions about the best up-to-date methods for data collection.

Methods: We present the results of three different studies that focused on ASD prevalence in Venezuelan children. We considered and analyzed sampling processes, screening and diagnostic procedures, and response rates. Then we reviewed and compared adjustments from standard prevalence estimation approaches used in other countries.

Results: The first report was designed as a population study However, birth records, visits to pediatricians, and vaccinations among others were not always registered. Other

logistic difficulties included the absence of public services (electricity, sewage, telephone) for many houses, which made them nonexistent in public records. In addition, some urban areas were dangerous, which prevented researchers from going into the houses to assess children. Obstacles to implementing this method hindered data collection, the determination of research findings, and, hence, the proper calculation of prevalence rates for ASD. The second study aimed to establish prevalence through the review of records in public and private institutions for special education and in specialized clinics. The overall prevalence of ASD was 1.7 per 1,000 (95% CI: 1.3-2.0). For this approach, we found that some of the children's records were missing. Moreover, despite legal requirements, not every child with disability was included in the school system or the health system. The third study used school records. Thus, it was possible to assess the children in their schools and, consequently, to avoid security issues. For this study, the estimated prevalence was 7.18 per 1,000 (95% CI: 5.3-9.6). We faced the same difficulties with records because not all children were attending school at the time of the study. The last approach was the best one we identified for the development of data in a culturally appropriate way.
Conclusions: In Venezuela, as in most Latin American countries, the difficulties experienced while conducting prevalence studies were not related to translation and the adaptation of diagnostic instruments. The main problems were related to sampling procedures and the quality of public records. As we develop a stronger, valid, cross-cultural process for the identification of ASD, our findings could be compared to those of other countries and larger databases.

Oral Session - 5A
120 - Social Cognition and Social Behavior
1:45 PM - 2:35 PM - Room 310

1:45 **120.001** Social Reinforcement Learning and Its Neural Modulation By Oxytocin in Healthy Young Adults

J. A. Kruppa[1,2], *A. Gossen*[1,2], *N. Großheinrich*[1], *H. Schopf*[1], *G. Kohls*[1], *G. R. Fink*[2], *B. Herpertz-Dahlmann*[1], *K. Konrad*[1,2] *and M. Schulte-Rüther*[1,2], *(1)Department of Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy, University Hospital RWTH Aachen, Aachen, Germany, (2)Cognitive Neuroscience, Institute of Neuroscience and Medicine (INM-3), Jülich Research Center, Jülich, Germany*

Background: Currently, no pharmacological treatment of the social symptoms of Autism Spectrum Disorder (ASD) is available and behavioral interventions only show modest effects. Recently, oxytocin (OXT) has been shown to enhance motivation and attention to social stimuli, by modulating the brain reward circuitry in social situations. Likely, these effects have the potential to enhance social reinforcement learning, the core mechanism of behavioral interventions. However, it is unclear whether these effects are mediated by an OXT-induced increase in saliency towards social stimuli per se or whether they are due to a modulation of the brains' reward circuitry, which is specific for social feedback. This question plays an important role for the design of future interventions aiming to combine OXT and behavioral treatments in ASD.
Objectives: We investigated the influence of OXT on socially reinforced learning and its underlying neural mechanisms in a social learning task, which allowed for the differentiation of social feedback stimuli and social stimuli as the target of learning.
Methods: Using functional Magnetic Resonance Imaging we assessed brain activation during performance of a probabilistic reinforcement learning task in 24 typically developing controls (18-25 years). We used a double-blind placebo-controlled cross-over design. Participants indicated whether social or non-social stimuli belong to category A or B. After a jittered delay, social or non-social feedback (either rewarding or neutral) with non-100% contingencies was provided. Data were analyzed using computational modeling of reinforcement learning, according to the Q-learning model. From the behavioral choice data, individual model parameters were estimated and used to calculate trial-by-trial reward-prediction error values. We assessed the correlation of brain activation with reward-prediction error values during feedback as well as brain activation related to the anticipation of reward during choice. Results were significant at $p<.05$ (cluster-level corrected, $p<.001$ voxel level).
Results: Analyses revealed a significant correlation of brain activation in the striatum with the reward prediction error across conditions, confirming that overall learning was mediated by striatal circuitry. During feedback anticipation, OXT selectively enhanced brain activation in the striatum and insular cortex for social *feedback* conditions despite the learning target being non-social. The learning *target* being social, however, did not show a modulation by OXT during feedback anticipation. Behaviorally, subjects demonstrated significant learning during the task independent of task or treatment condition. More extensive analyses including data of patients with ASD will follow.
Conclusions: Our results demonstrate that in healthy controls, OXT selectively enhances brain activation related to the acquired anticipation of social feedback, but no selectivity was evident for social stimuli as a learning target. This pattern suggests that the modulatory role of OXT during reward processing is tied to the feedback phase being social. Our investigation therefore provides deeper insights into the neural mechanisms of OXT-induced modulation of the reward system and its potential enhancement of socially reinforced learning. Combinations of behavioral interventions with OXT might be particularly effective, if emphasis is put on positive, socially mediated feedback. Further investigations are needed to study this mechanism and its implications for interventions with OXT in ASD.

1:57 **120.002** Influences of Others' Gaze Behaviors on Attentional Allocation during Activity Monitoring in Adults with and without ASD

C. Foster[1], *M. del Valle Rubido*[2], *J. McCracken*[3], *E. Hollander*[4], *L. Scahill*[5], *L. Boak*[6], *O. Khwaja*[2], *F. Bolognani*[7], *P. Fontoura*[8], *D. Umbricht*[2], *S. S. Jeste*[9], *E. S. Kim*[10], *R. J. Jou*[11], *C. A. Wall*[1] *and F. Shic*[1], *(1)Yale Child Study Center, Yale University School of Medicine, New Haven, CT, (2)F. Hoffmann - La Roche AG, Basel, Switzerland, (3)UCLA Semel Institute for Neuroscience & Human Behavior, Los Angeles, CA, (4)Albert Einstein College of Medicine, Mamaroneck 10543, NY, (5)Pediatrics, Marcus Autism Center, Atlanta 30329, GA, (6)F. Hoffmann-La Roche AG, Basel, Switzerland, (7)F. Hoffmann-La Roche, Basel, Switzerland, (8)Roche Pharma Research and Exploratory Development, Basel, Switzerland, (9)Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA, (10)The Children's Hospital of Philadelphia, Philadelphia, PA, (11)Yale Child Study Center, Yale School of Medicine, New Haven, CT*

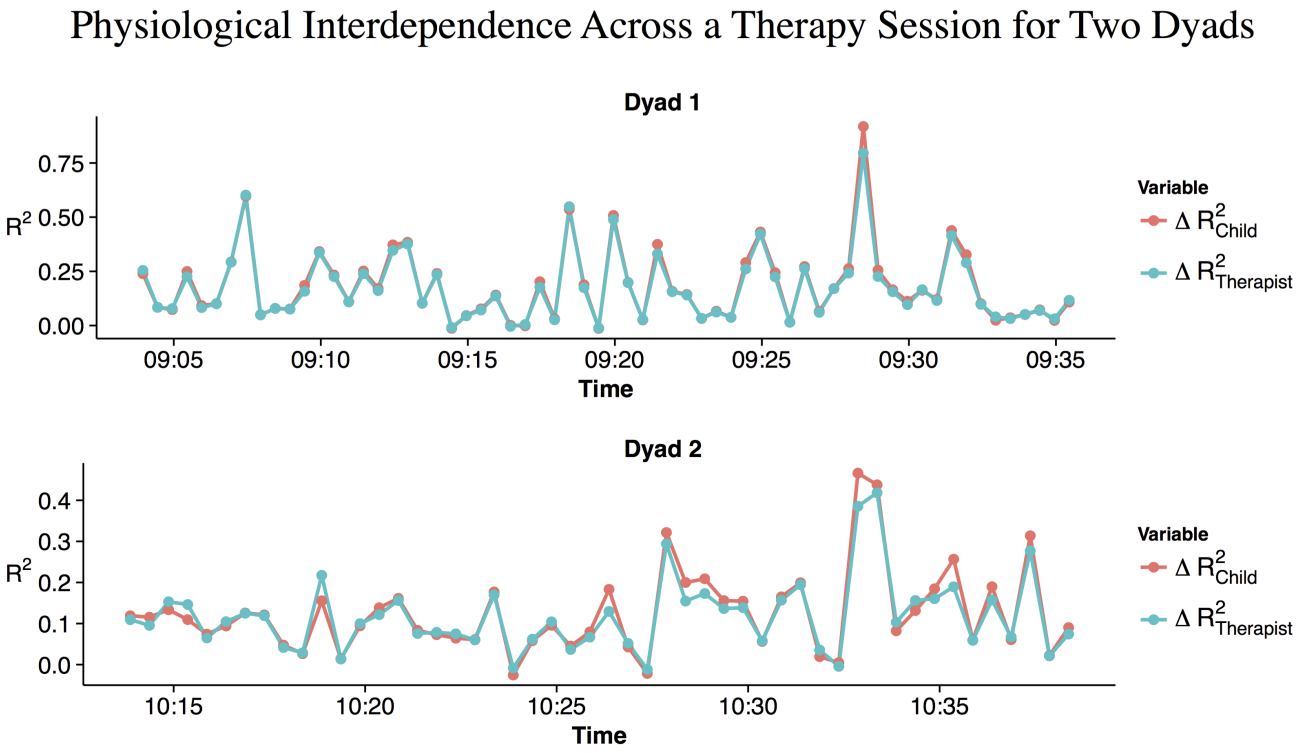
Background: Previous work implementing an activity monitoring eye-tracking task in 20-month-old toddlers suggested diminished attention towards people and their activities in toddlers with autism spectrum disorder (ASD) when compared to developmentally delayed and typically developing (TD) comparison groups (Shic et al., 2014). However, no significant differences in attentional allocation between ASD and comparison groups were found in response to varying gaze cues from actresses in the task. It is unknown if this lack of differential response to others' gaze behaviors in ASD and TD toddlers remains stable across development.
Objectives: To explore the effects of others' gaze behaviors on attentional allocation during activity monitoring in adults with and without autism.
Methods: Participants included high-functioning adult males with autism (n=18; M_{age}=24.89±6.45; M_{FSIQ}=102.26 SD=14.31) and TD adult males (n=19; M_{age}=26.68±4.33; M_{FSIQ}=117.68 SD=9.70). One participant with ASD was lost due to missing data, and an additional 2 ASD and 2 TD participants were excluded due to high numbers of trials with invalid calibration (n=15 ASD, n=17 TD remaining). Participants were seen over two days to complete clinical and experimental assessments, including an eye-tracking battery. One eye-tracking task was an activity monitoring task, in which participants viewed 12 video clips, each 20s in duration, of 2 actresses interacting in naturalistic scenes, engaging in a shared activity. This task was parsed into two gaze conditions: (1) the actresses fixated on the shared activity (activity gaze condition), (2) the actresses fixated on each other (mutual gaze condition). Analyses were conducted to examine the effect of gaze condition on the proportion of time participants spent looking at the actresses' heads (%Head).
Results: Linear mixed model analyses revealed a significant effect of gaze condition on %Head ($p<.001$, d= 0.67), with both TD and ASD participants directing their gaze more to actresses' heads during mutual gaze trials. However, there was a significant group x gaze condition interaction ($p<.05$), with differences in %Head in response to gaze condition significantly larger in the TD group.
Conclusions: Comparisons suggest that high-functioning individuals with ASD exhibit sensitivity to gaze behaviors of others during activity monitoring, but to a lesser degree when compared to TD participants. Unlike toddlers, adults with and without ASD appear to attend to actresses' gaze information. The significant group x gaze condition interaction may be attributed to the fact that the mutual gaze condition deviates more notably from typical gaze patterns, which may drive increased fixation to heads in TD participants. It is possible that the high-functioning adults with ASD were not recognizing the deviations from typical gaze patterns to the same degree as TD participants. These findings differ from those previously observed in toddlers, suggesting that sensitivity to gaze information in ASD and TD individuals presents differently across development, with once similar responses in childhood diverging in adulthood. Examination of response patterns in school-aged children and adolescents, and across greater variability in social and cognitive functioning, is still necessary in order to understand the complete developmental trajectory of sensitivity to gaze information during activity monitoring in ASD.

2:09 **120.003** Quantitative Assessment of Socio-Affective Dynamics in Autism Using Interpersonal Physiology

O. O. Wilder-Smith[1], *J. C. Sullivan*[1], *R. V. Palumbo*[1], *C. DiStefano*[2], *A. Gulsrud*[3], *C. K. McCracken*[4], *C. Kasari*[5] *and M. S. Goodwin*[1], *(1)Northeastern University, Boston, MA, (2)Psychiatry and Biobehavioral Sciences, University of California Los Angeles, Los Angeles, CA, (3)UCLA Semel Institute for Neuroscience & Human Behavior, Los Angeles, CA, (4)University of California, Los Angeles, El Segundo, CA, (5)University of California Los Angeles, Los Angeles, CA*

Background: Children with Autism Spectrum Disorder (ASD) often have great difficulty interpreting and using nonverbal communication, understanding and navigating social relationships, and making sense of their own and others' emotions. Many of these impairments relate to deficits in *social reciprocity* (SR), the ability to recognize and understand the mental states of others and respond appropriately. In addition, deficits in emotion regulation (ER), the ability to modulate emotional response to a situation to achieve a goal, are implicated in several core features of ASD, including socioemotional problems and challenging behaviors (Cohen, et al., 2011; Gross, 2013; Gulsrud, Jahromi, & Kasari, 2010; Mazefsky et al., 2013). One possible explanation for these findings is that early SR deficits interfere with effective infant-caregiver *co-regulation*, caregiver-driven regulation crucial for developing effective self-driven ER and an important target for early intervention (Gulsrud, Jahromi, & Kasari, 2010). SR and ER are under-studied in ASD, and existing methods for assessing co-regulation mainly rely on labor-intensive and potentially subjective behavioral observation. Physiological measures offer a complimentary means for objectively evaluating SR and ER simultaneously in dyads that include an individual with ASD and a partner (e.g., peer, caregiver,

teacher), shedding light on biological processes that may underlie observable behavior. However, dyadic physiological data is complex to analyze and interpret, and to-date only two published studies have examined such data in children with ASD (Baker et. al., 2015; Chaspari et. al., 2014).
Objectives: Develop a novel analytic procedure for modeling interpersonal physiological dynamics and evaluate that model on pilot data collected from minimally-verbal (MV) children with ASD and their therapists during an empirically validated intervention focused on joint engagement and co-regulation (Kasari, Freeman, & Paparella, 2006). Using dynamical systems models, our analytical method provides clear effect sizes for levels of physiological interdependence (i.e., synchrony) and shows consistency with existing behavioral coding data.
Methods: Electrodermal activity (EDA) data was wirelessly recorded from six MV children with ASD and their therapists during intervention sessions. Using a windowed time-series approach, we applied a dynamical systems model of self- and co-regulation. For each child-therapist dyad we extracted the percentage of variance explained by their partner's physiology via hierarchical regression. Subsequently, we assessed correspondence of these interpersonal physiological parameters with expert-coded behavioral measures of SR using a mixed-effects model to account for the nested structure of the data.
Results: Our dynamical systems model explained significant variance attributable to interpersonal influence (R^2 range: 0.0 – 0.67), and showed correspondence with behavioral coding of SR-relevant behaviors ($F(2,61)=4.21$, $p<.05$, $R^2=0.10$).
Conclusions: These data confirm the co-regulatory nature of the child and therapist physiology, and correspond to behavioral ratings, while providing greater temporal specificity on co-regulatory dynamics. To our knowledge, this is the first time interpersonal physiological measures using dynamical systems models have been applied to dyadic interactions in children with ASD. The utility of physiological measures for evaluating interpersonal functioning, and our new analytic technique, shows promise for allowing more efficient, objective, reproducible, and sensitive indices of SR and ER to study developmental underpinnings of socio-affective dynamics in ASD.

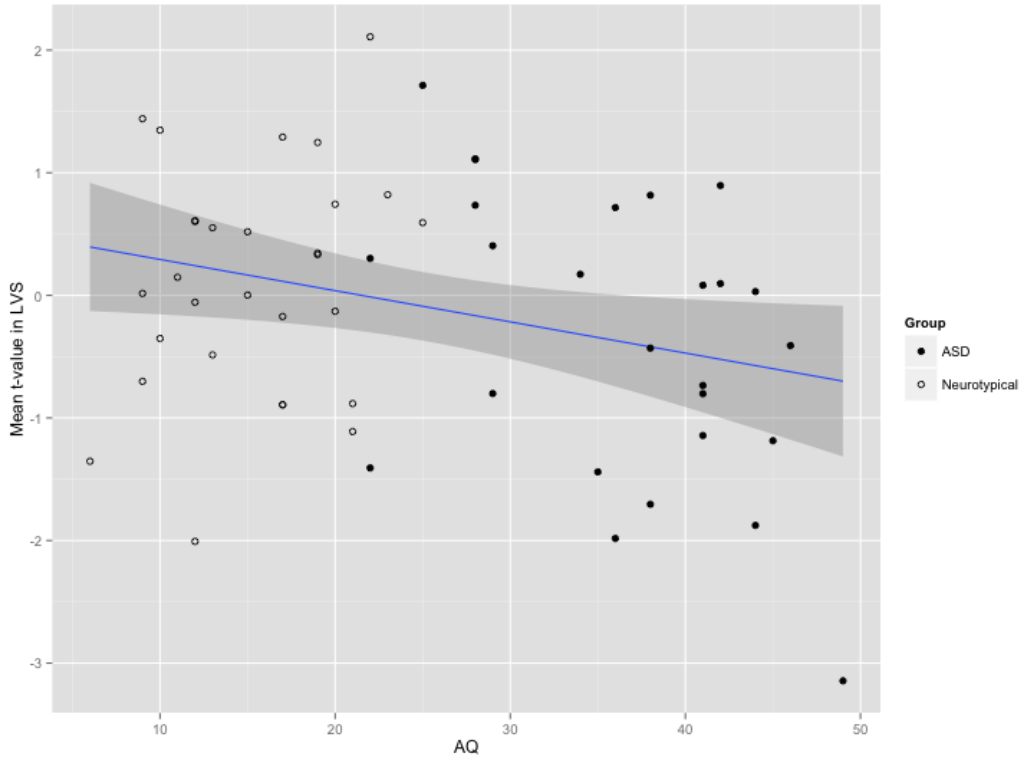


*R^2 = Percentage of variance explained in one person's physiology by her or his partner's physiology

2:21 **120.004** Reduced Reward Related Response to Imitation in Autism Spectrum Conditions

B. Chakrabarti[1], *J. Neufeld*[1,2] *and C. T. Hsu*[1], *(1)School of Psychology & Clinical Language Sciences, University of Reading, Reading, United Kingdom, (2)Center of Neurodevelopmental Disorders, Karolinska Institutet, Stockholm, Sweden*

Background:
Imitation facilitates the formation of social bonds in humans, from an early age. Parents routinely imitate their babies to build rapport. Neurotypical humans find others who imitate them to be more rewarding, and imitate those who are more rewarding to them. These phenomena suggest a link between imitation and reward. In separate EMG and fMRI studies in individuals with and without Autism Spectrum Disorders (ASD), we have previously demonstrated that autistic traits modulate imitative responses to rewarding social stimuli. These results suggest that autistic traits modulate the link from reward to imitation. However, the link from imitation to reward has not been studied in ASD. Investigating this link is vital in light of the crucial role of imitation as an instrument of social bonding. On the basis of our previous results showing an atypical reward-imitation link in individuals with high autistic traits and a clinical diagnosis of ASD, we hypothesised that being imitated may not be equally rewarding for individuals with ASD.
Objectives:
To test if individuals with ASD show a reduced reward-related neural response to being imitated.
Methods:
26 ASD and 30 neurotypical (NT) adults, matched for age, gender, and IQ, performed a 2-part task. The first part was a conditioning task outside the scanner, where participants were mimicked by one face and 'anti-mimicked' by another. The participants were instructed to make a facial expression (happy/sad) while watching faces on screen that would either make a congruent or an incongruent expression, 700ms after the participant initiated the instructed expression. This created the subjective impression of being mimicked/ anti-mimicked. The second part was done in a 3T fMRI scanner, where participants passively viewed neutral expressions of the conditioned faces one at a time, using an event-related design. We hypothesised that the NT group would show greater reward-related ventral striatal (VS) response to the mimicking compared to the anti-mimicking faces, when compared to the ASD group. The VS cluster was defined using an independent meta-analysis of reward processing studies (Liu et al, 2010).
Results:
Data were analysed using SPM8, using a standard processing pipeline. Contrast statistics for [mimicking>anti-mimicking faces] were extracted from the VS cluster, and analysed using multiple regression. This analyses showed a main effect of group in the left VS (beta [group] = -0.662, p = 0.0265). Specifically, the left VS response to [mimicking>antimimicking faces] was found to be significantly lower in the ASD group compared to the NT group (t = -1.69, p = 0.0486). The left VS response negatively correlated with self-reported autistic traits (as measured using the Autism Spectrum Quotient, AQ) across the whole sample (r = -0.29, p = 0.0307). No significant differences were observed in the right VS.
Conclusions:
The results support our hypothesis that in individuals with high autistic traits and those with a clinical diagnosis of ASD, being imitated is associated with lower reward-related striatal response when compared to controls. This result offers a potential explanation for why individuals with ASD find it difficult to form social bonds.

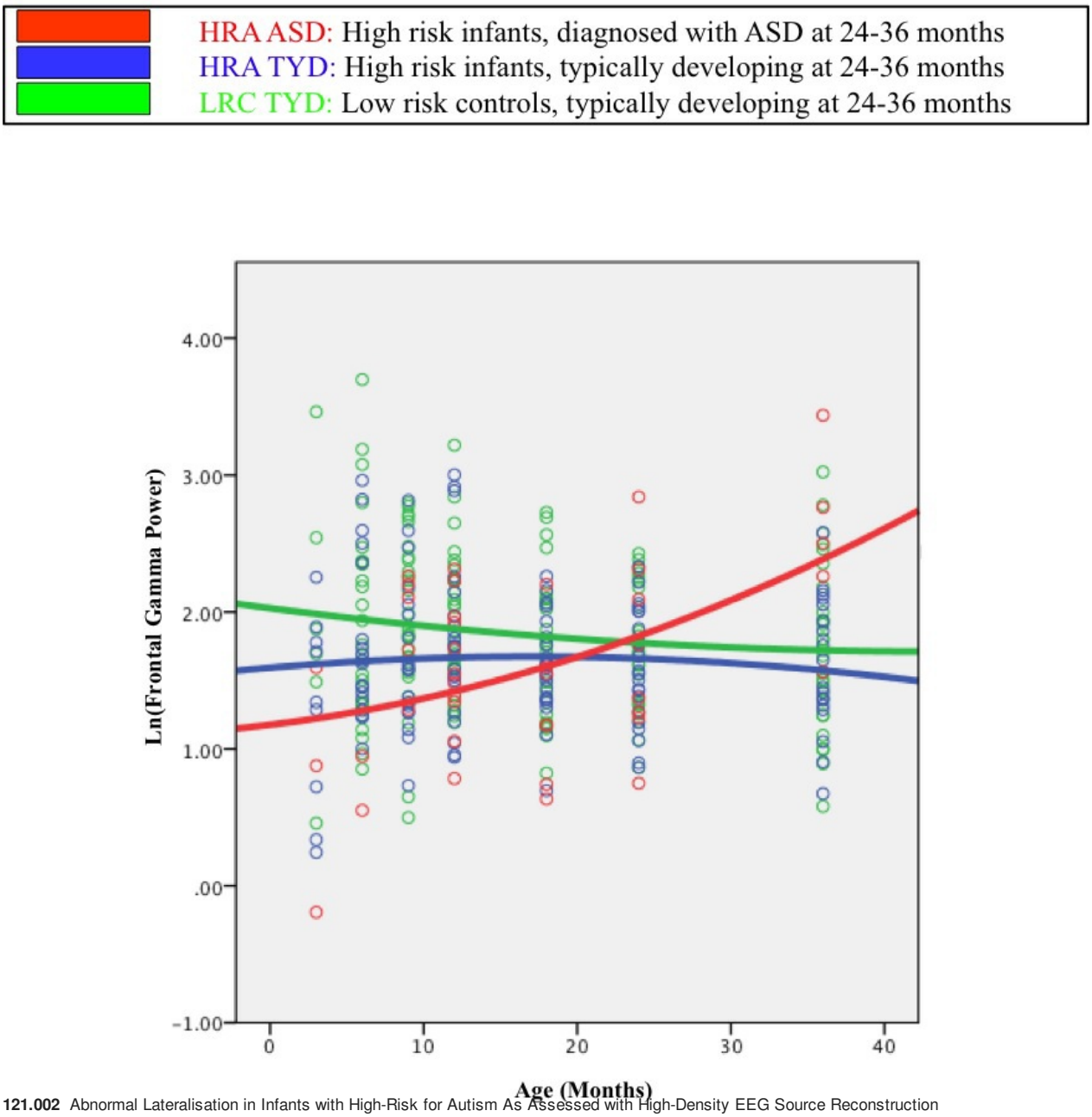


Oral Session - 5B
121 - New Frontiers in Infant Brain Functional Imaging
2:40 PM - 3:30 PM - Room 310

2:40 **121.001** Trajectories of Frontal Gamma Power from 3 to 36 Months in Infants Later Diagnosed with Autism Spectrum Disorder

A. R. Levin[1], *H. M. O'Leary*[2], *K. J. Varcin*[3], *M. K. Crossman*[4], *H. Tager-Flusberg*[5] *and C. A. Nelson*[6], *(1)Boston Children's Hospital, Brookline, MA, (2)Neurology, Boston Children's Hospital, Boston, MA, (3)Harvard Medical School, Boston Children's Hospital, Cambridge, MA, (4)Boston Children's Hospital, Watertown, MA, (5)Boston University, Boston, MA, (6)Boston Children's Hospital/Harvard Medical School, Boston, MA*

Background: Baseline gamma band activity is altered in people with autism spectrum disorder (ASD) at a variety of ages, and may represent abnormalities in local processing or feedback between excitatory and inhibitory neurons. Infants with an older sibling with autism have a high risk of developing ASD (HRA), whereas infants with a typically developing older sibling act as low risk controls (LRC). Tierney et al. (2012) previously demonstrated that from 6-24 months, the trajectory of EEG gamma power differed in HRA compared to LRC infants.
Objectives: We aimed to evaluate the extent to which the developmental trajectory of EEG gamma power in infants who go on to meet criteria for ASD differs from the trajectory of those that do not.
Methods: We collected serial high-density baseline EEGs on infants 3-36 months of age. At 36 months, diagnosis of ASD was determined via ADOS and confirmed by clinical impression. We calculated frontal gamma power in EEGs from 3 groups of subjects: Low risk controls who do not develop ASD ((LRC-, n=80); high risk subjects who do not develop ASD (HRA-, n=64); and high risk subjects who do develop ASD (HRA+, n=23). We used multilevel modeling to assess change over time in frontal gamma power for subjects in each of the 3 groups. We then calculated the sensitivity and specificity of an upgoing trajectory of gamma power in predicting ASD.
Results: High risk infants who subsequently developed ASD (HRA+) showed an altered trajectory of frontal gamma power during the first 36 months of life, compared to HRA- ($p<.05$) and LRC- ($p<.05$) infants. An upgoing trajectory of gamma power between 3 and 36 months is 70% sensitive and 72% specific for a diagnosis of ASD.
Conclusions: The developmental trajectory of frontal gamma power tends to be more positive in infants who later develop ASD. Further research is necessary to better understand the mechanism underlying this finding, and to develop clinically applicable tests and treatments that offer utility prior to the onset of definitive behavioral manifestations of ASD.



2:52 **121.002** Abnormal Lateralisation in Infants with High-Risk for Autism As Assessed with High-Density EEG Source Reconstruction

C. O'Reilly[1], *M. Elsabbagh*[2] *and T. B. Team*[3], *(1)École Polytechnique Fédérale de Lausanne, Geneva, GE, Switzerland, (2)McGill University, Montreal, PQ, Canada, (3)Birkbeck, University of London, London, United Kingdom*

Background: Aberrant lateralisation of functional connectivity has been reported in many EEG and MEG studies of autism. For example, using MEG recordings, Keehn et al. (2015) [Autism Res, 8(2), 187-198] reported autism to be associated with leftward (instead of the normal rightward) lateralisation of face processing emerging around one year of life. No such spatially-resolved analyses have yet been proposed using EEG source reconstruction.

Objectives: To investigate abnormal lateralisation in EEG functional connectivity.

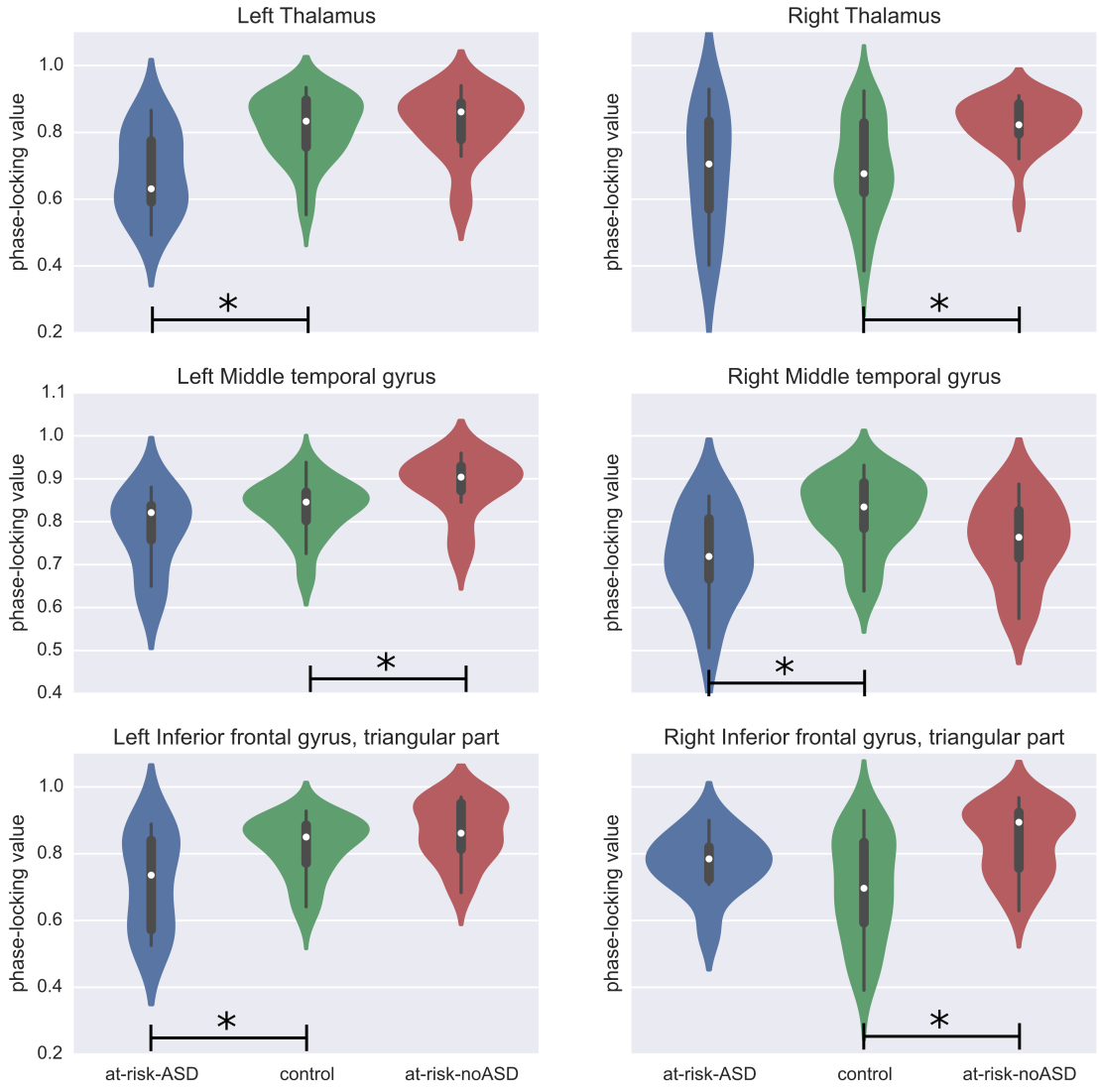
Methods: Our sample contains recordings from 14-months-old infants at-risk for autism who were later diagnosed with ASD (ASD; N=11) or not (noASD; n=24), as well as controls (Control; N=40). Infant EEG was recorded in response to gaze shift directed toward or away from the infants [Elsabbagh et al., (2012), Cur Biol, 22, 338-342]. After basic preprocessing (reformatting to average reference, notch filtering, within-condition time-locked averaging), sources were estimated from high-density EEG recordings using a newly developed MRI template. The first principal component was then computed from dipoles included within every region of the Tzourio-Mazoyer atlas. Finally, between-regions connectivity was computed using phase-locking values.

Results: Following a preliminary exploratory investigation, we concentrated our analysis on delta activity (1-4 Hz) during direct gazes because this condition yielded the strongest between-group differences. Three regions showed significant effects (Bonferroni corrected at $p<0.05$ corresponding to uncorrected $p<0.00056$) for ASD vs. Control comparison and four regions for the noASD vs. Control comparisons. All significant effects were showing overconnectivity for the noASD group and underconnectivity for the ASD group. The table accompanying this abstract gives the mean (± standard deviation) of the phase-locking value as well as p-values and t-values for the 7 most significant regions, for both group comparisons. Further, the three regions (see the accompanying figure for violin plots showing the distribution of the connectivity for these regions) giving the most significant differences for noASD group (right thalamus; left middle temporal gyrus; right inferior frontal gyrus, triangular part; all overconnected) were all showing clear underconnectivity in the homologous regions (i.e., same regions, opposite hemisphere) for the ASD group. These homologous regions were among the first seven most significantly affected regions for the ASD group, all with $p < 0.0065$ (uncorrected). Had these two sets of 3 and 7 regions been picked randomly, the odds of observing at least three such correspondences would only have been of only 0.03%.

Conclusions: Spatially-resolved connectivity obtained through source reconstruction distinguishes both noASD and ASD from controls, with strikingly opposed patterns of abnormal lateralisation. Our results also showed clear underconnectivity in the ASD group and clear overconnectivity in the noASD group, showing a possible compensatory mechanism in infants at-risk who do not develop ASD. These effects were clearly seen in the delta band, when showing pictures of direct gazes.

region	noASD	control	p-values	t-values
Left Middle temporal gyrus	0.91 (±0.03)	0.85 (±0.05)	9.0E-06	-5.00
Right Thalamus	0.83 (±0.07)	0.70 (±0.14)	1.2E-04	-4.10
Right Inferior frontal gyrus, triangular part	0.84 (±0.10)	0.70 (±0.16)	2.0E-04	-3.95
Left Superior frontal gyrus, medial orbital	0.87 (±0.09)	0.77 (±0.10)	4.2E-04	-3.75
Right Superior frontal gyrus, orbital part	0.84 (±0.12)	0.72 (±0.16)	1.3E-03	-3.37
Left Supplementary motor area	0.89 (±0.07)	0.80 (±0.12)	2.4E-03	-3.17
Right Inferior temporal gyrus	0.88 (±0.09)	0.80 (±0.09)	2.5E-03	-3.17

region	ASD	control	p-values	t-values
Right Temporal pole: superior temporal gyrus	0.64 (±0.16)	0.84 (±0.08)	6.9E-07	5.79
Left Thalamus	0.68 (±0.12)	0.82 (±0.09)	6.8E-05	4.38
Right Angular gyrus	0.72 (±0.11)	0.84 (±0.08)	1.9E-04	4.07
Right Gyrus rectus	0.60 (±0.16)	0.77 (±0.13)	8.4E-04	3.56
Right Middle temporal gyrus	0.72 (±0.11)	0.82 (±0.08)	1.7E-03	3.32
Left Insula	0.63 (±0.19)	0.80 (±0.13)	1.9E-03	3.30
Left Inferior frontal gyrus, triangular part	0.72 (±0.14)	0.82 (±0.09)	6.5E-03	2.86



 121.003 Restricted Behavior and Brain Functional Connectivity in Infants and Toddlers at Risk for Developing Autism Spectrum Disorder

A. T. Eggebrecht[1,2], C. J. McKinnon[2,3], A. Todorov[4], J. J. Wolff[5], J. T. Elison[5], C. M. Adams[6], A. Z. Snyder[7], A. M. Estes[8], L. Zwaigenbaum[9], K. Botteron[10], A. C. Evans[11], H. C. Hazlett[12], S. Dager[13], S. J. Paterson[14], R. T. Schultz[15], M. Styner[16], G. Gerig[17], .. The IBIS Network[16], B. L. Schlaggar[4], S. E. Petersen[4], J. Piven[16,18] and J. R.

Pruett[18,19], (1)Washington University School of Medicine, St Louis, MO, (2)Shared First Author, St Louis, MO, (3)Washington University in St. Louis, St. Louis, MO, (4)Washington University School of Medicine, St. Louis, MO, (5)University of Minnesota, Minneapolis, MN, (6)Washington University in St. Louis, St Louis, MO, (7)Radiology, Washington University School of Medicine, St. Louis, MO, (8)University of Washington Autism Center, Seattle, WA, (9)University of Alberta, Edmonton, AB, Canada, (10)Psychiatry and Radiology, Washington University School of Medicine, St. Louis, MO, (11)Montreal Neurological Institute, Montreal, QC, Canada, (12)Carolina Institute for Developmental Disabilities, University of North Carolina at Chapel Hill, Chapel Hill, NC, (13)University of Washington School of Medicine, Seattle, WA, (14)Department of psychology, Temple university, Philadelphia, PA, (15)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (16)University of North Carolina at Chapel Hill, Chapel Hill, NC, (17)New York University, New York, NY, (18)Shared Senior Author, Carrboro, NC, (19)Washington University School of Medicine, Saint Louis, MO

Background: Autism spectrum disorder (ASD) is a common neurodevelopmental disorder defined by impaired social communication and interaction, and restricted and repetitive behaviors. The relationships between restricted and repetitive behaviors and underlying brain function, especially during the first years of life, have yet to be elucidated.

Objectives: This work investigates whether particular patterns of correlations between brain regions, as measured with resting state functional connectivity MRI (fcMRI), relate to restricted behaviors, as assessed with the Repetitive Behavior Scale – Revised (RBS-R).

Methods: This work focuses on fcMRI and RBS-R data collected from N=95 24 month old (mo) children across four sites within IBIS, an NIH ACE Network.

Cohorts: Children were classified as high risk (HR) if they had a sibling with ASD, or low risk (LR) if they had at least one sibling without ASD and no 1st or 2nddegree relatives with ASD. Groups were assigned by research clinical best estimate using the DSM-IV-TR checklist at 24mo (HR+/HR-/LR-: n=22/59/13).

fcMRI data: For each child, fcMRI data were processed using state-of-the-art protocols, including motion scrubbing at a conservative FD level of 0.2 mm. Analyses utilized 150 frames of clean fcMRI data from each subject. Time traces from 230 functionally-defined regions of interest (ROI) throughout the cerebrum and cerebellum were correlated to yield fc values, and grouped into each of 17 putative functional networks, identified using the Infomap community detection algorithm (**Figure 1a**).

Restricted behavior data: The RBS-R is a behavioral assessment composed of 43 parent/caregiver-rated items that rates the level of stereotypical, self-injurious, compulsive, sameness, ritualistic and restricted behavior of the subject (**Figure 1b**). These analyses focus on the restricted subscale.

Brain-behavior analysis: Enrichment analyses were used to determine which functional brain networks are most associated with restricted behaviors. Each ROI-pair fc value was correlated (Spearman) across subjects with the RBS-R restricted subscale scores. These correlation values were then thresholded at an uncorrected p-value of 0.05. Two complementary metrics (a $\chi^2$and a hypergeometric test) were used to determine if the number of strong brain-behavior correlations within each network-pair of the matrix was greater than the number expected by chance. Empirical significance levels were determined using randomization. An experiment-wide false-positive rejection rate of 5% was used.

Results: Specific groupings of significant correlations of fc with restricted behaviors (**Figure 1c-f**) occurred for either an attention, a control, or the default mode network (i.e. the parietal dorsal attention network (pDAN), the default mode network (DMN), the posterior DMN (pDMN), the anterior frontoparietal task control network (aFPC), the posterior FPC (pFPC), the dorsal-anterior DMN (daDMN), the medial visual (mVis) network and the pPFC (**Figure 1g**)). The pPFC is also significantly enriched within its intra-network connections.

Conclusions: Restricted behavior and brain functional connectivity in 24mo children are strongly associated with a small set of specific functional brain networks. These involve infant-toddler manifestations of the default mode, dorsal attention, and fronto-parietal task control networks.

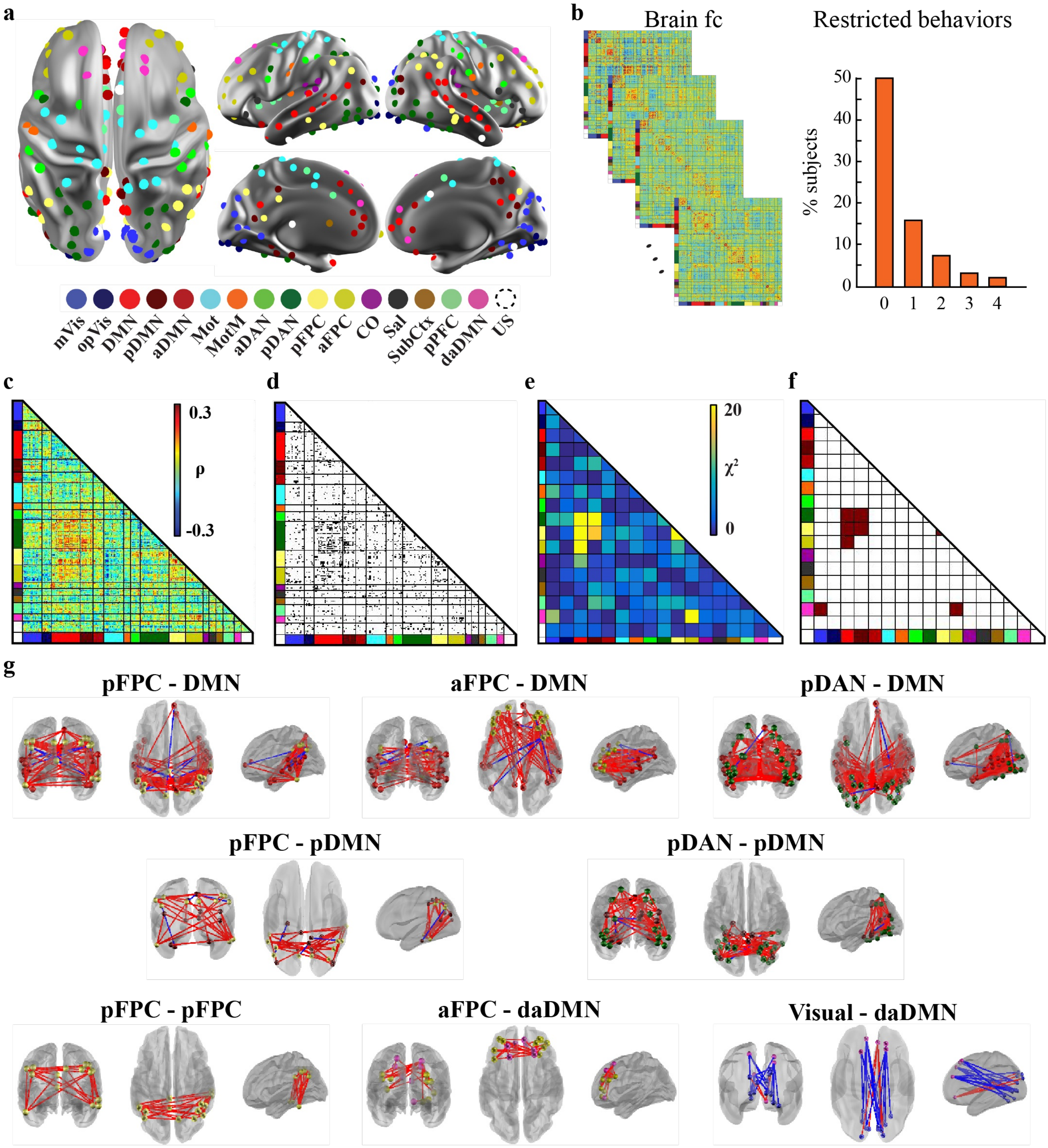


Figure 1 | Brain-behavior analyses of restricted behaviors in 24-mo toddlers. a The functional organization of the toddler brain throughout 230 regions of interest (ROIs) was derived using the Infomap algorithm on the mean fcMRI matrix from 37 subjects with longitudinal data. The color of ROIs represents their putative functional network. **b** Brain fc between 26,335 ROI pairs was correlated across subjects against the RBS-R restricted behavior score, yielding a matrix of Spearman - ρ correlation values (**c**) and a matrix of uncorrected p-values less than 0.05 (**d,** black). **e** The χ^2 statistic calculates the enrichment level of strong brain-behavior correlations within network pairs. **f** Significant enrichment (red squares) was determined through randomization. **g** Significantly enriched network pairs tend to exhibit primarily positive (red lines) or negative (blue lines) brain-behavior correlations.

3:16 **121.004** Gross Motor Function and Brain Functional Connectivity in Infants and Toddlers at Risk for ASD

N. Marrus[1], A. T. Eggebrecht[2], A. Todorov[3], J. T. Elison[4], J. J. Wolff[4], W. Gao[5], J. Pandey[6], M. D. Shen[7], M. R. Swanson[7], R. Emerson[8], C. L. Klohr[9], C. M. Adams[10], A. Z. Snyder[11], A. M. Estes[12], L. Zwaigenbaum[13], K. Botteron[14], R. McKinstry[3], J. N. Constantino[15], A. C. Evans[16], H. C. Hazlett[17], S. Dager[18], S. J. Paterson[19], R. T. Schultz[20], M. Styner[7], G. Gerig[21], .. The IBIS Network[7], B. L. Schlaggar[3], S. E. Petersen[3], J. Piven[7] and J. R. Pruett[15], (1)Washington University School of Medicine, Webster Groves, MO, (2)Washington University School of Medicine, St Louis, MO, (3)Washington University School of Medicine, St. Louis, MO, (4)University of Minnesota, Minneapolis, MN, (5)Cedars Sinai Medical Center, Los Angeles, CA, (6)Children's Hospital of Philadelphia, Philadelphia, PA, (7)University of North Carolina at Chapel Hill, Chapel Hill, NC, (8)University of North Carolina - Chapel Hill, Chapel Hill, NC, (9)Washington University, St. Louis, MO, (10)Washington University in St. Louis, St Louis, MO, (11)Radiology, Washington University School of Medicine, St. Louis, MO, (12)University of Washington Autism Center, Seattle, WA, (13)University of Alberta, Edmonton, AB, Canada, (14)Psychiatry and Radiology, Washington University School of Medicine, St. Louis, MO, (15)Washington University School of Medicine, Saint Louis, MO, (16)Montreal Neurological Institute, Montreal, QC, Canada, (17)Carolina Institute for Developmental Disabilities, University of North Carolina at Chapel Hill, Chapel Hill, NC, (18)University of Washington School of Medicine, Seattle, WA, (19)Department of psychology, Temple university, Philadelphia, PA, (20)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (21)New York University, New York, NY

Background: Gross motor deficits in infancy are one of the earliest findings linked to ASD, highlighting the potential interrelationship between motor delay and ASD-specific symptom emergence. Characterizing brain-behavior relationships for specific aspects of motor function may, therefore, elucidate neurobiology underlying the development of

ASD.

Objectives: To test whether correlations between gross motor behavior and ROI-ROI functional connectivity (fc) 1) are enriched for specific brain networks, and 2) change between 12 and 24 months.

Methods:

Participants:The Infant Brain Imaging Study includes high-risk (HR: has sibling with ASD) and low-risk (LR: has sibling(s) without ASD) infants. A clinical best estimate ASD diagnosis was assigned at 24 months. Included participants had fcMRI and behavioral data at 12 (n=129; HR+/HR-/LR-=12/76/38) and/or 24 months (n=108; HR+/HR-/LR-=19/63/25).

***Imaging*:** Resting state fcMRI data were acquired on identical 3T Tim Trio scanners at 4 sites with up to 3 BOLD runs (130 frames each run with TR=2.5 seconds). Data processing included motion scrubbing at a FD level of 0.2 mm. One-hundred-fifty frames of clean data were used per subject. Time traces were correlated between 230 functionally-defined regions of interest (ROI) to yield fc values (**Fig.1b**). ROIs were sorted into 17 putative functional networks using the Infomap community detection algorithm run on the mean connectivity matrix for longitudinal fcMRI data from 37 subjects (**Fig.1a**).

Measures: Gross motor function was indexed by raw gross motor scores on the Mullen Scales of Early Learning (**Fig.1c**). Five items were summed to create a "walking scale" at 12 months.

Brain-behavior analysis* (Fig.1d):* We identified network-network pairs significantly enriched for ROI-ROI fc values that strongly correlated with behavior. fc values for all ROI pairs were correlated against behavioral scores and thresholded at p<.05 (uncorrected). 2x1 X^2 tests and hypergeometric tests established whether enrichment within network pairs exceeded that expected by chance. A 5% false-positive rejection rate was determined by permutation**.** McNemar tests assessed whether enrichment differed between 12 and 24 months.

Results:

Brain-behavior correlations frequently involved the motor network, especially at 12 months (**Fig.1d-f**). Largely interhemispheric ROI pairs within the motor network markedly overlapped for gross motor and walking scores, mapped predominantly to the presumed lower limb region of motor cortex, and negatively correlated with behavior at 12 months (**Fig.1g-h**). Conversely, several motor-frontoparietal and motor-dorsal attention network pairs positively correlated with behavior. There were greater involvements of frontoparietal and dorsal attention network pairs at 24 months. Significant age-dependent differences in brain-behavior relationships were observed (**Fig.2a,b).**

Conclusions:

Motor network involvement at 12 and 24 months supports the face validity of this analytic approach. Brain-behavior correlations enriched within the motor network suggest that decreased fc between interhemispheric (potentially lower limb) motor ROIs correlates with greater walking ability in early development. At 24 months, enriched positive brain-behavior correlations involving task-control and dorsal attention networks implicate these networks in motor skill development. Future directions include comparisons of brain-behavior relationships for motor functioning in children with and without ASD, and investigating whether similar observed brain-behavior relationships correlate with the differential development of social communication in ASD.

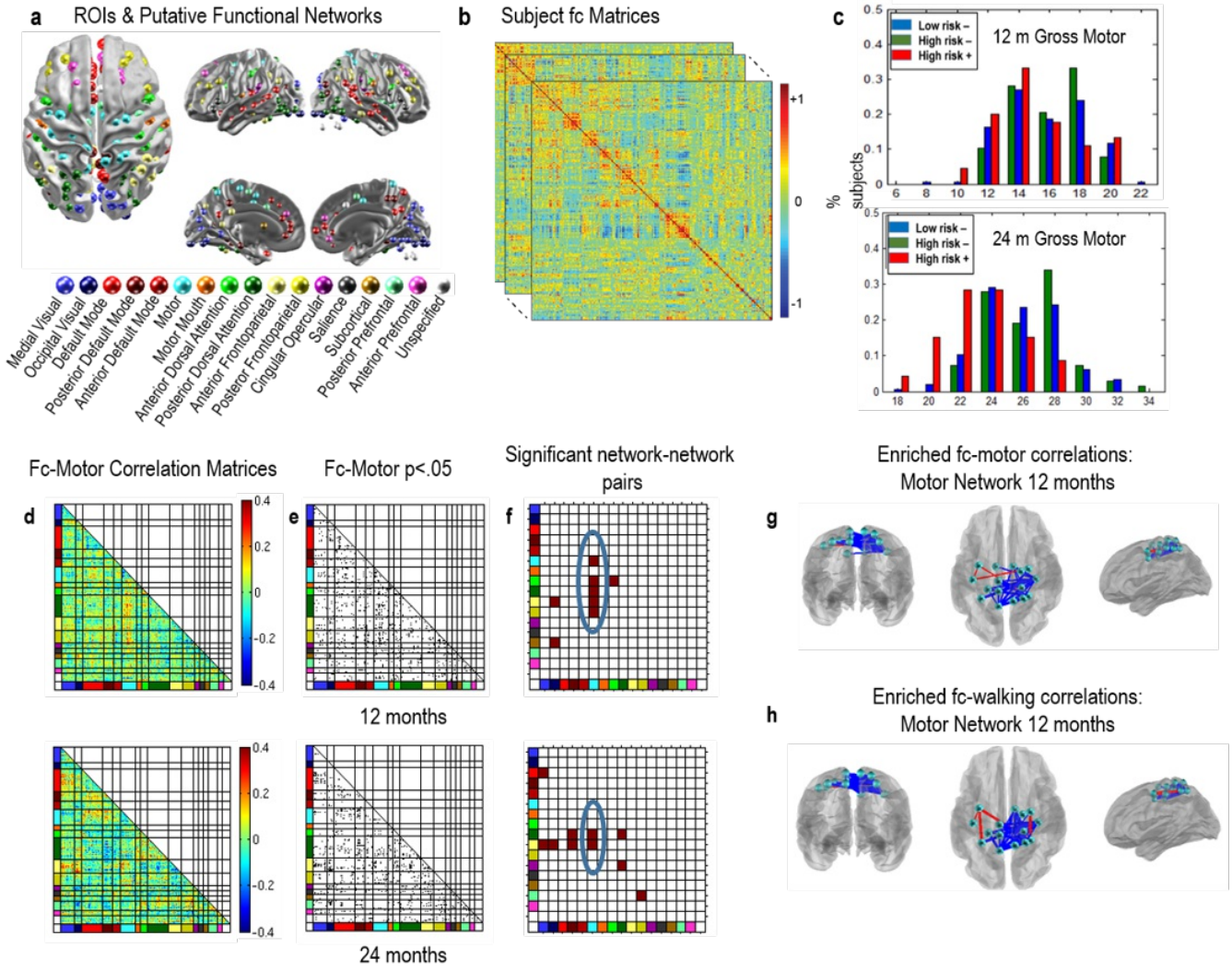
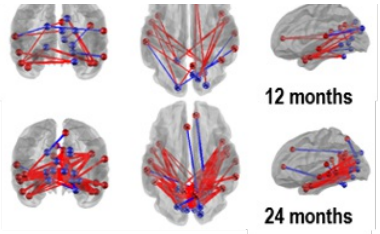
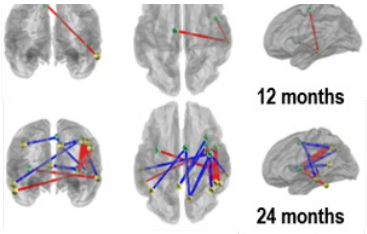


Figure 1. Brain Behavior Analysis (a) Balls represent functionally defined ROIs. Colors indicate network associations as listed. (b) Each child contributes a 230 ROI x ROI fc-matrix. (c) Raw gross motor score distributions at 12 and 24 months, divided by diagnostic subgroup. Children across all diagnostic subgroups were pooled for brain-behavior analyses. (d-g) Parallel analyses for 12 and 24 months to identify network-network blocks enriched for brain-behavior relationships in which functional connectivity (fc) for given connections (ROI-ROI pairs) is significantly associated with motor score. (d) ROI-ROI Pearson correlation of fc with behavior. Side bar indicates correspondence between colors and strength of brain-behavior correlation values, which range between 0.4 and -0.4. (e) ROI-ROI pairs with fc-motor correlation of p<0.05 (uncorrected). (f) Network pairs passing significance testing as determined by permutation analysis are shown in red. Blue circles indicate blocks involving the motor network. (g) ROI pairs in motor-motor subnetwork block whose fc significantly correlates with gross score at 12 months. Blue indicates a negative brain-behavior relationship between ROI pairs, which are mostly interhemispheric. (h) ROI pairs in the motor-motor network block whose fc correlates with a derived walking score at 12 months. Note the close similarity in the ROIs for walking and gross motor scores, as well as the location near regions of motor cortex associated with control of lower limbs.

Figure 2. Changes in Patterns of Enriched fc-Motor Correlations in Network Pairs at 12 and 24 months: 2a & b



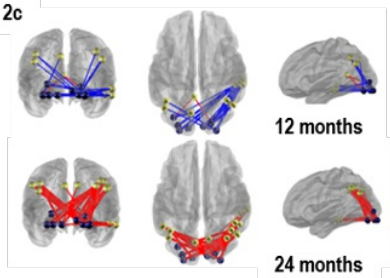
Default Mode-Medial Visual



Posterior Fronto-parietal-
Poster Prefrontal Cortical

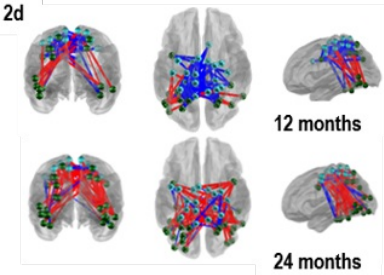
Correlations in Network Pairs at 12 and 24 months: 2a & b show the 2 network pairs with a significant change in the pattern of enrichment based on the McNemar test. Red and blue lines indicate positive and negative brain-behavior relationships, respectively. At 24 months, both 2a and 2b show more ROI pairs whose fc significantly correlates with motor function. 2c-e display the 3 significant network pairs at 12 and 24 months *which did not significantly change in amount of enrichment*. In 2c, the direction of the fc-motor correlations switched from negative to positive, while in 2d, a profile of mixed positive and negative fc-motor correlations became predominantly positive, showing the potential for marked variability in brain-behavior relationships over time.

2c



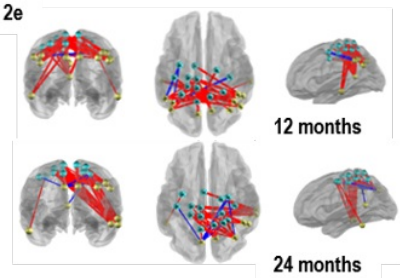
Posterior Fronto-parietal-Occipital Visual

2d



Posterior Dorsal Attention-Motor

2e



Posterior Fronto-parietal-Motor

Poster Session
122 - Cognition: Attention, Learning, Memory
5:30 PM - 7:00 PM - Hall A

1 **122.001** . Altered Pupil Responsivity to a Gaze Following Task in Children with an Autism Spectrum Disorder

M. A. Braeken, *L. Van Schuerbeeck and M. Vanvuchelen, Faculty of Medicine and Life Sciences - Rehabilitation Research Center (REVAL), Hasselt University, Diepenbeek, Belgium*

Background: Previous research has shown that changes in pupil size reflect cognitive resource allocation. Moreover, pupillary response is often used as a physiological measure for emotional arousal. Therefore, pupillary responses potentially can provide more insight in cognitive deficits and stress regulation as an underlying mechanism in deficits characteristic for Autism Spectrum Disorders (ASD).
Objectives: The aim of this study is to investigate which aspect primarily affects the physiological response (i.e., pupillary response) to a gaze following task in children with ASD and age-matched typically developing children, i.e. an object presence or an adult's eyes state.
Methods: Twenty children were divided into three groups: 7 children with an ASD (mean chronological age 64 months, SD 7.6 months and mean mental age 35.8 months, SD 19.9 months), 7 mental-age-matched typically developing children (mean chronological age 36.7 months, SD 19.4 months) and 6 chronological-age-matched typically developing children (mean chronological age 63.1 months, SD 9.2 months). All children were observed when seeing a video clip in which a female adult model, wearing a black shirt, sat behind a table against a neutral background. The clip had two open-eyes state conditions and two closed-eyes state conditions. Each condition was once performed towards an object (object-present) and once towards an empty space (object-absent), resulting in four conditions in total.
Results: Multilevel regression analyses revealed a statistically significant negative association between the object presence and pupillary response (b=-0.1, SE=0.04, p= .03). No association was found between the eyes state and pupillary response. Furthermore, both the mental-age-matched c and chronological-age-matched typically developing children had a significant larger pupil dilatation (b=0.15, SE=0.07, p= .04; b=0.29, SE=0.08, p< .001) than children with an ASD. No significant interaction was found between group (i.e., ASD vs. mental-age-matched and chronological-age-matched children) and object presence.
Conclusions: The results of this study confirm earlier studies showing altered physiological reactivity to a gaze following task in children with an ASD. More specifically, we found that children with an ASD show less pupil dilatation over all conditions compared to typically developing children. Additionally, the present study suggests that children's pupillary responses are not influenced by the adult's eyes, but rather by the presence of objects. Children showed less pupil dilatation when the adult looked at an object compared to an empty space, but this response did not differ between children with ASD and mental-, respectively chronological-age-matched peers.

2 **122.002** A Profile of Visual Illusion Susceptibility in ASD

O. Landry[1], *I. Sperandio*[2], *S. Crewther*[3] *and P. Chouinard*[1], *(1)La Trobe University, Bendigo, Australia, (2)University of East Anglia, Norwich, United Kingdom, (3)La Trobe University, Melbourne, Australia*

Background: Visual illusions provide a means to understand how contextual visual information is used to perceptually rescale how people see objects in the world. Previous research examining illusion susceptibility in ASD has yielded inconsistent conclusions as to whether or not people with an ASD perceive illusions differently. One possible explanation is that previous research has tended to treat global processing, which underlies illusory susceptibility, as a singular cognitive construct. We hypothesize that one cannot treat visual illusions this way. Illusions come in different classes, each class reflecting distinct cognitive operations, which may or may not be affected in ASD.
Objectives: Our objectives were to test a battery of visual illusions in participants with ASD and examine susceptibility across different classes of illusions. These classes of illusions were derived in a separate study of 131 typically developing adults using factor analysis (Chouinard et al., under review).
Methods:
24 participants, including 12 with ASD were included. Comparison participants were selected to best match the participants with ASD one-to-one on age and Raven's Progressive Matrices raw scores (mean age: 13 yrs, range: 7 to 23 yrs; mean RPM score 36, range 24-50). We measured susceptibility to 13 of some of the most frequently tested visual illusions using the Methods of Adjustment approach. The illusion battery consisted of the Ponzo, Sander's Parallelogram, Ehenstein, Jastrow (Component 1), Helmholtz-Square, Horizontal-Vertical line, Muller-Lyer, (Component 2), Delboeuf, Ebbinghaus (Component 3), Shepard's tabletops, Square-Diamond (Component 4), Oppel-Kundt and Poggendorf (Component 5) illusions. To allow meaningful comparisons between illusions, we computed normalised indices of susceptibility for each illusion as: ((Perceived Size of Stimulus B - Perceived Size of Stimulus A) / (Perceived Size in Stimulus A + Perceived Size of Stimulus B)); B denoting the stimulus one would expect to see greater judgements in perceived size. Participants also completed control tasks to measure basic abilities in visual acuity and discrimination.
Results:
We found significantly reduced susceptibility on Component 4 ($t(22) = 2.10$, $p=.048$) but not on any of the other four Components (largest $t(22)=1.71$, $p=.10$). Examination of the illusions that made up this Component revealed that the reduced susceptibility was specific to the Shepard's tabletop illusion ($t(22)=2.28$, $p=.032$) and not found for the Square-Diamond illusion ($t(22)=0.20$, $p=.844$).
Conclusions: In ASD, we found reduced susceptibility to one specific illusion, the Shepard's tabletop illusion. This is consistent with a previous report by Mitchell, Mottron, Soulières, and Ropar, (2010). Furthermore, in adults, this specific illusion elicits a strong illusory percept, which is correlated with autistic traits as measured by the AQ (Chouinard et al., under review). Within our sample, the Shepard's tabletop is also the only illusion for which children's susceptibility scores are lower than those of adults (as reported in Chouinard et al., under review), however susceptibility was not correlated with age within our sample. These findings will contribute to our more general understanding of altered visual perception in ASD, shedding light into the nature of global processing. Particularly, what types may or may not be affected in ASD.

Table 1: Susceptibility index scores for participants on five classes of visual illusion for participants with and without ASD, matched on age and Ravens Progressive Matrices raw scores. The classes were derived using factor analysis (reported in Chouinard et al., under review). The illusions are: Ponzo, Sander's Parallelogram, Ehenstein, Jastrow (Component 1), Helmholtz-Square, Horizontal-Vertical line, Muller-Lyer, (Component 2), Delboeuf, Ebbinghaus (Component 3), Shepard's tabletops, Square-Diamond (Component 4), Oppel-Kundt and Poggendorf (Component 5).

	Group	N	M	sd	t
Comp1	ASD	12	0.1418	0.03895	1.712
	NON	12	0.1691	0.03909	p=.101
Comp2	ASD	12	0.1631	0.05289	1.660
	NON	12	0.1954	0.04184	p=.111
Comp3	ASD	12	0.1322	0.1161	0.504
	NON	12	0.1537	0.09125	p=.619
Comp4	ASD	12	0.0791	0.06905	2.099
	NON	12	0.1324	0.05444	p=.048
Comp5	ASD	12	0.1115	0.03799	-0.144
	NON	12	0.1078	0.08273	p=.889

3 **122.003** Accessing Meaning of Ambigous Homographs Embedded within Sentences in Children with ASD

R. E. Beabout, *Psychology, Marietta College, Marietta, OH*

Background: Considerable research focus concerning the theories of Weak Central Coherence (WCC) and Executive Functioning (EF) have been directed towards the cognitive atypicalities that may account for verbal comprehension impairments in individuals with ASD. The cause of language comprehension deficits in individuals with ASD is still not fully understood. To date evidence pertaining to individuals with ASD to process information in context remains mixed and has mainly focused on pronunciation tasks
Objectives: My thesis study investigated how children with ASD can use meaning activation of word primes to disambiguate target homographs inserted in the context of a sentence at automatic (300ms) and controlled (1000ms) stimulus onset asynchronies (SOAs).
Methods: Ten children with ASD and ten typically developing controls were first matched on chronological age and mental by utilizing the Kauffman Brief Intelligence Test, Second Edition. ASD symptomatology was verified using the Adolescent Autism Quotient and Vineland II Adaptive Behavior Scales. A semantic priming keystroke task was created using Inquisit Priming software. Participants were given 120 prime-homograph word target pairs split into four different conditions. Each trial consisted of the priming task consisted of a word prime(related or unrelated to the homograph), a 300ms or 1000ms delay, followed by a homograph word target embedded within the context of a sentence. Participants judged if the sentence made sense or not by either pressing X(Does not make sense) M(Makes sense) on the keyboard. Reaction time and accuracy of each trial were recorded.
Results: Children with ASD were as accurate as typically developing children in disambiguating the target homograph in each sentence. Incorrect responses between related and unrelated meaning trials did not differ. The second major finding of this study is that children with ASD were as fast as typically developing children in making a determination as to whether a sentence made sense in both related and unrelated conditions. Additionally, no differences in reaction time were observed between the ASD and typically developing group in conditions involving short or long SOAs.
Conclusions: The most fitting explanation concerning the results of this study is that children with ASD may have a specific language-processing deficit that prevents them from using semantic knowledge in spoken language. The patterns of results from this study show no deficit in verbal comprehension on a priming task that did not require pronunciation. Results run contrary to other studies concerning the accounts of WCC and EF and that may be because the research examining these theories put too much emphasis on pronunciation of a word rather than actual comprehension of the meaning of a word. Overall, children with ASD were able to use contextual information provided by the word primes in order to disambiguate target homographs embedded within the context of a sentence.

4 **122.004** Adults with Autism Spectrum Disorders Imitate Means to an End: The Effects of Sensorimotor Integration and Interference

M. Andrew[1], *S. J. Bennett*[2], *D. Elliott*[2] *and S. J. Hayes*[2], *(1)Liverpool John Moores University, Rossendale, England, United Kingdom, (2)Research Institute for Sport and Exercise Sciences, Liverpool John Moores University, Liverpool, United Kingdom*

Background:
When imitating a novel action, the sensorimotor system is configured by representing and executing observed biological motion kinematics. Although this process is functional in early development, individuals with autism spectrum disorders (*autism*) show significant difficulties imitating biological kinematics. Rather than this deficit being underpinned by a core dysfunction in the sensorimotor system, it could be a function of how the lower-level sensorimotor processes are engaged to integrate information during imitation. Here we present three experiments that used a novel 'true' imitation protocol designed to facilitate (Exp. 1), and disrupt (Exp. 2 and 3) sensorimotor integration during the imitation of biological motion kinematics in individuals with autism.
Objectives:
Examine whether the imitation of biological kinematics is influenced by sensorimotor integration and interference.
Methods:
Fifteen (*neurotypical*) adults, and fifteen adults with *autism*, diagnosed by a clinical assessment and ADOS, participated in each experiment of this study. The study was approved by an ethics committee. Participants imitated *atypical* and *typical* biological motion. A control stimulus displayed *typical* biological motion where peak velocity occurred at 44% of the movement. This is typical of most "bell-shaped" velocity profiles exhibited during goal-directed aiming. An experimental model displayed *atypical* biological motion where peak velocity occurred at 18% of the movement. Although this peak occurred earlier, it was still achievable, and thus allowed the direct examination of imitation of biological kinematics. In Experiment 1, the stimuli were presented in a fixed predictable trial order (e.g., 30 trials of *atypical* motion, followed by 30 trials of *typical* motion). This order facilitates integration across trials because afferent and efferent sensorimotor information from trial *n* can be processed and integrated during the inter-trial delay, and used to plan trial *n+1*. In Experiments 2 and 3, we disrupted sensorimotor integration using a secondary interference task that was placed in the inter-trial delay (Exp. 2), or by presenting the stimuli in a random unpredictable (Exp. 3) trial order (i.e., 60 trials of *atypical* and *typical* motion randomised).
Results:
Individuals with autism imitated *atypical* biological motion to a similar level of accuracy as matched neurotypical controls ($p > 0.05$), and significantly ($p < 0.01$) different to the *typical* control stimulus. Following the secondary task (Exp. 2), and random trial order (Exp. 3), the autism groups became significantly less accurate than the neurotypical control groups at imitating *atypical* biological motion ($ps < 0.05$). The interference effects resulted in the autism groups exhibiting comparable timing of peak velocity in the *atypical* and *typical* models ($p > 0.05$).
Conclusions:
Poor voluntary imitation in autism, and its underlying sensorimotor aetiology, has received a great deal of attention and is still a matter of controversy. Experiment 1 established robust imitation effects when adults had opportunity to integrate, consolidate and represent atypical biological kinematics in a predictable environment. Experiments 2 and 3 disrupted sensorimotor integration and consequently attenuated imitation fidelity. Rather than there being a core deficit in imitation, the findings indicate intact sensorimotor processing of biological motion in autism when the system has opportunity to repeatedly integrate information.

5 **122.005** Age-Related Differences in Local and Global Processes for Social and Non-Social Information in Autism: How Do Children and Adolescents Differ?

J. Guy[1,2], *J. Mettler*[2,3], *D. Tullo*[2,3], *L. Mottron, M.D.*[4] *and A. Bertone*[2,3,5], *(1)Integrated Program in Neuroscience, McGill University, Montreal, QC, Canada, (2)Perceptual Neuroscience Laboratory for Autism & Development, Montreal, QC, Canada, (3)Educational and Counselling Psychology, McGill University, Montreal, QC, Canada,*

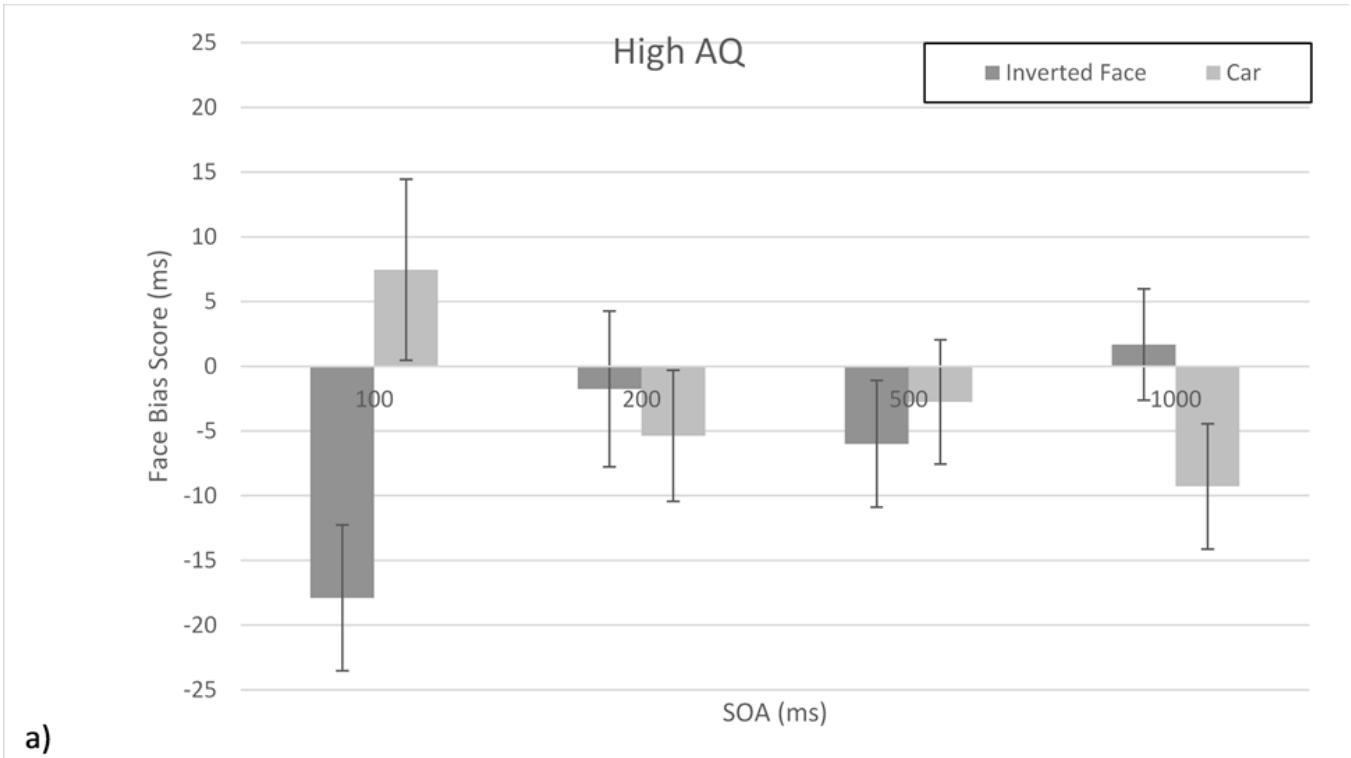
(4)Centre d'Excellence en Troubles Envahissants du Développement, Montréal, QC, Canada, (5)Centre d'excellence en Troubles envahissants du développement, Montréal, QC, Canada

Background: Individuals with autism present both an atypical and distinctive visuo-perceptual profile (Mottron et al., 2006; Bertone et al., 2010). Despite marked social and behavioural impairments, individuals with autism often excel at tasks requiring a local analysis of detailed information and preferentially attend to the constituent parts of a stimulus rather than its whole form. It remains unknown, however, whether a bias for such local analysis is at the origin of other aspects of the social cognitive phenotype in autism, such as facial information processing. Age-related changes in local and global processes are also poorly understood.
Objectives: The goal of this study was to assess age-related differences in local and global visual processing strategies used in social (face identity discrimination task) and non-social (Block Design task) visuo-perceptual tasks in children and adolescents with and without ASD.
Methods: Twenty-eight participants with autism and twenty typically-developing participants were split into child and adolescent age groups (5-11; 12-17 years). All participants performed social and non-social visual perceptual tasks under conditions favouring either a local or global analysis. Both tasks incorporated a simultaneous presentation of a central target and four surrounding choice probes on a touchscreen monitor. In the social task, participants completed a face identity discrimination task wherein they matched identities across varied viewpoints (i.e. front, inverted and view-change). The presentation of faces in the same-view (front or inverted) biased a local analysis, whereas in different views (view-change) biased a global analysis. In the non-social task, participants completed a block design task incorporating puzzle-like designs wherein they identified the correct match to a target design. The puzzles were manipulated in terms of perceptual coherence (PC), with high PC patterns favouring a global analysis and low PC patterns a local analysis. All responses were made with a simple press on the display. Measures of accuracy and reaction time were recorded.
Results: In the social task, children and adolescents with autism were significantly less accurate than typically-developing participants only when matching faces across different views. Interestingly, adolescents with autism responded significantly slower than children with autism in the view-change condition, when access to local information was minimized and a more global analysis was required. In the non-social task, all participants achieved higher accuracy on the high than low PC patterns, and adolescents made significantly more correct responses than children. All participants responded significantly faster to the high than to the low PC patterns.
Conclusions: Our findings illustrate subtle, yet significant differences in social information processing in children and adolescents with autism, specifically when a global analysis is required. However, we found no differences between groups in the local and global processing of non-social information. Strengths in local and/or weaknesses in global processing in ASD may be more apparent in adolescence than in childhood, consistent with other age-related findings (Guy et. al, in press).

6 **122.006** Assessing Temporal and Contextual Factors Affecting Preferential Attention to Faces in Individuals with High and Low Levels of Autistic Traits

***C. I. Mitchell**, C. Dickter and J. Burk, College of William & Mary, Williamsburg, VA*

Background:
Past research on attentional preferential attention to faces (face-bias) in individuals with and without autism spectrum disorder (ASD) shows conflicting results, depending on how long stimuli are presented (the stimulus onset asynchrony (SOA)), and what types of distractor stimuli are used (Bar-Heim et al., 2006; Moore et al., 2012). Inverted faces and face-like objects such as cars are often used as "control" distractor images but there are important perceptual differences between these stimuli that might account for discrepancies in study results (Hadjikhani et al., 2009; Haxby et al., 1999). Finally, as ASD individuals process social stimuli more slowly than individuals without ASD (Dawson et al., 2005), examining face-bias at different SOAs could reveal temporal factors influencing attention to faces in this group.
Objectives:
This study examined preferential attention to faces in a sub-clinical sample of students with different levels of autistic traits using a dot-probe paradigm with four distinct SOAs and two types of distractor stimuli.
Methods:
Participants consisted of 105 undergraduate students (36 males; M_{age}= 19.10), who completed the Autism Quotient (AQ; Baron-Cohen et al., 2001), a self-report measure of autistic behaviors. Each participant completed a dot-probe task to measure attentional bias to probes following a target or distractor stimulus. Faces were target stimuli; cars and inverted faces were distractor stimuli. SOAs of 100ms, 200ms, 500ms, and 1000ms were used. A median split on AQ scores (M=20.26, SD=8.34, Median=21) divided participants into High AQ and Low AQ groups for
Results:
Face-bias scores were created by subtracting the mean reaction time (RT) on distractor-cued trials from the RT on face-cued trials. A 2(Distractor type) x 4(SOA) x 2(AQ group) mixed ANOVA indicated a three-way interaction, $F(3,309)=3.10$, $p=.03$. This interaction was examined separately for the High (Figure 1a) and Low (Figure 1b) AQ groups. There was a significant Distractor type x SOA interaction only for the High AQ group, $F(3,165)=4.29$, $p<.01$. Pairwise comparisons indicated that High AQ participants had significantly lower face bias scores at 100ms in the inverted face condition than in the car condition, $t(55)=2.90$, $p<.01$, but marginally higher face bias scores in the inverted face than the car condition at 1000ms, $t(55)=1.671$, $p=.10$ (see Table 1 for means). Additionally, one-sample t-tests were run for High AQ and Low AQ participants for each Distractor/SOA to identify face-bias scores significantly different from zero. Low AQ participants exhibited marginally positive face-bias scores at 200ms for both car, $t(48)=1.70$, $p=.10$, and inverted face, $t(48)=1.01$, $p=.11$, distractor trials. Conversely, High AQ participants exhibited significantly negative face-bias scores in the car distractor condition at 1000ms, $t(55)=1.97$, $p=.05$, and in the inverted face condition at 100ms,$t(55)=2.85$, $p<.01$.
Conclusions:
These results suggest that individuals who are high in autistic traits show a different temporal pattern of attention to faces depending on what kind of competing stimulus is present, with a trend over time of increasing face-bias for inverted face distractors and decreasing face-bias for car distractors. These results highlight the importance of examining temporal and contextual factors in face-bias studies when drawing conclusions.



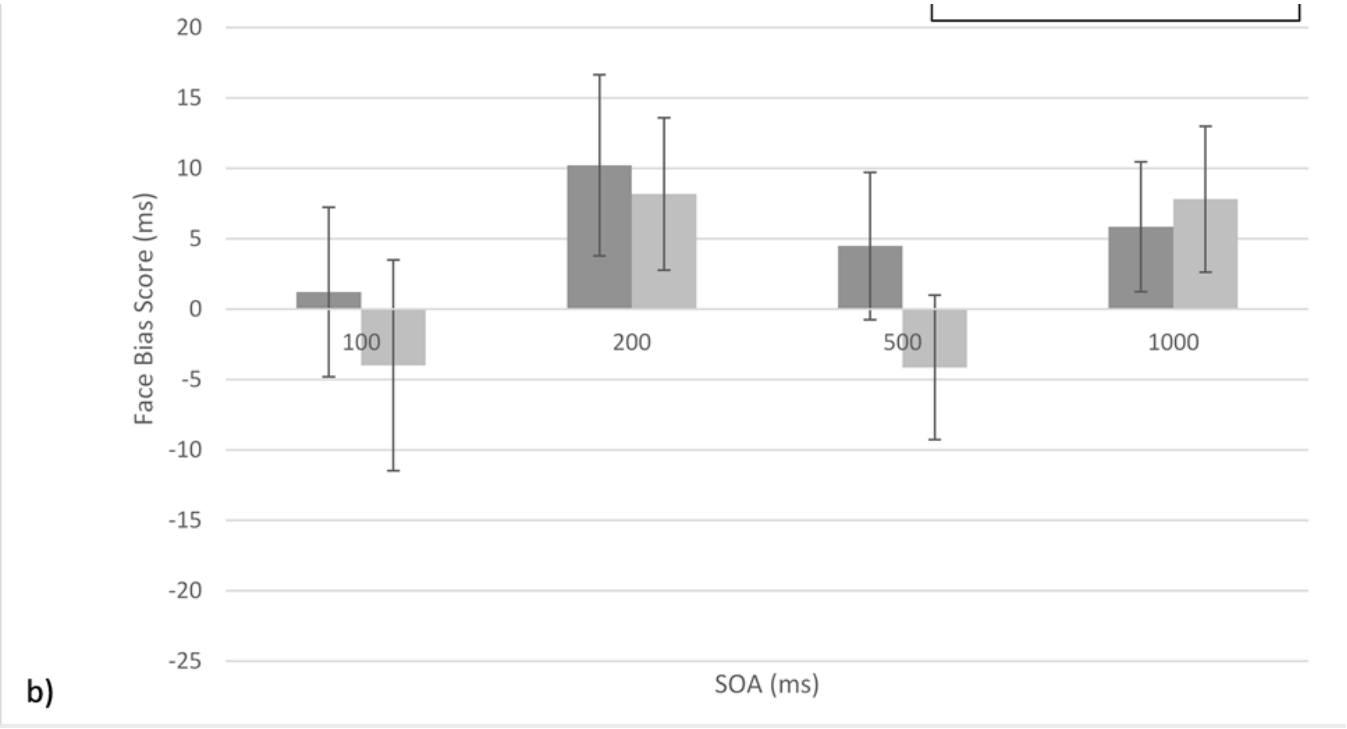


Figure 1. Face-bias scores at each Distractor/SOA condition for a) High AQ participants and b) Low AQ participants. Positive face-bias scores indicate an attentional preference toward faces, face-bias scores of zero indicate no attentional preference to face or distractor stimuli, and negative face-bias scores indicate an attentional preference for the distractor stimulus.

Table 1. Face-bias scores for each AQ Group/Distractor/SOA condition.

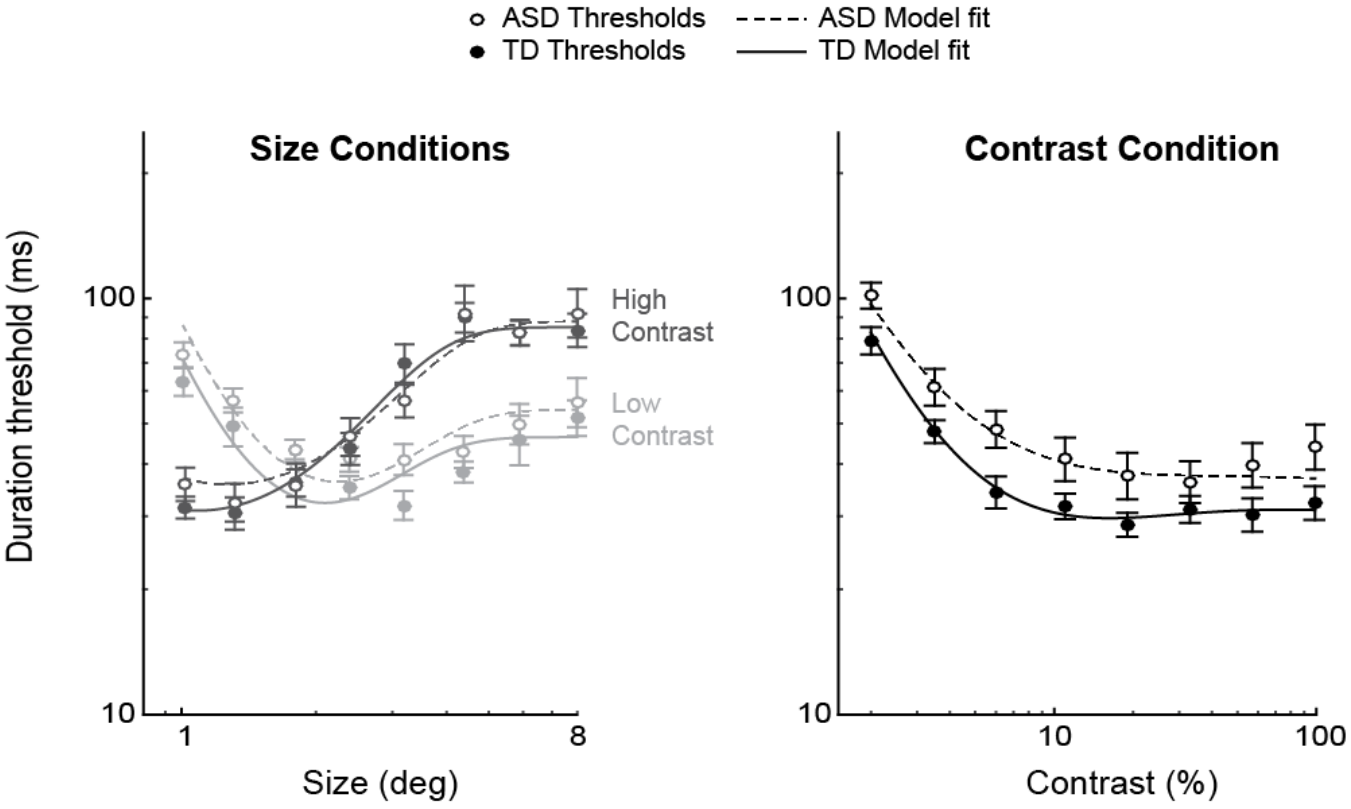
Condition			Face-Bias Scores	
Group	Distractor	SOA (ms)	M	SD
High AQ	Inverted Face	100	-17.90	42.15
		200	-1.74	45.03
		500	-5.99	36.67
		1000	1.68	32.22
	Car	100	7.45	52.35
		200	-5.37	37.89
		500	-2.76	35.94
		1000	-9.28	36.24
Low AQ	Inverted Face	100	1.21	42.15
		200	10.21	45.03
		500	4.48	36.67
		1000	5.85	32.23
	Car	100	-4.00	52.35
		200	8.17	37.88
		500	-4.15	35.94
		1000	7.81	36.25

7 **122.007** Atypical Motion Sensitivity Characterized By Larger Receptive Fields in Autism Spectrum Disorder

W. J. Park[1], *K. B. Schauder*[2], *L. Bennetto*[2] *and D. Tadin*[1], *(1)Brain and Cognitive Sciences, University of Rochester, Rochester, NY, (2)Clinical and Social Sciences in Psychology, University of Rochester, Rochester, NY*

Background: Individuals with autism spectrum disorder (ASD) demonstrate atypical visual processing abilities across a wide range of tasks. However, we still have a limited understanding of mechanisms contributing to such perceptual abnormalities. Recent studies have identified two possible mechanistic explanations: differences in 1) contrast gain control, a mechanism responsible for regulating the amplitude of neural responses in relation to stimulus contrast, and 2) visual receptive field (RF) sizes, which can affect how the brain responds to stimuli of different sizes. Notably, both of these mechanisms are important for maintaining the balance between excitatory and inhibitory (E/I) neural responses. This is of specific interest given growing evidence for E/I imbalance in ASD.
Objectives: To investigate the integrity of contrast gain control and RF size, and their effects on visual motion perception in ASD.
Methods: Participants were 20 children and adolescents with ASD and 20 age- and IQ- matched typically developing (TD) controls. A visual motion discrimination task was employed, where participants judged the motion directions (left or right) of briefly presented moving gratings. Contrast and size of stimuli were manipulated in three

conditions. In two Size conditions, stimulus size varied (1-8 deg in radius) while the contrast was fixed at either low (2.3%) or high (99%) contrast. In the Contrast condition, contrast varied (2-99%) with a fixed stimulus size (1 deg). Duration thresholds (i.e., minimum stimulus duration required to reliably judge motion direction) were estimated to evaluate motion perception. A computational model, based on divisive normalization of E/I responses with parameters representing gain control and RF sizes, was fitted to the thresholds, thus assessing the underlying mechanisms contributing to differences in performance. Group differences in thresholds were assessed using a Mixed Model ANOVA, and a non-parametric bootstrap analysis was used to compare the model parameters between groups.
Results: Individuals with ASD had higher thresholds (worse performance) across all contrast levels in the Contrast condition ($F(1,38) = 5.49$, $p < 0.05$). No significant group differences in thresholds were observed in either of the Size conditions (p's > 0.05), but there was a trend for higher thresholds overall in the Low-contrast Size condition, and for the smallest size in the High-contrast Size condition in ASD. The model analysis revealed this pattern of results can be explained by a significantly larger excitatory RFs in ASD compared to TD ($p< 0.05$).
Conclusions: Our threshold results reveal decreased perceptual sensitivity to motion directions in ASD for small stimuli across all contrast levels. This motion perception difference was best explained by larger size of excitatory RF in ASD, consistent with a previous fMRI study showing larger population RFs in ASD (Schwarzkopf et al., 2014). Our findings suggest that differences in RF sizes may disrupt the E/I balance in ASD; reduction in excitatory responses to stimuli smaller than the RF size may lead to changes in the E/I response ratio and perceptual sensitivities to stimuli with different sizes. Future studies can further investigate the association between RF size differences and other behavioral and sensory symptoms of ASD.



8 **122.008** Auditory Spatial Attention and Symptom Severity in Children with Autism Spectrum Disorder

L. N. Soskey[1], *P. D. Allen*[2] *and L. Bennetto*[1], *(1)Clinical and Social Sciences in Psychology, University of Rochester, Rochester, NY, (2)Department of Otolaryngology, University of Rochester Medical Center, Rochester, NY*

Background: One of the earliest observable impairments in autism spectrum disorder (ASD) is a failure to orient to speech and other social stimuli. Auditory spatial attention, a key component of orienting to sounds in the environment, is likely to play a critical role in the early development of social communication skills and social functioning throughout the lifespan. In fact, auditory spatial attention has already been shown to be impaired in adults with ASD, but has not yet been characterized in children with ASD or linked to core ASD symptoms.
Objectives: We aimed to characterize auditory spatial attention in children with ASD and neurotypical peers. Our secondary goal was to explore the relationship between auditory spatial attention abilities and core behavioral symptoms of ASD.
Methods: Sixteen rigorously diagnosed (ADOS, ADI-R) children and adolescents (ages 10-17) with ASD and 18 neurotypical age- and IQ-matched peers participated in this study. In the spatial attention task, target and distractor sounds were played randomly in rapid succession from six speakers in a free-field array. Subjects attended to a speaker directly in front of them, and were instructed to respond to target sounds at the attended location while ignoring sounds from adjacent speaker locations. The spatial attention gradient was characterized using the proportion of subjects' responses to target sounds at attended vs. adjacent speakers, using *d'* as a measure of spatial attention. Well validated parent report measures provided information regarding current ASD symptom severity, as well as a characterization of attention deficit hyperactivity disorder (ADHD) symptoms.
Results: Children with ASD had significantly more diffuse auditory spatial attention compared to neurotypical children (F=8.94, p=.005, partial eta-squared =.22). While both groups had equal accuracy in detecting the target sound, children in the ASD group had significantly increased responding to sounds at adjacent non-target locations. Due to the magnitude of the group difference in spatial attention, correlational analyses were conducted separately by group. Within the ASD group, more diffuse auditory spatial attention was significantly associated with greater ASD symptom severity (r=.675, p=.01). In contrast, diffusion of auditory spatial attention was not related to ADHD attention symptom severity (r=.310, p=.33) or age (r=.311, p=.24). Spatial attention was not significantly associated with ASD symptoms, ADHD symptoms, or age in the neurotypical group.
Conclusions: Auditory spatial attention was significantly more diffuse in children with ASD than their neurotypical peers, primarily due to difficulty ignoring nearby competing sounds. In the children with ASD, those with more diffuse auditory spatial attention had greater ASD symptom severity. Importantly, spatial attention abilities were not significantly related to ADHD attention symptoms in this population, providing further evidence that auditory spatial attention abilities may be uniquely associated with the development of ASD symptoms. It will be crucial for future research to examine the early development of auditory spatial attention and its role in the development of social communication differences in ASD.

9 **122.009** Childhood Profiles of Cognitively Gifted Individuals with Autism Spectrum Disorder

J. Gilger[1], *J. Kaboski*[2] *and M. Cain*[3], *(1)School of Social Sciences, Humanities & Arts, University of California - Merced, Merced, CA, (2)University of Notre Dame, Notre Dame, IN, (3)Psychology, University of Notre Dame, South Bend, IN*

Background: Historically, cognitive giftedness and autism spectrum disorder (ASD) were considered mutually exclusive. As a result, there is only a dearth of knowledge regarding those who display this unlikely combination of giftedness and ASD. Previous studies on cognitive giftedness and ASD relied mostly on case studies with small nonrandom samples. A number of prominent researchers in the field have noted this serious lack in the literature and recommended longitudinal research with larger samples (e.g., Foley-Nicpon et al., 2011).
Objectives: This study was designed to accurately describe the children who are identified as having both giftedness and ASD in terms of their prevalence, demographics, characteristics of schools attended, and patterns of school services utilized. In order to understand how their academic performance may fluctuate over time, we also plotted academic trajectories as they moved from preschool through adolescence. The results were juxtaposed against the rest of the ASD sample.
Methods: Secondary data analysis was conducted on PEELS (Pre-Elementary Education Longitudinal Study) and SEELS (Special Education Elementary Longitudinal

Study). When combined, these datasets comprise nationally representative samples of children ages 3 through 16 who received special education services. The sample for this study was reduced to those with the primary diagnosis of ASD (n=1642). In this study, an individual was categorized as "gifted" if he/she: (1) scored above 90th percentile on any of the subtests on the Woodcock Johnson III achievement test; or (2) qualified for gifted/talented programs offered by the students' school[1]. Single proportion results were compared using an independent samples proportion test comparing gifted to non-gifted participants. Childhood trajectories were obtained by fitting children's achievement test results over five waves of PEELS and SEELS to a multilevel model using linear and quadratic trends of age as random effects, and giftedness as a level-2 predictor for all random effects.

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[1] These criteria are consistent with the conceptualization of giftedness often found in other studies.

Results: 263 (16%) of individuals with ASD could be categorized as gifted in at least one academic subject. When gifted children were compared to their non-gifted counterparts, statistically significant differences emerged in many dimensions: the gifted subsample had more females, more racially white, higher maternal education, and higher family income. Speech therapy was the most utilized school services for both groups. In general, the gifted group tended to use more school services compared to those who are not gifted. In terms of academic trajectories, there was a significant initial difference between the two groups and there was no significant change in academic performance over time in either group.

Conclusions: The results suggest that gifted students come from a more privileged background than their non-gifted counterparts. They also used more school services than the rest of the ASD population. This may be a reflection of their parents' more effective advocacy and influence rather than the actual need for more services. Further inferential analysis is needed in order to establish causality.

Table 1. Comparison of Sample Characteristics: ASD Gifted vs. ASD Not-Gifted

	Gifted N=204	Not-Gifted N=996	*Z, t or* X^2
Gender: Female	21%	16%	1.73**
Race: White	79%	56%	41.78**
Black	6%	19%	
Hispanic	9%	19%	
Other/Multi	6%	6%	
Mother has B.A./B.S.	66%	37%	7.61**
Income Less than $50,000	25%	49%	-6.30**
Mental Functioning (Range 4-16, higher better)	13.5	11.0	
Living Skills (Range 1-4, lower better)	2.0	2.0	
Classroom Behavior (Range 1-4, higher better)	2.5	2.5	
Adequate Insurance	77%	81%	
Social work services used	20%	14%	
Mental health services used	33%	28%	
Speech therapy used	80%	85%	
Occupational therapy used	68%	58%	
Physical therapy used	15%	18%	
Personal assistant in classroom	55%	45%	
Assistive technology used	36%	45%	
Tutoring or learning strategy services	66%	62%	

Note: *$p < .05$, **$p < .01$.

10 **122.010** Cognitive Remediation Therapy in Autism Spectrum Disorder: Effects on Working Memory

***M. Hajri**, Z. Abbes, H. Ben Yahia, S. Ouenness, S. Halayem and A. Bouden, psychiatric hospital Razi, Tunis, Tunisia*

Background: Cognitive impairment, especially executive dysfunction has been linked to a number of developmental disorders, including Autism Spectrum Disorder (ASD). Cognitive Remediation Therapy (CRT) is a novel rehabilitation method that aims to produce improvement in cognitive processes. CRT has been used in patients with schizophrenia.

Objectives:

we aimed in this study to examine the effectiveness of CRT for improving working memory and clinical symptoms in children with ASD.

Methods: Children meeting the Diagnostic and Statistical Manual for Mental Disorders (DSM-5) criteria for ASD were recruited from clinical population at the Child and Adolescent Psychiatry Department in Razi University Hospital – Manouba - Tunisia. The CRT program was conducted at the rate of one session per week of 45 minutes each. The main outcomes measures are working memory, assessed by forward and backward digit span, and clinical symptoms assessed by Childhood Autism Rating Scale (CARS). These outcomes were measured at baseline and one week after completion of the treatment.

Results:

Of the 25 patients included, 16 achieved assessments tests after CRT, thus constituting our final sample. Their average age was 10.87 years. The mean number of sessions performed was 22.38. After completion of CRT, patients showed significant improvement (p=0.001) on forward digit span which score was 3.38 before CRT and 4 after

completion of the program. Concerning backward digit-span, the mean score increased from 2.21 before CRT to 3.09 after it. This improvement was significant (p=0.006). As for clinical symptoms, lower scores (26.81) were found after CRT in comparison with baseline mean scores (27.87). This improvement was also significant (p=0.001).
Conclusions:
Our study showed evidence that CRT can yield positive effects in cognitive performance and clinical symptoms, but it is not known whether these effects are sustainable. The durability of cognitive and clinical benefits obtained from neurocognitive treatment should be investigated in further studies.

11 **122.011** Comparison and Structural Alignment Processes of Learning New Relational Concepts in Children with ASD

O. E. Hetzroni *and M. Hessler, Special Education, University of Haifa, Haifa, Israel*

Background:
Structural Mapping Theory (SMT) uses multiple comparisons for creating a map of structural similarities between different structures of knowledge, with low (perceptual) and high (conceptual) levels to enable efficient learning and reasoning processes. In terms of SMT, individuals with ASD often find it difficult to deal with tasks that require the creation of structural similarity based on deep internal connections.
Objectives:
This study used SMT to examine learning patterns of individuals with high functioning ASD (HFASD) to investigate structural mapping processes that occur during acquisition of new relational concepts (using comparisons and familiarity) among children with HFASD, compared to children with typical development (TD) and children with intellectual and developmental disabilities (IDD).
Methods:
Participants included 24 children with IDD (ages 8-16), 24 children with HFASD (ages 5-8), and 24 children with TD (ages 5-6), all matched in receptive mental language age. A computerized task included 13 sets of graphic illustrations of familiar, partly familiar and unknown items that were presented in novel spatial configurations with and without comparison to the standards; first with a presentation of one standard (no comparison), followed by a presentation of two standards (with comparison). The children heard a label for a standard followed by a request to extend this label to one of two alternatives: one that shared an item with the standard and another that shared relational configuration.
Results:
When one standard was available (no comparison), participants from all three groups demonstrated a preference style for extending concepts by matching to items (perceptual categorization) rather than to relational structures (conceptual categorization). However, when presented with two standards (with comparison), children with TD and IDD demonstrated significant increase in their tendency for matching based on relational concepts, while participants with HFASD did not change their preference and continued selection based on item matching. When presented with familiar and partially familiar stimuli, there was a significant increase in selection of relational concepts for children with TD and IDD in the comparison condition, with no difference for children with HFASD.
Conclusions:
Results demonstrate that children IDD and TD were able to benefit from comparisons in learning new relational concepts presented to them as graphic illustrations and used structural mapping processes to highlight common features for creating new relational concepts. However, children with HFASD did not benefit from the opportunity to compare between the graphic representations. Thus, children with HFASD continued to base their preferences on perceptual characteristics even in the comparison conditions. Moreover, in contrast to children with TD and IDD, who benefited from the opportunity given to them to apply existing knowledge for creating conceptual categories, children with HFASD demonstrated a similar trend regardless of the level of familiarity.
In this, individuals with HFASD were characterized by atypical activity of the structural mapping processing, demonstrating a tendency to perceptual categorization in the process of concept acquisition, without producing significant benefits from the opportunity to compare different knowledge structures and / or use existing knowledge structures, for a comprehensive analysis of the connections between structures.

12 **122.012** Concept Identification and Formation in High-Functioning Adolescents with ASD

J. Beck[1]*, J. Shapleton*[2]*, M. South*[1] *and M. Solomon*[3]*, (1)Brigham Young University, Provo, UT, (2)Duke University, Durham, NC, (3)MIND Institute, Sacramento, CA*

Background: Abstraction refers to the ability to find common features across different stimuli. *Concept identification* involves recognizing patterns of features created by an external agent. *Concept formation* is more difficult, requiring independent creation of schemata to organize information. Impairments in concept identification and formation are theorized to underlie a variety of practical difficulties of individuals with ASD (e.g., failure to generalize learning in one context to a similar, but new context). However, past research has yielded mixed results, with some finding significant impairment and others finding intact concept identification and formation. Contradictory findings may be due to differences in assessment methodology. For example, studies utilizing strictly perceptual tasks likely minimized impairment in ASD, while studies using strictly verbal tasks likely exaggerated impairment.
Objectives: We sought to use a single task that would allow the evaluation of (1) concept *formation* relative to concept *identification*, and (2) *verbal* concept formation and identification relative to *perceptual* concept formation and identification. Also, we sought to explore (3) the relationship between concept identification and formation and autism symptomatology. We hypothesized that (1) we would replicate previous findings of intact concept identification but impaired concept formation in ASD (Minshew et al., 2002); (2) impaired concept formation would be more notable on verbal tasks; and (3) worse impairments would be associated with more severe autism symptoms.
Methods: The sample consisted of 27 high-functioning (FIQ > 80) adolescents with ASD and 27 age (*M* 14.8 years)- and FIQ (*M* 102.8)-matched typically-developing controls. Concept formation and identification abilities were assessed using the Delis-Kaplan Executive Function System (D-KEFS) Card Sorting task. One-way ANOVAs explored group differences on task performance variables. Partial correlations explored the relationship between task performance and autism symptomatology measured using the Social Responsiveness Scale (SRS-2). Given the significant correlation between FIQ and every measure of task performance, FIQ was entered as a covariate in all analyses.
Results: Controlling for FIQ, (1) there was no group difference on tasks requiring concept identification (Sort Recognition; assessor sorts cards); however, there was a small significant effect of group on concept formation tasks (Free Sort; participant sorts carts) ($F(1,51) = 4.218$, $p = .045$, $\eta^2 = .02$), with the ASD group exhibiting worse performance; (2) there was no group difference on verbal or perceptual tasks of concept identification and formation; and (3) SRS-2 Total scores (higher scores indicate more severe autism symptoms) were associated with concept formation ($r(54) = -.31$, $p < .05$), but not concept identification ($r(54) = -.20$, $p = .15$).
Conclusions: Our findings add to a growing body of research showing a dissociation between concept identification and concept formation in ASD. This dissociation, which existed after covarying FIQ, suggests that concept formation deficits may underlie impairments across levels of cognitive functioning in ASD. While previous research demonstrated that a combined measure of concept identification and formation was correlated with autism symptom severity (McLean et al., 2014), our finding that autism symptoms are significantly associated with *only* concept formation further strengthens the theoretical significance of concept formation deficits in ASD.

13 **122.013** Differentiating Old from New-but-Similar: Tracking Episodic Memory Profiles in Children with Autism

H. N. Wakeman[1]*, M. Rosenberg-Lee*[1]*, M. South*[2]*, B. Kirwan*[2] *and V. Menon*[1]*, (1)Stanford University School of Medicine, Stanford, CA, (2)Brigham Young University, Provo, UT*

Background:
Autism spectrum disorders (ASD) are marked by an uneven profile of memory performance; with reports of selective deficits in episodic memory, yet intact semantic memory (Shalom, 2003). A key feature of successful episodic memory is distinguishing old experiences from similar but distinct new ones, a task thought to require hippocampal pattern separation (Kirwan et al., 2012). Previous research finds that adults with ASD struggle to correctly differentiate previously seen stimuli from similar yet distinct distractors (i.e. lures), instead tending to label lures as new (South et al., 2015). Little is known about this crucial memory capacity in children with autism.
Objectives:
In this study, we sought to characterize the ability of children with ASD to distinguish old from new-but-similar items, in multiple contexts.
Methods:
16 children with autism ages 8-11 and 13 age-, IQ-, and gender- matched TD peers completed the Behavioral Pattern Separation Object (BPS-O) and NEPSY-II Memory for Designs Delayed (MDD) tasks. The BPS-O is a modified visual object recognition task where items are identified as “old” (i.e. previously seen stimuli), “new” (i.e. stimuli not previously seen in the context of the experiment) or “similar” (i.e. lures that are similar but not identical to previously presented stimuli). MDD is a standardized spatial memory task, where participants distinguish between target and distractor designs to recreate a layout of 10 abstract designs after a delay.
Results:
On the BPS-O, children with ASD were less likely to correctly identify lures than TDs (p=0.019), and more likely to call lures “new” (p=.007). While children with ASD demonstrated unimpaired spatial location performance (p=0.251), they were more likely to incorrectly select distractors on the MDD task than TDs (p=0.039). Among children with ASD, the number of distractors selected in MDD correlated with performance on BPS-O lure identification, with increased selection of distractors related to lower performance identifying lures (r=-.57, p=.021). This same correlation was not observed in TD children (r=-.23, p=.449).
Conclusions:
Consistent with studies of adults on the spectrum, our results suggest that difficulty differentiating between old and new-but-similar items may be a hallmark of memory impairments in children with ASD. Crucially, spatial memory was intact in children with ASD, indicating that not all forms of episodic memory are impaired in this group. Further, the unique relationship between two distinct measures of lure detection suggests a common origin for this capacity among children with autism, potentially relating to

hippocampal functioning.

14 **122.014** Do Individuals Diagnosed with Autism Spectrum Disorders Have an Advantage in Real-World Visual Search Tasks?

***N. C. Russell**, K. G. Stephenson, T. Shuman, A. Ward, L. Peacock, M. South and S. Luke, Brigham Young University, Provo, UT*

Background: People diagnosed with Autism Spectrum Disorders (ASD) often perform better than typically developing (TD) individuals in lab-based visual search tasks. This ability is often attributed to superior bottom-up processing (an ability to discriminate between a target and distractors, related to weak central coherence). However, research has also suggested that individuals with ASD show difficulties with top-down processing (integrating contextually relevant information to aid search), which may cause problems in real-world situations. Little is known about whether these differences in the performance of individuals with ASD are also represented in more ecologically valid visual searches and how this might influence their everyday functioning.
Objectives: We report findings from a real-world scene search study to compare ASD, TD, and Anxious control (ANX) participants. We used eye tracking data to the record the task performance and search strategy for contextual and non-contextual targets.
Methods: Twenty-five individuals with ASD, 27 TD individuals, and 28 ANX individuals completed two simple visual search tasks. For both tasks, participants had to find a named object within a real-world scene. In one task, objects were located in contextually-relevant locations; in the other task, the objects were superimposed upon the picture in a non-relevant position. Each participant completed 41 trials in each condition, each with a unique scene. Eye movements were recorded using an SR Research EyeLink 1000 eyetracker.
Results: All groups performed better in the contextual target condition than the non-contextual condition. In the non-contextual search, the ASD group were less accurate than the other two groups. However, preliminary analyses indicate that this difference was not significant. For the contextual search, the ASD group were also less accurate. Group means were significantly different with the ASD group being lower than the other two groups. Reaction time (RT) data suggest that the ASD group were also significantly slower than the TD and ANX groups in both conditions.
Conclusions: Our preliminary results suggest that a previously proposed advantage for ASD in locating targets without contextual information may be lost when these targets are contained within real-world scenes. Our ASD group appears to benefit less than both typical and anxious comparison groups, when targets are contextually relevant to these scenes. Previous research has also suggested that ASD groups may perform faster in some visual search tasks. However, these RT data suggest that, even though their accuracy was comparable to TD and ANX individuals when finding the non-contextual targets, they took longer to do so. This suggests that the presence of complex real-world information, whether related to the target they are searching for or not, may interfere with simple visual search and increase difficulty in navigating daily physical and social interactions.

15 **122.015** Examining the Complex Experiences of Parents of Gifted Students with Autism Spectrum Disorder

***L. D. Rubenstein**[1] and S. M. Wilczynski[2], (1)Educational Psychology, Ball State University, Muncie, IN, (2)Ball State University, Muncie, IN*

Background: Parents of students on the autism spectrum often experience higher levels of stress than both parents of typically developing children and parents of students with other disabilities. This stress can lead to fatigue, strained relationships, and increased levels of anxiety and depression. Understanding and promoting parents' psychological well-being is essential not only for the parents themselves, but also because they significantly affect their children's ability to be successful in school and form stable relationships. While several studies have examined parents of students on the spectrum, little is known about parents of intellectually gifted students on the spectrum.
Objectives: This study aimed to address this gap, guided by the research question, "What are the lived experiences of parents of gifted students on the spectrum?" The research team used a phenomenological, qualitative design to capture both the nuances of each parent's experiences and the common themes across experiences.
Methods: The research team recruited participants through a twice-exceptional website, and interested parents contacted the researchers. Thirteen parents participated from across the United States and Australia. All parents had students who were both identified as gifted and diagnosed on the spectrum. Researchers used an interview protocol to guide interview sessions. Interviews were recorded, transcribed, and analyzed using an iterative coding approach with two researchers. Following the first analysis, the parents were provided copies of the findings and given the opportunity to review and comment, thereby adding trustworthiness to the data through the use of a member checks/respondent validation.
Results: Parents' experiences illustrated the complexity of raising gifted students on the spectrum. First, parents wrestled with the identification/diagnosis process. Receiving the labels caused many emotions, ranging from relief to devastation. Because of the extreme asynchronous development within many of these students, some parent's spouses or family members did not accept the label, causing social conflicts. Beyond the label, parents also struggled to find appropriate educational opportunities for their children. Either schools would meet students' social needs with specialized autism support, or schools would address students' cognitive needs with enrichment opportunities. Rarely, however, were schools equipped to address both, so parents worked tirelessly to advocate for their children. Additionally, many parents discussed alienation and judgment from peers, teachers, family, or even strangers. Their children were asked to leave playgroups or schools, and the parents worried their children's behavior reflected the parents. Finally, the parents also recognized the joy that accompanies raising such unique children. They enjoyed their children's interests, sense of humor, and often, logical view of the world.
Conclusions: This study provides unique insight into the lived experiences of parents of gifted students on the spectrum. While they share some experiences with other parents of students with exceptionalities, they also face additional challenges, including advocating for services, explaining their child's asynchronous development to others, and finding a support system for themselves. The results of this study have the potential to promote empathy from outside individuals and to encourage other parents with gifted students on the spectrum that they are not alone.

16 **122.016** Examining the Executive Function Profile of Children with Autism, Autism Plus Significant Symptoms of Attention Deficit Disorder, and Typical Development

***S. Faja**[1], G. Greco[2] and T. Clarkson[3], (1)Boston Children's Hospital/Harvard Medical School, Boston, MA, (2)Boston Children's Hospital, Boston, MA, (3)Boston Children's Hospital: Harvard Med School, Boston, MA*

Background: Attention deficit/hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) are very common early onset neurodevelopmental disabilities. ADHD co-occurs in 28-53% of children with ASD (Sinzig et al., 2009, Simonoff et al., 2008; Leyfer et al., 2006). Executive function (EF), or the ability to manage complex or conflicting information in the service of a goal, is significantly impaired in both ASD and ADHD. EF encompasses inhibition, shifting and working memory by mid childhood. Executive function impairments are particularly problematic because poor EF is related to: (1) lower academic performance, and (2) higher rates of aggression and disruptive behavior. In 2013, the DSM-5 first permitted the dual diagnosis of ASD and ADHD. As a result, there is relatively little information about the behavioral profiles of children with both disorders in contrast to ASD alone.
Objectives: To examine the executive function profile of 7 to 11-year-old children with ASD, ASD+ADHD and typical development.
Methods: To date, participants include 20 children with ASD, 8 children with ASD+ADHD and 33 children with typical development (TD) all between 7-11 years of age. Enrollment of children with ASD is ongoing. ASD was confirmed via the ADOS-2 and ADI-R. Symptoms of ADHD were measured via the Child Behavior Checklist (CBCL). The three groups did not differ on age, sex, verbal IQ, or performance IQ. Executive function was measured by four separate tasks, each completed using a laptop computer: The Color-Word Stroop and the Child ANT Flanker Task measured inhibition of interfering information, the Change Task assessed inhibition of responses and set-shifting, and the Backward Digit Span Task examined verbal working memory skills.
Results: For the two measures of inhibition that involved suppressing interfering information (Stroop and Flanker), the overall effect of group approached significance (ps=.06). The groups significantly differed on the inhibitory measure that required suppression of a dominant response (Change Task), $F(2,53)=7.96$, p=.001 (ASD+ADHD < ASD, TD). Shifting (Change Task) also differed by group, $F(2,54)=5.23$, p=.008 (ASD < ASD+ADHD, TD). Finally, groups differed in verbal working memory skills, $F(2,58)=5.57$, p=.006 (ASD+ADHD < ASD, TD).
Conclusions: We found that children with ASD+ADHD were distinguished from children with TD and ASD alone using a behavioral battery of EF tasks by measures of inhibition of dominant responses and working memory. Children with ASD were distinguished by a measure of shifting. Results suggest that the type of inhibitory task demands may be particularly informative in distinguishing children with ASD from children who have both ASD and ADHD. Additionally, results suggest that other EF domains such as working memory and shifting contribute to the unique profile of ASD versus ASD+ADHD.

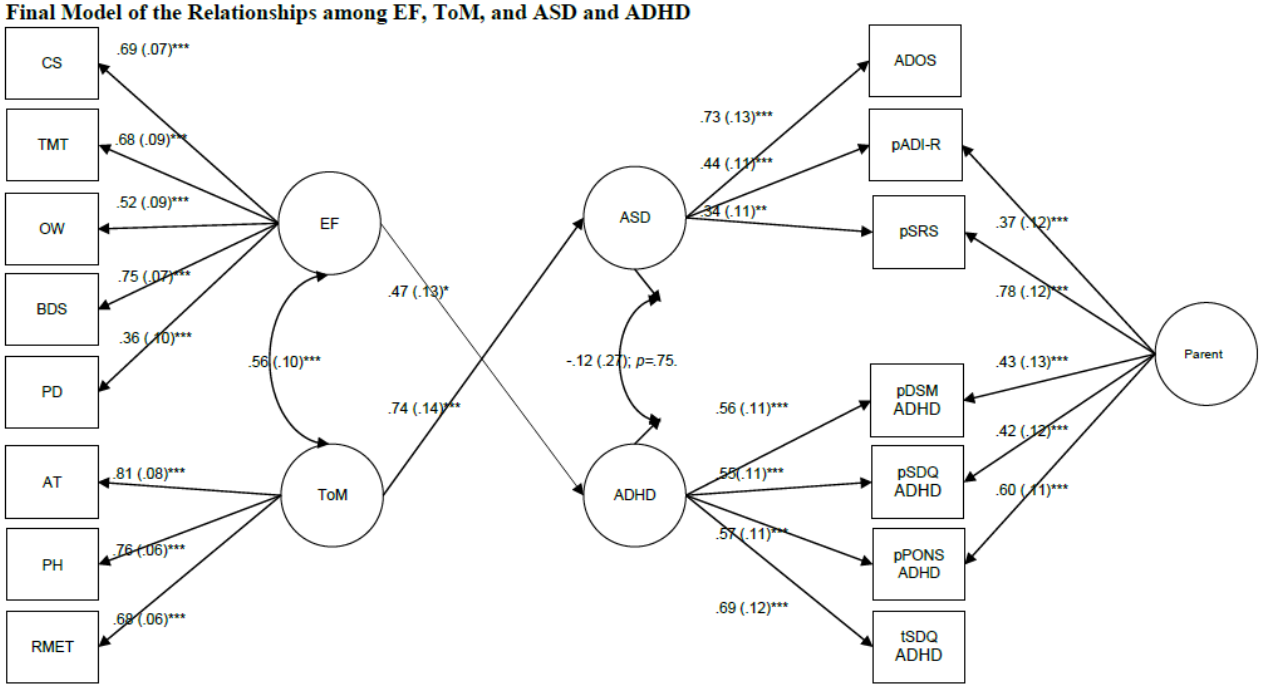
17 **122.017** Executive Function Deficits Are Associated with ADHD Symptoms Whilst Theory of Mind Is Associated with ASD Symptoms in Adolescents with ASD

***S. Lukito**[1], C. Jones[2], A. Pickles[3], G. Baird[4], F. Happé[5], T. Charman[6] and E. Simonoff[6], (1)Child & Adolescent Psychiatry, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (2)School of Psychology, Cardiff University, Cardiff, United Kingdom, (3)Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (4)Guy's and St Thomas' NHS Foundation Trust, London, United Kingdom, (5)Social Genetic and Developmental Psychiatry, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (6)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom*

Background: Individuals with autism spectrum disorder (ASD) have high levels of attention-deficits/ hyperactivity disorder (ADHD) symptoms, although the reasons for this are unknown. ASD is often linked to deficits of theory of mind (ToM), i.e., the ability to mentalise or understand others' mind; and of executive functions (EF), i.e., the capacity for self-control. In contrast, ADHD has been associated with impairments of EF, and to a lesser extent, ToM. The relationships among these factors in the ASD population are the focus of this study.

Objectives: We build a working model of the associations among EF, ToM and symptoms of ASD and ADHD in adolescents with ASD.
Methods: We investigated a population-based cohort of 100 adolescents with ASD (the Special Needs and Autism Project – SNAP), aged 14-16 years and full scale IQ≥50. Structural equation modelling was used to model the relationships between EF, ToM and ASD or ADHD symptom levels. Measures of inhibition (TEA-Ch Opposite Worlds), planning (drawing task), switching (Trail Making Test and card sorting task), and working memory (Backward Digit Span) indexed EF; while measures of mentalising (the Frith-Happe Animated Triangles, Strange Stories, Reading the Mind in the Eyes) indexed ToM. All neurocognitive assessments took place at 14-16 years. ADHD symptoms were indexed by the parent-rated Strengths and Difficulties Questionnaire (SDQ) hyperactivity subscale (14-16 years) and teacher-ratings of SDQ (10-12 years), parent-rated Profile of Neuropsychiatric Symptoms (PONS) ADHD (14-16 years), and DSM-IV ADHD symptom counts from structured diagnostic interviews with parents (10-14 years). ASD symptoms were indexed by the algorithm scores of Autism Diagnostic Interview-Revised (ADI-R) and Autism Diagnostic Observation Schedule (ADOS), both from 10-12 years, and the parent-reported Social Responsiveness Scale (SRS) from 14-16 years. To account for shared sources of information, a parental-rating latent factor was constructed using a subset of the ASD and ADHD symptom measures (ADI-R, SRS, parent-rated SDQ, PONS, and ADHD symptom counts).
Results: The final model reached acceptable fit ($\chi^2[81] = 101.7$, $p = .06$; CFI = .94; TLI = .92; RMSEA = .051). EF deficits were associated with ADHD symptoms (standardized coefficient = .47), and not with ASD symptoms, while ToM deficits were associated only with ASD symptoms (standardized coefficient = .74). The EF and ToM latent factors were significantly correlated (standardized coefficient = .56). Prior to including a parent rating factor, a significant correlation was found between ASD and ADHD symptoms (standardized coefficient = .63). However, this model had an overall poorer fit than the present and the correlation between the ADHD and ASD factors became non-significant after including the parent rating factor, which suggests that the association between the two symptom domains was due to a shared parental rating effect.
Conclusions: ADHD symptoms in individuals with ASD are specifically associated with EF deficits. This is consistent with the finding of EF deficits in those with ADHD alone. Our findings would benefit from replication in samples of individuals with pure ASD, ADHD and combined ASD-ADHD profiles to better understand whether this represents a shared underlying factor for observed co-occurrence.

Final Model of the Relationships among EF, ToM, and ASD and ADHD



Note: Abbreviations of neurocognitive measures: CS = Cardsort, TMT = Trail-making, OW = Opposite worlds, BDS = Backward Digit Span, PD = Planning/drawing task, AT = animated triangle, PH= Penny Hiding, RMET=Reading the Mind in the Eye Tasks, EF=Executive Function, ToM=Theory of Mind. Abbreviations for ASD or ADHD measures: ADOS =Autism Diagnostic Observation Schedule Total Score, ADI-R=Autism Diagnostic Interview-Revised, SRS=Social Responsiveness Scale, DSM = Diagnostic and Statistical Manual of Mental Disorders symptom numbers, SDQ ADHD=Strengths and Difficulties Questionnaire ADHD domain, PONS ADHD=Profile of Neuropsychiatric Symptoms ADHD domain. The prefix p on these behavioural measures indicates parent-based reports whereas the prefix t on the SDQ indicates a teacher-based report. Adding the latent factor Parent isolates the parental-reporting effect resulting in increased loadings of ADOS on the ASD factor and tSDQ ADHD on the ADHD factor. Significant levels * $p < .05$, ** $p < .01$, and *** $p < .001$

18 **122.018** Executive Function in Autism: A Systematic Review and Meta-Analysis

A. M. Nader[1], *V. D. Therien*[2], *M. E. Leclerc*[3], *Z. Khalladi*[4], *S. Grot*[5], *D. Luck*[6] *and I. Soulières*[7], *(1)Psychology, University of Quebec at Montreal, Montreal, QC, Canada, (2)Psychology, University du Québec à Montréal (UQAM), Terrebonne, QC, Canada, (3)Centre de recherche de l'Institut universitaire en santé mentale de Montréal, Montréal, QC, Canada, (4)Bishop University, Montreal, QC, Canada, (5)Centre de recherche de l'Institut universitaire en santé mentale de Montréal, 7331, rue Hochelaga, QC, Canada, (6)Psychiatry, University of Montreal, Montréal, QC, Canada, (7)University of Quebec in Montreal, Montreal, QC, Canada*

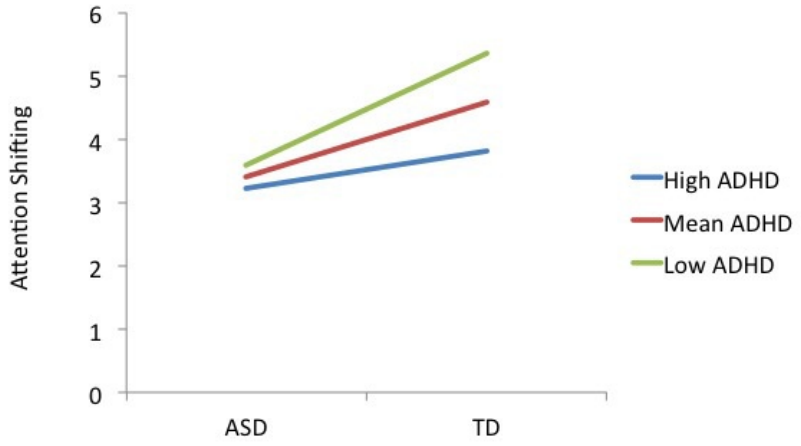
Background: Executive function (EF) is an umbrella term for functions such as working memory, impulse control, planning, mental flexibility and fluency. Deficits in EF are common in autism but not present in all individuals. Numerous studies investigated EF among the spectrum but have yielded varying findings according to the age of the participants and the type of task used (Hill, 2004). Some studies revealed global deficits in overall functions, some more specifically in planning and flexibility (Ozonoff et al., 1999) while some indicated no difference with typically developing (TD) individuals (Russell, 1999). Furthermore, greater deficits seem present in children compared to adults (Happé, 2006). The nature of EF difficulties in autism remains unclear due to an important heterogeneity among previous results and the lack of systematic review.
Objectives: The main goal of this meta-analysis was to determine the pattern and magnitude of executive deficits in autism spectrum disorder.
Methods: A systematic literature search was performed (PubMed, PsycINFO; 1970-2015) using key word such as “autism”, “ASD”, “PDD”, “Asperger”, “working memory” and “executive function”. A total of 1770 studies were identified. 100 cognitive behavioural studies met the inclusion criteria (presence of an age and IQ-matched control group; FSIQ≥70; use of standardized test), involving 2706 ASD and 2778 typically developed (TD) individuals. Results were analyzed with comprehensive meta-analysis software according to the different executive functions (inhibition, flexibility, planning / organization, fluency and working memory) for ASD and TD individuals. Effect sizes were calculated (Cohen’s *d*, standardized mean difference) for each executive function and supplementary analysis were computed for each type of measure and more recurrent test used.
Results: Analyzes showed inferior results for autistic individuals, relative to TD individuals, in all areas of executive functions ($d = 0.25$ to 0.54; all $p \leq .001$). ASD individuals showed the strongest and most consistent difficulties in set-shifting and planning (d = respectively 0.54, 0.49, both $p \leq .001$). Significantly lower performances in working memory are found exclusively in visuospatial tasks (d=0.25, p=.001), not in verbal working memory tasks. Lastly, moderate group differences were found on measures of inhibition ($d = 0.45$, $p \leq .001$) and fluency (d= .46, $p \leq .001$) relative to controls. Data analysis is still undergoing for the effect of intellectual level and the developmental aspect.
Conclusions: This systematic review reveals that while autism is associated with global executive difficulties, executive function difficulties are most consistent for measures of planning and mental flexibility. A better understanding of the executive functions profile of autistic individuals will support 1) a better understanding of the nature of some symptoms seen in autism and 2) development of appropriate intervention and educational strategies, especially since the development of executive functions in autism seems to follow a different pathway. However, detailed research is needed to define the role of some comorbidities in the autism spectrum executive profile, especially the role of ADHD.

19 **122.019** Externalizing Behaviors, Attention Shifting, and ADHD Symptoms in Young Children with ASD

E. F. Geib[1], *H. Dauterman*[2], *W. Mason*[1], *R. Bowler*[3] *and B. Wilson*[1], *(1)Clinical Psychology, Seattle Pacific University, Seattle, WA, (2)Seattle Pacific University Department of*

Clinical Psychology, Seattle, CA, (3)Seattle Pacific University, Seattle, WA

Background:
Children with autism spectrum disorder (ASD) often present with comorbid and clinically significant attention deficit/hyperactivity disorder (ADHD) symptoms, which result in higher rates of externalizing problems (Simonoff et al., 2008; Yerys et al., 2009). Research is attempting to outline the deficit profiles of children with ASD and ADHD. Executive functioning impairment, specifically attention shifting deficits, has been hypothesized as one such deficit (Corbett, Constantine, Hendren, Rocke, & Ozonoff, 2009). Further, deficits in attention shifting are hypothesized to partially explain the risk for increased externalizing problems in children with ASD and ADHD (Lawson et al., 2015).
Objectives:
We hypothesized that children with ASD would exhibit higher levels of externalizing behaviors than typically developing (TD) children and that this relation would be partially explained by their attention shifting ability. Additionally, we hypothesized that the link between diagnostic status and attention shifting would be conditional on their level of ADHD symptomatology.
Methods:
Participants were 162 children (3 to 6 years), their parents, and teachers. Sixty-nine children were diagnosed with ASD and ninety-three were TD. The Behavioral Assessment System for Children – Second Edition (BASC-2; Reynolds & Kamphaus, 2004) and the Child Behavior Questionnaire (CBQ; Rothbart, Ahadi, & Hershey, 1994) were completed by teachers to assess externalizing behaviors and attention shifting respectively. Parents completed the Conner's Parent Rating Scale (CPRS-R-S; Conners, 1997) to assess ADHD symptoms.
Results:
A moderated-mediation analysis was conducted using PROCESS (Hayes, 2013) to examine the conditional indirect effects of diagnostic status (ASD vs. TD) on externalizing behaviors through attention shifting, as moderated by ADHD symptomology on the alpha pathway. Findings revealed support for a full moderated-mediation model. Attention shifting skills, which were lower in the ASD group compared to the TD group, significantly mediated the relation between diagnostic status and externalizing problems at low (t = 7.70, SE = 1.76, CI = 4.22 – 11.28) and mean levels of ADHD symptoms (t = 5.13, SE = 1.22, CI = 2.93 – 7.67). However, at high levels of ADHD symptoms, attention shifting no longer accounted for the relation between diagnostic status and externalizing symptoms (t = 2.55, SE = 1.89, CI = -0.73 – 6.62).
Conclusions:
Our findings suggest that ADHD symptoms moderate the relation between diagnostic status and externalizing behaviors through attention shifting skills. At low and mean levels of ADHD symptoms, children with ASD had worse attention shifting skills than their TD peers, partially accounting for their elevated rates of externalizing problems. However, at high levels of ADHD symptoms, attention shifting no longer explained the relation between diagnostic status and externalizing problems. These results help to clarify the executive functioning profile of children with ASD. Attending to and shifting between relevant stimuli in their environment appears to be a marked deficit for these children, likely impacting their abilities to regulate their behavior. Attentional training targeting these skills may offer productive avenues for intervention to reduce externalizing problems in children with ASD.



20 **122.020** Facial Affect Recognition in Autism, ADHD and Typical Development

S. Berggren[1], *A. C. Engström*[2] *and S. Bolte*[3], *(1)Karolinska Institutet, Stockholm, Sweden, (2)BUP Södertälje, Child and Adolescent Psychiatry Stockholm,, Södertälje, Sweden, (3)Department of Women's and Children's Health, Pediatric Neuropsychiatry Unit, Karolinska Institutet, Stockholm, Sweden*

Background:
Autism spectrum disorder (ASD) and Attention-Deficit Hyperactivity Disorder (ADHD) have been associated with explicit facial affect recognition (FAR) alterations, but comparative studies are scarce.
Objectives:
This study examined FAR accuracy and response times for overall and specific basic emotions FAR performance in whole face and eye-region stimuli.
Methods:
FAR was assessed in carefully matched samples of participants with ASD (n=35), ADHD (n=32) and typical development (n=32), taking into account possibly mediating effects of attentional functions and social communication problem severity. Results: Compared to TD, the ASD group performed less accurate and showed longer response times for general and specific FAR in both types of stimuli, mostly driven by problems in neutral and happy face identification. There were few differences between ASD and ADHD, and no differences between ADHD and TD. Cognitive distractibility explained a substantial proportion of variance of FAR performance in ASD and ADHD. Social communication problem severity and cognitive impulsivity had no impact on FAR performance. Conclusions: Findings confirm FAR alterations in ASD, but not ADHD, and endorse mediating effects of certain attention functions. FAR training seems clinically meaningful in ASD. Future studies should include control for visual attention, facial configuration skills, use naturalistic FAR material and also investigate implicit FAR.
Results:
Partial correlations between cognitive distractibility and face and eye test FAR accuracy and response time were essentially null associations for the TD group (r =-08 to .07, p>.70), but partly significantly negative in ASD and ADHD. In ASD, face and eye FAR accuracy was negatively correlated with cognitive distractibility (r = -.34 & -.44, p<.04). In ADHD, face and eye FAR accuracy and eyes test response time was negatively correlated with cognitive distractibility (r = -.31 to -.33, p<.05). Eye and face FAR accuracy and speed correlated highly negatively in TD (r = -.66 & -.73, p<.001) and ASD (r = -.60 & -.76, p<.001), but not in ADHD (r = -.15 & -.16, p=.75). Interestingly, in the ASD group, performance on the eyes test correlated negatively quality of eye contact on the ADOS (r = -.38, p =.02).
Conclusions:
In this study of explicit FAR, we found significant general and specific FAR difficulties in ASD for different stimuli regarding accuracy and response time, compared to TD, only few differences between ASD and ADHD, and no differences between ADHD and TD. Cognitive distractibility explained a substantial proportion of variance of FAR performance in ASD and ADHD. Future studies should aim to investigate FAR in ASD and ADHD using a model also integrating visual attention, facial configuration skills as

predictors as well as naturalistic FAR material and implicit FAR as dependent measures.

21 **122.021** Impact of Autism Diagnosis on Neural Systems of Nonverbal Fluid Reasoning in Adolescent Male Monozygotic Twins

L. Kalbfleisch[1], *J. Roberts*[2] *and A. Loughan*[3], *(1)Pediatrics, The George Washington University School of Medicine and Health Sciences, Washington, D.C., DC, (2)Johns Hopkins University School of Medicine, Baltimore, MD, (3)Virginia Commonwealth University School of Medicine, Virginia Commonwealth University School of Medicine, VA*

Background: Characterizing neural trajectories of fluid reasoning in special populations (including gifted) and in neurotypical children will sharpen our understanding of the influence of reasoning on the acquisition of a range of intellectual skills and talents. This skill is one of those enhanced or preserved at certain high levels of function in autism (Soulieres et al., 2009). Matrix reasoning, an identified construct of intelligence, has been acknowledged as a chief marker of changes in crystallized abilities, in addition to changes seen within real-world contextual thinking when you have enough information but not sufficient time to make decision (Kalbfleisch, Van Meter, and Zeffiro, 2006), and in academic settings including quantitative ability, declarative knowledge, and reading (Ferrer et al., 2009; Soulieres et al., 2009; Wright et al., 2008). Matrix reasoning tests have also been shown to better identify giftedness (i.e. intellectual aptitude in disadvantaged populations) at higher rates than culturally biased traditional intelligence tests (Naglieri, 1997). Furthermore, aspects of metacognitive ability are untouched in twice exceptional children with autism (Kalbfleisch & Loughan, 2011).
Objectives: The present study investigated the impact of two types of autism diagnoses (high-functioning autism versus Asperger's syndrome) on fluid reasoning (Ferrer, O'Hare, & Bunge, 2009; Kalbfleisch, Van Meter, & Zeffiro, 2006; Wright, Matlen, Baym, Ferrer, & Bunge, 2008) in a pair of adolescent male monozygotic twins. We report psychometric, behavioral, and neuro-functional differences of fluid reasoning assessed with a novel matrix reasoning task in the pair who presented as volunteers for an ongoing study of higher-level cognition in children with high-functioning autism. We report them here as a separate case due to their genetic identity, which lends an opportunity to examine demonstrative functional consequences of autism diagnosis on fluid reasoning.
Methods: We evaluated the impact of autism diagnosis on neural systems of nonverbal fluid reasoning in adolescent male monozygotic twins, age 16.3 years, using psychometric (WISC-IV, BRIEF) and functional neuroimaging methods utilizing a novel matrix reasoning task.
Results: Twin with high-functioning autism (HFA) displayed lower Full Scale IQ resulting from decreased verbal aptitude and clinically significant executive function deficits compared to the twin with Asperger's (ASP). Twins displayed comparable behavioral accuracy and speed during fluid reasoning. Conversely, neural systems in ASP correlated with right medial frontal cortex, posterior cingulate gyrus, and precuneus. Neural systems in HFA correlated with right superior and middle frontal gyri, right superior temporal gyrus and bilateral precuneus.
Conclusions: These functional results coincide with brain structure changes that currently define differential conditions on the autism spectrum in the medical literature. Our findings potentially demonstrate the functional consequences of differences in verbal ability and executive function in twins with two forms of autism. Furthermore, this approach presents a format for exploring the nature of twice exceptionality within a larger framework for mapping atypical brain development. We consider implications for the role of intelligence in the context of preserved and enhanced fluid reasoning ability in autism that leads to the presence and expression of certain talents and skills, sometimes described as twice exceptionality.

22 **122.022** Implicit Processing of Category Information in Autism

O. E. Parsons[1] *and S. Baron-Cohen*[2], *(1)University of Cambridge, Cambridge, England, United Kingdom, (2)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom*

Background: Statistical learning in low-level contexts is intact in autism. However, statistical learning in more complex contexts has not yet been investigated in autism. The tendency to generalize is reduced in autism and could lead to over-specificity in category formation. Statistical learning also operates at the semantic categorical level in the typical population. If statistical learning is atypical in autism in higher-level contexts, such as at the categorical level, then we should expect atypical predictive ability in individuals with autism.
Objectives: (1) To investigate whether individuals with autism implicitly process statistical regularities occurring in complex images to the same extent as typically developing individuals. (2) To assess whether learning occurs when these regularities are at the level of the semantic category.
Methods: 40 male adults with autism and 40 male controls (matched for age and IQ) took part. Participants were exposed to image streams consisting of natural scenes. The order of image presentation was dictated by a deterministic underlying structure based on the semantic categories of the scene images (e.g., images of mountain ranges would always be followed by images of bathrooms). Participants were randomly assigned to one of two conditions where the underlying structure occurred at the level of the individual image or occurred at the level of the image categories. In the first condition a single image was used to represent each semantic category. However, in the second condition a novel image was presented for each incidence of a particular semantic category. Thus statistical learning could occur in the first condition without attending to the semantic category, but not in the second condition. A cover task was used to ensure participants did not explicitly attend to image-order. A forced two-choice paradigm was then used to assess participant's ability to correctly identify images occurring in the correct order over foil sequences.
Results: Individuals with autism showed equal performance to controls when the underlying structure was based on individual images. This suggests that individuals with autism do not show any impairment in implicit learning even when the stimuli used are complex, real-world images. However, performance in the autism group was below controls when the structure occurred at the semantic level of the category.
Conclusions: Individuals with ASC do not automatically process complex images in the same way as controls. Specifically, the semantic context of images is not processed as much in people with autism compared to controls. This may reflect their greater attention to detail. These findings have implications for how environmental regularities are processed and for learning, in individuals with autism.

23 **122.023** Individual Differences in Executive Function Are Predictive of Autistic Children's School Readiness

L. Kenny[1], *H. Lichwa*[1], *E. Klaric*[1], *J. L. Brede*[1], *R. McMillin*[1] *and E. Pellicano*[1,2], *(1)Centre for Research in Autism and Education (CRAE), UCL Institute of Education, University College London, London, United Kingdom, (2)School of Psychology, University of Western Australia, WA, Australia*

Background: Long-term follow-up studies show that the developmental outcomes of autistic people are highly variable, even for individuals at the more able end of the autism spectrum. While some individuals go on to live independently, the majority fail to attain full-time employment or to enjoy fulfilling friendships. Explaining this variability is of critical import: to discover why developments take place in some areas and not in others, and especially in some children and not in others. One potential source of this variability may be autistic children's emerging executive function (EF): a set of higher-order processes, closely associated with the prefrontal cortex, which are necessary for regulating and controlling behaviour. EF is a promising candidate not least because poor EF is well documented in autism but also because research in typical development indicates that well-regulated EF (1) helps to shape young children's social awareness, (2) is predictive of pre-schoolers' school readiness and academic achievement and (3) is amenable to intervention. Furthermore, research has demonstrated longitudinal links between EF and another core neurocognitive function impaired in autism – theory of mind.
Objectives: The present study investigated the relationship between emerging executive abilities and school readiness in pre-school children with and without autism. Further, we examined the extent to which individual differences in executive skills were associated with a child's readiness for school in autism and typical development alike.
Methods: 30 preschool children on the autism spectrum (*M* age = 4.44 years; *SD*=1.02) and 30 typical children (*M* = 4.42 years; *SD*= .88), matched for age and ability, were assessed on a battery of tasks measuring components of EF, including set-shifting, working memory and inhibition, and school readiness (indexed by performance on the Bracken School Readiness Scale).
Results: Compared to typical children, autistic children performed significantly lower on the School Readiness Composite score, $F(1,58) = 8.13$, $p = .006$ and the School Readiness Social subtest, $F(1,58) = 63.46$, $p < .001$. Children on the autism spectrum also had more difficulty with set-shifting, $F(1,58) = 34.26$, $p < .001$, working memory, $F(1,58) = 30.72$, $p < .001$ and inhibition, $F(1,58) = 13.20$, $p = .001$. Additionally, and in line with our predictions, individual differences in autistic children's EF skills, especially in spatial working memory, were related to variation in their school readiness, just like they were in typically developing children
Conclusions: The findings from this cross-sectional study provide further support for the potential role of EF in explaining the variability in autistic children's functional outcomes, in this case, their readiness to learn at school. Intervention programmes to boost EF development in preschool children with autism – especially those that 'exercise' EF or rely on implicit rather than explicit instruction of such skills – should be a key priority for future research.

24 **122.024** Investigating Potential Biases in Self-Evaluations of Reading and Math Performance By Individuals with ASD, ADHD, and Typical Development

J. B. McCauley[1,2], *M. C. Zajic*[3], *H. K. Schiltz*[2], *L. E. Swain-Lerro*[3], *M. A. Harris*[2], *T. Oswald*[1], *N. S. McIntyre*[3], *K. Trzesniewski*[2], *P. C. Mundy*[4] *and M. Solomon*[5], *(1)University of California at Davis MIND Institute, Sacramento, CA, (2)Human Development, University of California at Davis, Davis, CA, (3)University of California at Davis MIND Institute, Davis, CA, (4)Education and Psychiatry, University of California at Davis, Sacramento, CA, (5)MIND Institute, Sacramento, CA*

Background: Self-evaluative abilities for academic competence are critical for student success. Biased self-evaluations have the potential to prevent children and adolescents from knowing when they need to work harder, and or get help from their teachers. Researchers have examined overly optimistic self-ratings of competencies, referred to as positive illusory biases (PIB), by comparing self-rated ability to performance. There is some evidence youth with autism spectrum disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD) demonstrate PIB when assessing abilities on laboratory tasks. However, it is unclear if PIB occurs when children with ASD rate their abilities more generally on perceptions of their academic abilities in reading and math, and whether these biases are associated with self-esteem, implying they serve a self-protective function.

Objectives: To answer these questions, we: (1) examined the extent to which youth with ASD, ADHD and typical development (TYP) displayed PIB when making self-assessments of their reading and math achievement; and (2) tested whether there was a positive association between PIB and self-esteem, suggesting the biases are self-protective.
Methods: 98 youth, aged 9 to 17 (see Table 1), were administered assessments of their perceptions of their reading, and math abilities, and their general self-esteem using subscales from the Marsh SDQ (Marsh, 1992). Actual math ability was assessed with the Numerical Operations and Problem Solving subtests from the Wechsler Individual Achievement Test, 3rd edition (WIAT-III; Pearson, 2009). Reading fluency and comprehension was assessed using the Gray Oral Reading Tests, 5th Edition (GORT-V; Wiederholt & Bryant, 2012). Subtracting z-scored performance scores from z-scored self-rated abilities, we quantified the amount of bias to examine if positive biases were related to self-esteem. Bivariate correlations were performed using SPSS 22.
Results: All groups showed significant positive associations between self-rated ability on math and performance on WIAT-III Numerical Operations (Pearson's *r* ranged from .36 to .65). The ASD group did not, however, exhibit a similar relationship between their math self-ratings and WIAT-III Problem Solving ($r(35)=.16$, $p=.34$). Additionally, the ASD group did not show a positive association between self-rated reading ability and performance on fluency ($r(37)=.06$, $p=.70$) or comprehension ($r(37)=.09$, $p=.58$), and the ADHD group had an association between self-rated reading ability and fluency, but not comprehension ($r(23)=.23$, $p=.26$). On the contrary, the TYP group showed significant associations between self-rated abilities and performances in each domain. Finally, there was a significant positive association with self-esteem and positive bias scores in the reading domain in the ASD group ($r(37)=.33$, $p=.04$), suggesting that the function of positive biases may be self-protective for this group.
Conclusions: These results indicate that youth with ASD may be evaluating their math abilities in relation to arithmetic rather than problem solving ability, suggesting that they may need extra help identifying all abilities relevant to math. In addition, youth with ASD, and to some extent youth with ADHD, are not making accurate appraisals of their reading ability, but there is evidence that these biases are self-protective. Future work should develop self-assessments that help support these abilities for individuals with ASD.

Table 1
Sample Characteristics

	ASD (n=39)	TYP (n=34)	ADHD (n=25)
Males (%)	33 (85%)	22 (65%)	18 (72%)
Females (%)	6 (15%)	12 (35%)	7 (28%)
Chronological Age (SD)	12.75 (2.22)	12.82 (2.26)	13.01 (2.20)
Verbal IQ (SD)	96.97 (15.62)	110.56 (14.44)	100.96 (14.75)
Nonverbal IQ (SD)	104.41 (15.57)	117.06 (15.04)	100.68 (15.10)
Full-Scale IQ (SD)	100.48 (13.91)	115.59 (13.83)	100.96 (15.04)
ADOS-2 Total	10.46 (2.87)	NA	3.48 (3.88)
ADHD Comorbidity	8 (21%)	NA	NA

25 **122.025** Latent Profile Analysis Reveals Distinct Executive Function Profiles Across Children with ASD and ADHD

D. R. Dajani[1], *M. B. Nebel*[2,3], *S. H. Mostofsky*[4] *and L. Q. Uddin*[5], *(1)University of Miami, Miami, FL, (2)Department of Neurology, Johns Hopkins School of Medicine, Baltimore, MD, (3)Center for Neurodevelopmental and Imaging Research, Kennedy Krieger Institute, Baltimore, MD, (4)Johns Hopkins School of Medicine, Baltimore, MD, (5)University of Miami, Coral Gables, FL*

Background:
Executive functions (EF), the mental control processes necessary to carry out goal-directed behaviors (Denckla, 1994), are impaired in both autism spectrum disorder (ASD) and attention deficit/hyperactivity disorder (ADHD). Although studies have attempted to delineate specific executive dysfunction profiles that discriminate ASD from ADHD (e.g., Sergeant et al., 2002), the high comorbidity of ADHD diagnoses in those with ASD (30%) complicates matters. As an alternative to considering DSM-based diagnoses, the scientific community is moving towards a neurobiological assignment of cognitive dysfunction in a manner consistent with the Research Domain Criteria (RDoc) put forward by NIMH (Insel, 2010).
Objectives:
The aim of the current study is to delineate subgroups of children based on patterns of EF strengths and deficits, or "EF profiles". We investigated a mixed group of typically developing (TD, 45%) children, children with an ASD diagnosis (4%), children with an ADHD diagnosis (29%), and ASD with comorbid ADHD (22%).
Methods:
A latent profile analysis was calculated using MPlus, with 10 indicators of executive function (8 subscales from the parent-report of the Behavior Rating Inventory of Executive Function (BRIEF; Gioia, 2002), the statue subscale of the Developmental Neuropsychological Assessment (Korkman & Kemp, 1998), and the backward digitspan subscale of the Wechsler Intelligence Scale for Children- IV (Wechsler, 2004)). Together, these indicators measure inhibition, shifting, working memory, and planning/organizing. Participants included 207 children (Females: $N = 45$) ages 8-13 years ($M = 9.98$, $SD = 1.22$) with average full-scale IQ ($M = 109.55$, $SD = 13.76$).
Results:
The model that best fit the data contained three classes (entropy: .92; Lo, Mendell, Rubin LRT for 3 *v* 2 classes: 234.95, $p = .02$). The first class ($N = 88$) had overall above average executive functions ("superior"). The second class ($N = 57$) had slightly below average scores on all of the EF indicators ("middle"). The third class ($N = 61$) had overall the poorest executive function, which was below average for their age ("low"). Interestingly, these classes did not reproduce the groups based on clinical diagnosis. Most TD children were in the "superior" class (89%), while the majority of ADHD children were split between the "middle" (47%) and "low" (46%) classes. Similarly, children with ASD were primarily in the "low" class (63%), with 35% in the "middle". EF classes predicted robust phenotypic differences between children. Specifically, the EF classes accounted for unique variance, over and above diagnosis, in anxiety and depression ($R^2 = .56$, R^2 *change*$=.04$, $p=.001$), social problems ($R^2 =.73$, R^2 *change*$=.07$, $p < .001$), attention problems ($R^2=.79$, R^2 *change*$=.08$, $p < .001$), and aggressive behavior ($R^2 =.58$, R^2 *change*$=.10$, $p < .001$).
Conclusions:
Using an RDoc framework, the present study examined EF in a mixed group of TD children and children with neurodevelopmental disorders. Importantly, the EF classes that emerged from latent profile analysis predicted variance in behavioral problems unique from diagnosis. Future studies should validate these EF classes biologically by investigating whether unique brain-based markers for EF dysfunction can be determined.

26 **122.026** Links Between Hyperfocused Attention, Pupillometry, and the Locus Coeruleus Across the Broader Autism Phenotype

A. S. DiCriscio *and V. Troiani, Geisinger Autism & Developmental Medicine Institute, Lewisburg, PA*

Background:
Pupillometry measures changes in pupil dilation, which are tightly linked with activity in the Locus Coeruleus (LC). The LC controls baseline arousal as well as stimulus-locked, or "phasic", responses that focus attention in response to environmental cues. More specifically, a phasic LC-NE response is thought to induce a more strategic visual discrimination filter, which serves to restrict information processing to only the most relevant locations. Atypical attention has frequently been reported in autism spectrum disorders (ASD). In particular, individuals with ASD sometimes demonstrate superior performance in visual search and block design tasks, relative to age and IQ matched peers. One hypothesis suggests a 'hyperphasic' LC underlies heightened visual discrimination abilities and the inflexibility and hyperfocused attention that leads to restricted interests present in ASD.
Objectives:

The purpose of the current study was to critically test the relationship between performance on tasks requiring focused attention, traits associated with the Broader Autism Phenotype (BAP), and the link to the LC via pupillometry.
Methods:
Experiment 1: We used phenoytype and genotype data collected through the Simons Variation in Individuals Project (SVIP; www.simonsvipconnect.org) to examine the relationship between symptoms of the BAP and performance on visual discrimination tasks in 16p11.2 probands with a confirmed *de novo* deletion (*del*) or duplication (*dup*) (N=26; 15 males; mean age = 4.8±1.5), a copy number variant (CNV) known to increase the risk for ASD.
Experiment 2: We designed a Navon Figures eyetracking paradigm (i.e. large letter composed of small letters), requiring an individual to vary only the information attended to within an image. This controlled for low-level visual features such as luminance that impact pupil changes. Participants were healthy young adults (N=49; mean age =25.2).
Results:
Experiment 1: In children with 16p11.2 syndrome, average scores on a block design task were directly related to average scores on the Broader Autism Phenotype Questionanire (BAP-Q) (r=0.42, p<0.03). These results confirm a relationship between heightened visual discrimination abilities and the BAP.
Experiment 2: Participants display larger changes in task evoked pupil response when identifying local information (smaller letter) within objects relative to global information (larger letter) (p<0.001). We also show a relationship between relative change in pupil diameter (Local:Global conditions) and behavioral measures associated with the BAP, specifically the rigidity subscale, which measures flexibility and preoccupation with details (r=0.58, p<0.003). This effect was specific to stimulus-locked ('phasic') responses and was not linked to baseline pupil diameter.
Conclusions:
This work represents the first characterization of the specificity in phasic pupil response and the relationship with the BAP and suggests that mechanisms that control the earliest parts of visual selection are associated with autism traits. Ongoing data collection will characterize the pupil responses in children with 16p11.2 syndrome.

27 **122.027** Metacognitive Awareness of Facial and Vocal Affect in Higher-Functioning Children and Adolescents with Autism Spectrum Disorder

C. McMahon[1], *R. Schatz*[2], *J. Haut*[2], *A. Merrill*[2] *and T. Otero*[2], *(1)Hamilton College, Clinton, NY, (2)Indiana University - Bloomington, Bloomington, IN*

Background:
Metacognition is one's ability to monitor and assess one's own task performance (e.g., Jacobs & Paris, 1987). Two previous studies (McMahon et al., 2015; Sawyer et al., 2014) have examined metacognition of facial affect identification in individuals with Autism Spectrum Disorder (ASD). In McMahon et al. (2015), children and adolescents with ASD were impaired in metacognition relative to a comparison group; in Sawyer et al. (2014), adults with ASD did not show evidence of a metacognitive impairment, although a mild impairment in metacognitive control was observed.
Objectives:
The objective of this study was to assess metacognition of facial and vocal affect in children and adolescents with ASD. To the authors' knowledge, this is the first study to examine metacognition of vocal affect in individuals with ASD.
Methods:
Children and adolescents (ages 9-17) with typical development (n = 10) and ASD (n = 14) participated in this study. There were no significant differences between diagnostic groups on age, $t(22) = -1.20$, $p = 0.24$, verbal IQ, $t(22) = 1.74$, $p = 0.10$, performance IQ, $t(22) = 1.29$, $p = 0.21$, or gender, $\chi^2 (1, N = 24) = 0.97$, $p = 0.32$. Participants completed the Diagnostic Analysis of Nonverbal Accuracy 2 (Baum & Nowicki, 1997; Nowicki & Carlton, 1993); they were asked to determine the affect of 24 faces and 24 voices and indicate their degree of certainty (1 = very uncertain, 5 = very certain) for each affect selection. A hierarchical linear model was used to analyze the data, with degree of certainty and stimulus type (face/voice) assessed as stimulus-level predictors of affect accuracy and diagnosis, age, verbal IQ, and gender assessed as participant-level predictors of affect accuracy.
Results:
There was a significant effect of age, $t(22) = 2.57$, $p = 0.02$, and certainty, $t(1125) = 9.02$, $p < 0.01$, on accuracy of affect selection, such that older participants were more accurate in their affect selections and greater certainty in affect selection was associated with greater accuracy across all participants, regardless of diagnostic group. Finally, there was a marginal effect of stimulus type on accuracy of affect selection, $t(1125) = -1.86$, $p = 0.06$, which was qualified by an interaction between stimulus type and diagnostic group, $t(1125) = -2.15$, $p = 0.03$, such that all participants, particularly those with ASD, were more accurate in processing facial affect than vocal affect (see Table 1 and Figure 1).
Conclusions:
Contrary to the results of McMahon et al. (2015), this study suggests that children and adolescents with ASD do not have metacognitive impairments in monitoring facial or vocal affect. As the face processing task used in this study was simpler than the face processing task used in McMahon et al. (2015), individuals with ASD may have greater metacognitive impairments on more difficult affective processing tasks. Individuals with ASD had more difficulty identifying vocal affect than facial affect in this study, suggesting that future studies should explore the relation between metacognition and task difficulty for both facial and vocal affect identification tasks.

Figure 1. Interaction between stimulus type and diagnostic group on accuracy of affect selection.

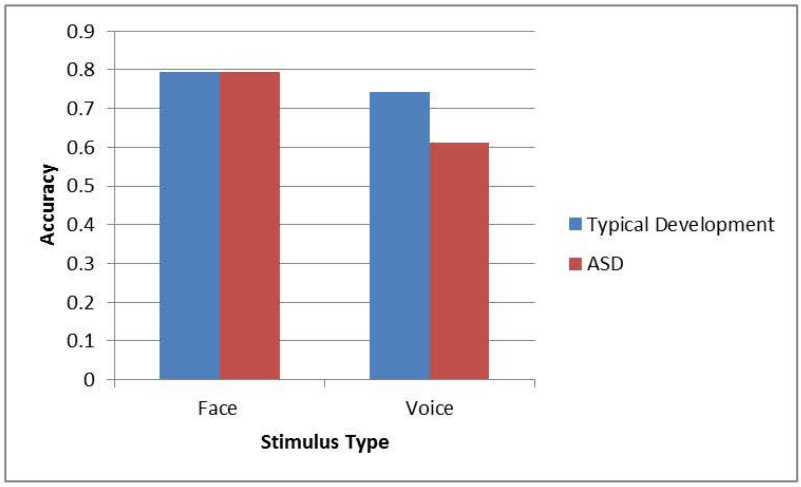


Table 1

Hierarchical linear model

Parameter	Model
	Fixed Effects
Intercept	
Intercept (β_{00})	1.35** (0.13)
Age (CGM; β_{01})	0.09** (0.04)
Slope for Confidence (CWC)	
Intercept (β_{10})	0.72** (0.08)
Slope for Stimulus Type	
Intercept (β_{20})	-0.36* (0.20)
Diagnosis (β_{21})	-0.49** (0.23)
	Variance Components
Intercept (r_0)	0.12** (0.34)

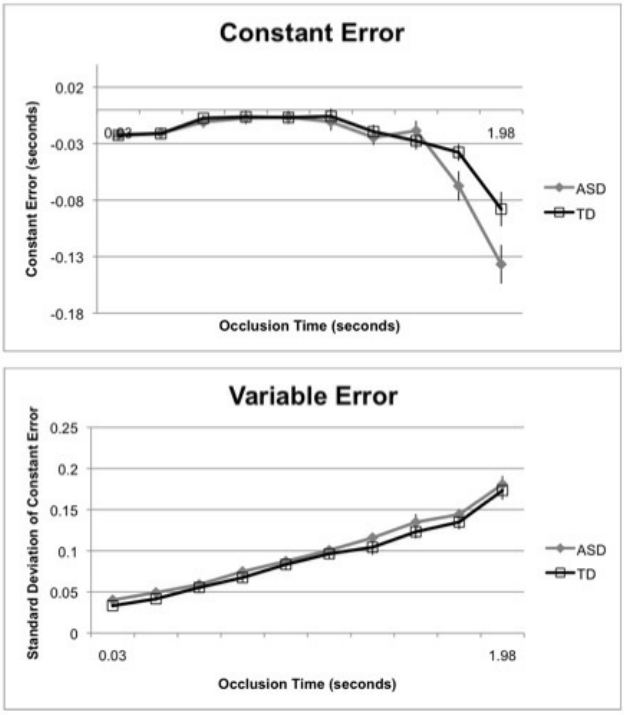
Note. Standard errors are in parentheses for fixed effects, and standard deviations are in parentheses for variance components. ** $p < 0.05$, * $p < 0.10$. CWC = Centered Within Context; CGM = Centered at the Grand Mean.

28 **122.028** Motion Prediction Abilities in Autism Spectrum Disorder

K. B. Schauder[1], *W. J. Park*[2], *O. Kwon*[2], *D. Tadin*[2] *and L. Bennetto*[1], *(1)Clinical and Social Sciences in Psychology, University of Rochester, Rochester, NY, (2)Brain and Cognitive Sciences, University of Rochester, Rochester, NY*

Background: Individuals with autism spectrum disorder (ASD) prefer routine and have difficulties in unpredictable situations (e.g., social interactions). Emerging theories suggest that an underlying prediction impairment may contribute to ASD (Van de Cruys et al., 2014; Sinha et al. 2014). Prediction occurs at various information processing levels, making this account appealing to understanding ASD at a mechanistic level. However, it is crucial to determine the nature and extent of this impairment empirically. One ubiquitous type of prediction that has been studied in typical development is motion prediction, which requires estimating future object position based on experienced sensory information. Real world examples include predicting when a moving car will emerge from a driver's blind spot and knowing when to swing at a baseball. Motion prediction abilities have not yet been assessed in ASD.
Objectives: To investigate motion prediction abilities in ASD.
Methods: 20 children and adolescents with ASD and 20 age- and IQ- matched typically developing (TD) controls completed a standard motion prediction task. Participants viewed an object that moved across the screen and disappeared behind a visual occluder; their task was to press a button when they thought the object had arrived at the visual target at the end of the occluder. Speed of object motion (10-20 deg/sec) and occluder length (0.5-20 deg) varied independently across trials, which together determined occlusion time. Mixed Model ANOVAs were used to examine effects of occlusion time and diagnostic group on three common measures of prediction ability. *Constant error* represents the difference between participants' estimate and the actual time to target, with negative values representing a bias to respond too quickly.

Absolute error represents the discrepancy between actual and estimated time to target contact irrespective of under- or over- estimation. *Variable error* is the standard deviation of the individual's constant error, representing consistency of estimations across trials.
Results: For all three measures, there was a main effect of occlusion time indicative of increased error as prediction demands increase (all *p*'s < .001). For constant error, there was a significant group x occlusion time interaction ($F(9,38) = 3.22$, $p < .05$), in which the ASD group underestimated the stimulus's arrival to the target more than the controls at the longest occlusion times (> 1s). However, for absolute and variable error, group differences and group x occlusion time interactions were not significant.
Conclusions: Overall, individuals with ASD did not differ from those with TD in their abilities to estimate the time to target contact of a moving stimulus, suggesting that motion prediction abilities are not generally affected in ASD. However, greater underestimation in ASD at the longest occlusion times may represent a systematic bias or particular kind of prediction deficit at occlusion times longer than one second. Ongoing analysis of eye tracking data from this task will provide additional insights into tracking strategies used to perform this task. Although prediction deficits are not robustly apparent in this nonsocial, laboratory task, future studies should examine prediction abilities in ASD in social and other higher level processing domains.



29 **122.029** Neural Correlates Underlying Binding of Information in Autism: Preliminary Results

M. E. Leclerc[1,2], *S. Grot*[3,4], *I. Soulières*[5] *and D. Luck*[2,3], *(1)Psychiatry, University of Montreal, Montreal, QC, Canada, (2)Centre de recherche de l'Institut universitaire en santé mentale de Montréal, Montréal, QC, Canada, (3)Psychiatry, University of Montreal, Montréal, QC, Canada, (4)Centre de recherche de l'Institut universitaire en santé mentale de Montréal, 7331, rue Hochelaga, QC, Canada, (5)University of Quebec in Montreal, Montreal, QC, Canada*

Background: Working memory (WM) is a limited-capacity system devoted to temporary storage and short-term handling of information. Within the different components of working memory, the ability to combine various information, referred to as *binding*, is crucial for episodic memory and learning processes. There are two types of binding: the automatic form, for which associations between pieces of information are made unconsciously (information being presented already bound together), and the controlled form, for which these associations require a conscious effort. These two forms of binding are based on separate neural substrates: automatic binding is based on the functioning of the hippocampus, while controlled binding is based on the communication between the hippocampus and prefrontal cortex. Some studies have suggested preserved automatic binding capabilities in autistic individuals, while other studies have shown controlled binding difficulties. This profile of performance could result from alterations of the neural circuit connecting the prefrontal cortex and hippocampus.
Objectives: To investigate the cognitive and brain mechanisms underlying both automatic and controlled forms of information binding in autism, using functional magnetic resonance imaging (fMRI).
Methods: 13 autistic participants (diagnosed by a multidisciplinary team with ADI-R and ADOS-G) and 15 typically developed participants were recruited from the research database of a specialized clinic for autism diagnosis. Participants were matched on gender, IQ and age (18-40 years old). In an MRI scanner, participants performed the working memory experimental task, which consisted of the presentation of words and ellipses (indicating a spatial position) of different colors, to memorize. In the automatic condition, words were presented directly into ellipses. In the controlled condition, the words were presented in the center of the screen, separated from ellipses. Participants had to associate same color words and ellipses. Stimuli were presented for 3 seconds and participants had to maintain information for 10 seconds in WM. After this delay, a word was presented in a spatial position and participants had to decide whether the word/spatial position association was correct or not.
Results: Participants had significantly lower accuracy in controlled binding than in automatic binding, with no between-group differences. During encoding phase, typical participants presented greater levels of activity in the middle frontal gyrus for controlled binding, and in dorsolateral prefrontal cortex for automatic binding, compared to autistic participants. During maintenance phase, autistic participants showed greater levels of activity in the left median frontal gyrus, hippocampus and parahippocampal gyrus, for controlled binding, and in the parahippocampal gyrus and left inferior gyrus for automatic binding, compared to typical participants.
Conclusions: Despite similar performances, autistic and typical participants presented different patterns of cerebral activity. When encoding information, the different level of activity in prefrontal cortex suggests the use of different encoding strategies in the two groups. Typical participants probably used a more active strategy of manipulation of information to remember. However, when maintaining information in WM, greater activity in the hippocampus and prefrontal regions was found in autistic participants, suggesting more effortful strategies employed by autistic participants.

30 **122.030** Planning Skills in Autism Spectrum Disorder Across the Lifespan: A Meta-Analysis and Meta-Regression

L. M. Olde Dubbelink[1,2] *and H. M. Geurts*[3], *(1)Dutch Autism & ADHD research center (d'Arc) Dept of Psychology, Brain and Cognition, University of Amsterdam, Amsterdam, Netherlands, (2)Dept. of Research, Development & Innovation, Dr. Leo Kannerhuis, Doorwerth, Netherlands, (3)Dutch Autism & ADHD research center (d'Arc) Dept of Psychology, Brain and Cognition, University of Amsterdam; Dr. Leo Kannerhuis, Amsterdam, Netherlands*

Background: Planning is an important part of life as it both directs and evaluates the strategy we use to reach our pre-specified goals. People with autism spectrum disorder (ASD) are thought to encounter difficulty with planning. Experimental research, however, lacks consensus on the mastery of this skill in ASD. The last, narrative, review on this topic dates back to 2004 and concluded that people with ASD have planning difficulties and that age might influence planning (Hill, 2004). To date, however, the literature on planning in ASD has not been quantitatively reviewed, and still little is known about possible age-related effects on planning in ASD.
Objectives: By means of a meta-analysis and meta-regression, we aim to conceptualize (1) the magnitude of possible planning deficits in ASD; (2) potential age-related effects on planning; (3) which of the array of planning measures is most consistent in its findings; (4) whether intelligence levels have an effect on planning.
Methods: A systematic literature search identified 49 eligible studies with a combined sample size of 1737 people with ASD and 1600 typically developing (TD) controls (mean age range: 4.9-63.6 years). For each continuous outcome, a Hedges' *g*effect size was calculated. A positive effect size indicated poorer planning by the ASD group as compared to the TD group. Next, a random-effects meta-analysis was performed, followed by meta-regression techniques to examine moderating effects of age, type of task and IQ.
Results: The preliminary meta-analysis indicated that individuals with ASD perform worse on planning tasks as compared to TD controls (effect size 0.53). Age and type of

task did not seem to have an effect on planning. IQ was a relevant moderator (explaining 31.25% of the total heterogeneity), with smaller effects with increasing IQ. The residual heterogeneity between studies remained large and significant. Investigation of publication bias suggested missing studies with a negative effect. Although inclusion of these hypothetical studies would decrease overall mean effect size, the effect size would remain significant.
Conclusions: Our preliminary results of this meta-analysis on planning performance in ASD showed that people with ASD have indeed difficulty with planning. Furthermore, it showed that age does not moderate effects, while IQ does. However, a large amount of variation between studies remained unexplained. Thus, while people with ASD have planning problems across the lifespan, there are additional factors that influence their planning performance that need to be considered in future studies.

31 **122.031** Predictors of Adult Outcomes in Cognitively Gifted Individuals with Autism Spectrum Disorder

J. Kaboski[1], *J. Gilger*[2] *and M. Cain*[3], *(1)University of Notre Dame, Notre Dame, IN, (2)School of Social Sciences, Humanities & Arts, University of California - Merced, Merced, CA, (3)Psychology, University of Notre Dame, South Bend, IN*

Background: Although the past few decades have seen an increasing interest in gifted children with ASD, adult outcomes of this population remain a mystery. It may seem natural to presume that cognitively exceptional students would be successful in adulthood, regardless of their ASD diagnosis; however, there has not been any scientific confirmation of this presumption. This study is an attempt to fill this gap in the literature.
Objectives: The overall objective of this quantitative study was to (1) descriptively compare adult outcomes between gifted and non-gifted individuals with ASD and (2) identify key factors that predict postsecondary outcomes in gifted individuals with ASD.
Methods: This project utilized the National Longitudinal Transition Study 2 (NLTS2). The data were collected from a nationally representative sample of children who qualified for special education services under the primary diagnosis of autism. Participants were 13-17 of age at the start of the data collection and 21-25 at conclusion. Giftedness was defined as having either: (1) scored above 90thpercentile on any of the subtests on the Woodcock Johnson III achievement test; or (2) qualified for gifted/talented programs offered by the students' school. Regression analyses were performed on various adult outcomes: romantic relationship, employment, wage, college enrollment, and residential independence. All adult outcomes were analyzed using logistic regression except for wage, which could be modeled using linear multiple regression. All predictors were entered in one step.
Results: Of the 440 individuals with ASD in this sample, 62 (14%) met the criteria for gifted. Only 11% of the gifted, and 7% of the non-gifted reported ever being married or in a romantic relationship; this difference was not statistically significant. In all the other adult outcome domains, gifted adults demonstrated significantly favorable results compared to their non-gifted counterparts: higher employment rate, wages, residential independence, and college enrollment. Surprisingly, in the regression analysis using adult outcomes as dependent variable and giftedness as the primary predictor, giftedness was no longer significant when other factors such as maternal education and living skills were included in the model. Most notably, mother's college education was consistently significant for most of the adult outcome domains considered. The only exception was college enrollment: being gifted was significant - along with having a mother who graduated from college, utilizing educational services in childhood, and having higher mental functioning.
Conclusions: Cognitively gifted adults fared better than their non-gifted counterparts in a number of outcomes as predicted; however upon closer examination, it appears that their success may not necessarily be attributable to giftedness *per se* but to other factors that are correlated to giftedness, such as maternal college education and educational services received in childhood. Further exploration with a special focus on environmental factors that could serve as potential points of intervention – such as health insurance, school services, medication use, and characteristics of schools – will be reported in the full presentation.

Table 1. Sample Characteristics of Adults ages 21-25

	ASD plus Gifted N=62	ASD non-Gifted N=378	Z, t	*p*
Romantic Relationship	11%	7%	1.06	0.86
Dropped out of High School	8%	8%	0.00	0.50
Hourly Wage	$9.67	$8.06	10.34	0.00
Live Independently	26%	9%	6.63	0.00
Ever Had a Job	26%	7%	7.84	0.00
Ever Attended College	84%	37%	12.25	0.00
Identify Self as Disabled	62%	88%	-8.86	0.00

Table 2. Predictors of Adult Outcomes
(variables included in each model: age, gifted, gender, race, maternal education, income, developmental services, mental health services, assistive technology, mental functioning, living skills, classroom behavior; only listed giftedness and significant variables)

	Estimate	Exp (estimate)	SE	sig
Residential Independence				
Gifted	0.09	1.09	0.38	
Maternal education (B.A./B.S.)	0.39	1.48	0.20	*
Mental Functioning	0.23	1.25	0.12	*
Living Skills	-0.81	0.45	0.38	*
Employment				
Gifted	0.09	1.09	0.38	
Maternal education (B.A./B.S.)	0.39	1.48	0.20	*
Mental Functioning	0.23	1.25	0.12	*
Living Skills	-0.81	0.45	0.38	*
College				
Gifted	1.50	4.50	0.45	*
Maternal education (B.A./B.S.)	0.71	2.03	0.24	*
Educational Services Utilized	0.60	1.82	0.36	*
Mental Functioning	0.36	1.44	0.14	*

32 **122.032** Reduced Spatial Suppression in ASD Children

*O. Sysoeva[1], I. A. Galuta[1], E. Orekhova[2], M. Davletshina[1] and **T. A. Stroganova**[3], (1)Autism Research Laboratory, Moscow State University of Psychology and Education, Moscow, Russia, (2)University of Gothenburg, Moscow, Russian Federation, (3)MEG-center, Moscow State University of Psychology and Education, Moscow, Russia*

Background: Paradoxically, as stimuli size increases the motion perception of high-contrast gratings deteriorates. This phenomenon is called "spatial suppression" and is believed to reflect center-surround neural inhibition (Tadin et al., 2003). The abnormal excitation/inhibition (E/I) balance has been implicated in Autism Spectrum Disorder (ASD), predicting the reduced spatial suppression in this population. To the best of our knowledge only one study examined spatial suppression in ASD individuals (Foss-Fieg et al., 2013). Although the reduction of spatial suppression in high-contrast stimuli was not found in this study, the authors suggested that reduction of spatial suppression in ASD can be masked by attenuated gain control, an inhibitory mechanism that underlies saturation of neural responses at high contrast, which characterize their ASD subjects. Additionally, the general enhanced sensitivity to motion of high-contrast stimuli in ASD was reported. Noteworthy, this study comprised only high-functioning ASD children with extremely high IQ scores (116.7±12.4), questioning the generalizability of the results into broader ASD sample.
Objectives: The aim of our study was to examine the spatial suppression and gain control in a broader sample of ASD children with wider range of IQ scores.
Methods: Subjects were 22 ASD boys and 32 TD boys, aged between 6 and 15 years with IQ ranging from 62 to 136: intellectual ability was assessed by the Kauffman Assessment Battery (Kauffman&Kauffman, 2004). Experimental groups did not differ by chronological age, but mean IQ score was higher in TD than ASD children (117.5±12.0 and 90.9±19.8, respectively). The experimental procedure was similar to those used by Foss-Feig et al., 2013. The stimuli were the drifting vertical sine wave

gratings of either small (2°) or big (12°) size, presented in high- (100%) or low- (1%) contrasts. The duration of stimuli presentation was adjusted using two interleaved one up two down staircases that converged on 71% correct performance. Participants were asked to judge the direction of motion. The logarithm of the obtained threshold was taken as a dependent variable for ANOVA analysis performed separately for high- and low- contrast condition with stimuli Size as within-subject factor and Group as between subject factor. To examine for gain control ANOVA with Contrast as within-subjects factor was applied to the thresholds for small stimuli obtained in low and high contrast blocks.
Results: In high-contrast condition the was significant Size by Group interaction ($F(1,52) = 5.49$, $p = 0.023$, $\eta 2 = 0.094$), with ASD children having smaller difference between thresholds obtained for small and big stimuli (spatial suppression) as compared to TD boys (log scaled: 0.18±0.19 and 0.30±0.19, respectively for ASD and TD). No group difference in low-contrast condition was found. The group also did not differ either in gain control or in general sensitivity to motion.
Conclusions: Our study provides evidence for a reduced spatial suppression in a representative sample of ASD boys comparing to their TD peers.

33 **122.033** Semantic and Visuospatial Analogical Reasoning in Autistic Children

E. Danis[1], *A. M. Nader*[1], *V. Courchesne*[2] *and I. Soulières*[1], *(1)University of Quebec in Montreal, Montreal, QC, Canada, (2)University of Montreal, Montréal, QC, Canada*

Background: Studies have demonstrated intact fluid reasoning abilities, such as relation manipulation and logical solution inference, in children with an autism spectrum disorder (ASD) when assessed with analogical visuospatial reasoning problems (Dawson et al., 2007). Similar performance between ASD and typically developing (TD) children has also been found when semantic analogical problems are presented with pictures (Morsanyi & Holyoak, 2010), but literature supports preferential use of visuospatial reasoning strategies in ASD individuals (Stevenson & Gernsbacher, 2013). Only a few studies used equivalent formats of semantic and visuospatial analogical problems to compare the performance of ASD and TD children on both types of problems. Furthermore, few studies assessed how analogical reasoning develops in autism, but little evidences suggest slower reasoning development in ASD individuals (Green et al., 2014).
Objectives: (1) To assess performance in semantic and visuospatial analogical reasoning in ASD and TD children. (2) To document reasoning development in autism.
Methods: 31 ASD and 42 TD children matched on age (6-13 years; *M*=10.00, *SD*=1.11) and on Raven's Progressives Matrices' percentiles (*M*=56.65, *SD*=24.66) completed 240 reasoning problems on a computerized task. Problems consisted of 2x2 matrices with last entry to be filled with one of the three responses options presented. Problems were composed of pictures and varied in content (semantic vs visuospatial) and complexity (0-, 1-, 2-relations to be manipulated to correctly solve the problem). Accuracy and reaction time (RT) were recorded. Mixed ANOVAs were conducted with Content and Problem Complexity as within-subject factors and the Group and Age (6-9, 10-13 years) as between-subject factors.
Results: In both ASD and TD groups, visuospatial content, increased complexity and younger age decreased accuracy and increased RT ($p<.05$). Moreover, for the 1-relation visuospatial problems, older children of both ASD and TD groups were more accurate than younger children ($p<.05$), while there was no significant difference between younger and older children for the semantic problems of the same level of complexity (1-relation). Overall, TD group (*M*=.89, *SD*=.08) was significantly more accurate than ASD group (*M*=.83, *SD*=.15), though the difference was relatively small. In terms of RT, ASD group (*M*=5485.84, *SD*=2113.11) was faster than TD group (*M*=6649.41, *SD*=1913.09) in the most difficult condition, 2-relations visuospatial problems ($p<.05$). There was a trend for ASD group being faster than ASD group in other conditions, but it did not reach significance.
Conclusions: Both ASD and TD groups showed a similar pattern of performance: increased accuracy with age, decreased accuracy with relational complexity and better accuracy for semantic than for visuospatial problems. In both groups, accuracy was lower for visuospatial reasoning problems than for semantic ones. While TD children were overall more accurate, ASD children were faster. Finally, considering language deficits and visuospatial reasoning strategies in autism, the present semantic over visuospatial advantage in ASD group suggests that the way problems are presented influences their performance. Pictured problems and matrix format seem to suit well their reasoning strategies.

34 **122.034** Sensorimotor Adaptation Underpins Imitation Learning of Biological Motion Kinematics in Autism Spectrum Disorders

N. C. Foster[1], *S. J. Bennett*[1], *J. Causer*[1], *D. Elliott*[1,2], *M. Andrew*[1] *and S. J. Hayes*[1], *(1)Research Institute for Sport and Exercise Sciences, Liverpool John Moores University, Liverpool, United Kingdom, (2)Department of Kinesiology, McMaster University, Hamilton, ON, Canada*

Background: Internal action models underpinning social interaction are developed by imitating biological motion. Although processes subserving automatic imitation of biological motion are functional in autism spectrum (*autism)* disorders (Sowden et al., in press), they are suggested to be compromised during voluntary imitation (Williams et al., 2004). This is said to be based on processing difficulties associated with integrating sensorimotor information across repeated trials of imitating biological motion. To this end, we examined sensorimotor integration and adaptation using a novel methodology that displayed *atypical* and *typical* biological motion in a random (control) and fixed (experimental) trial order.
Objectives: (1) examine imitation of biological kinematics; (2) examine whether imitation of biological kinematics is facilitated by promoting sensorimotor integration
Methods: Twenty one (*neurotypical*) adults, and twenty one adults with *autism*, diagnosed by a clinical assessment and ADOS, participated in the study, which was approved by the local ethics committee. Participants imitated *atypical* and *typical* biological motion. During pre-test and post-test, *atypical* and *typical* stimuli were presented in a random trial order. During acquisition, the stimuli were presented in a fixed predictable trial order, which was counterbalanced between participants. Orthogonal planned comparisons were used to answer a number of *apriori* questions. Alpha was set at $p < 0.05$.
Results: The neurotypical *control* group imitated biological motion accurately in all phases of the experiment. The *autism* group imitated *atypical* biological motion more accurately during acquisition when stimuli were presented in a fixed order, compared to the pre-test when the trial order was random ($p < 0.05$). Moreover, they imitated *atypical* motion more accurately across acquisition blocks ($p < 0.05$), thus demonstrating sensorimotor adaptation. Learning was confirmed with the *autism* group imitating *atypical* motion more accurately in the post-test compared to the pre-test ($p < 0.05$).
Conclusions: Consistent with previous work (Hayes et al., 2015), imitation of *atypical* biological motion was impaired in *autism* when stimuli were presented in a random order in the pre-test. When processing was facilitated using a fixed trial order, adults with *autism* demonstrated sensorimotor adaption resulting in high fidelity imitation of *atypical* biological motion. The ability to imitate *atypical* biological motion remained when stimuli were subsequently presented in a random order in the post-test. This persistence demonstrated sensorimotor learning. We suggest the fixed trial order removed the requirement to upregulate and downregulate alternative action models relating to the different kinematic properties of the observed *atypical* and *typical* stimuli. Thus, sensorimotor integration and consolidation of the representation of *atypical* kinematics was likely facilitated through repeated trial-to-trial sensorimotor transformations of the inverse (motor plan) and feedforward (efferent copy) models. This process would have yielded further opportunity for trial and error learning by facilitating trial prediction, such that sensory visual input from the next *atypical* model would have be processed to further consolidate the developing representation. These adaptation and learning effects offer some of the most promising evidence against a core deficit in voluntary imitation of biological motion in autism.

35 **122.035** Severity Scores on the Autism Diagnostic Observation Schedule 2 Relate to Inhibitory Control in Children with Autism Spectrum Disorders

J. M. Buirkle[1], *G. Greco*[2], *T. Clarkson*[3] *and S. Faja*[4], *(1)Developmental Medicine, Boston Children's Hospital / Harvard Medical School, Boston, MA, (2)Boston Children's Hospital, Boston, MA, (3)Boston Children's Hospital: Harvard Med School, Boston, MA, (4)Boston Children's Hospital/Harvard Medical School, Boston, MA*

Background:
Deficits in executive functioning, one's ability to solve complex problems through managing conflicting information, are present in many individuals on the autism spectrum (Robinson, 2009). Specifically, this ability involves inhibition, set-shifting, decision making, and working memory. Poor executive functioning skills are known to correlate with reduced social abilities, more disruptive and aggressive behavior, poorer academic performances, and less successful outcomes in adulthood (see Diamond, 2013 for review). While executive functioning impairments have been acknowledged in autism spectrum disorder (ASD), few studies have looked at the direct relationship between one's executive functioning and their severity score on the Autism Diagnostic Observation Schedule 2 (ADOS-2).
Objectives:
To investigate whether ADOS severity comparison scores correlate with executive function abilities in children diagnosed with ASD.
Methods:
Participants were 19 children with ASD who ranged in age from 7 to 11 years old (15 males; 4 females), with IQs of 80 or above measured using the WASI-2 (Wechsler, 2011). Additional subjects are in the process of being recruited and tested. All participants received a clinical diagnosis on the autism spectrum, determined by DSM-V criteria (American Psychiatric Association, 2013) after administration of the ADOS-2 (Gotham, Risi, Pickles, & Lord, 2007) and the ADI-R (Rutter, Le Couteur, & Lord, 2003). ADOS-2 Comparison Scores were determined by taking the sum of the social affect and restricted repetitive behaviors raw scores and using the Conversion Table for Module 3. Comparison Scores range from 1 to 10, with increasing scores indicating a more severe diagnosis.
Executive Functioning was broken down into four separate tasks, each completed using a laptop computer: The Color-Word Stroop task measured inhibitory control (Perlstein, et al 1999), the Change Task assessed set-shifting (De Jong, Coles & Logan, 1995; Geurts et al., 2004), the Delay Discounting Task looked at decision making skills (Lamm et al, 2006; Richards et al., 2009), and the Backward Digit Span Task examined verbal working memory skills (Cohen,1997).
Results:
These preliminary results showed a strong negative correlation between the ADOS-2 Comparison Score and the Congruent-Incongruent Correct Reaction Time for the Stroop ($R= -0.70$; $p = .001$), which specifically measures inhibition of interfering information. None of the other three tasks correlated with ADOS symptom severity. However, analysis is ongoing with the continued enrollment of subjects.
Conclusions:

The ability of children on the autism spectrum to inhibit conflicting information, a key feature of executive functioning, is related to the severity of their autism diagnosis determined by the ADOS-2. This is consistent with previous literature that shows that inhibiting conflicting information is specifically impaired relative to other aspects of inhibition (Christ et al., 2007). This finding is important in better understanding the underlying features of autism spectrum disorders, and suggests that the development of interventions that target inhibitory deficits specifically may be helpful in reducing the severity of one's diagnosis.

36 **122.036** Sex Differences in Implicit Learning Among Youth with Autism

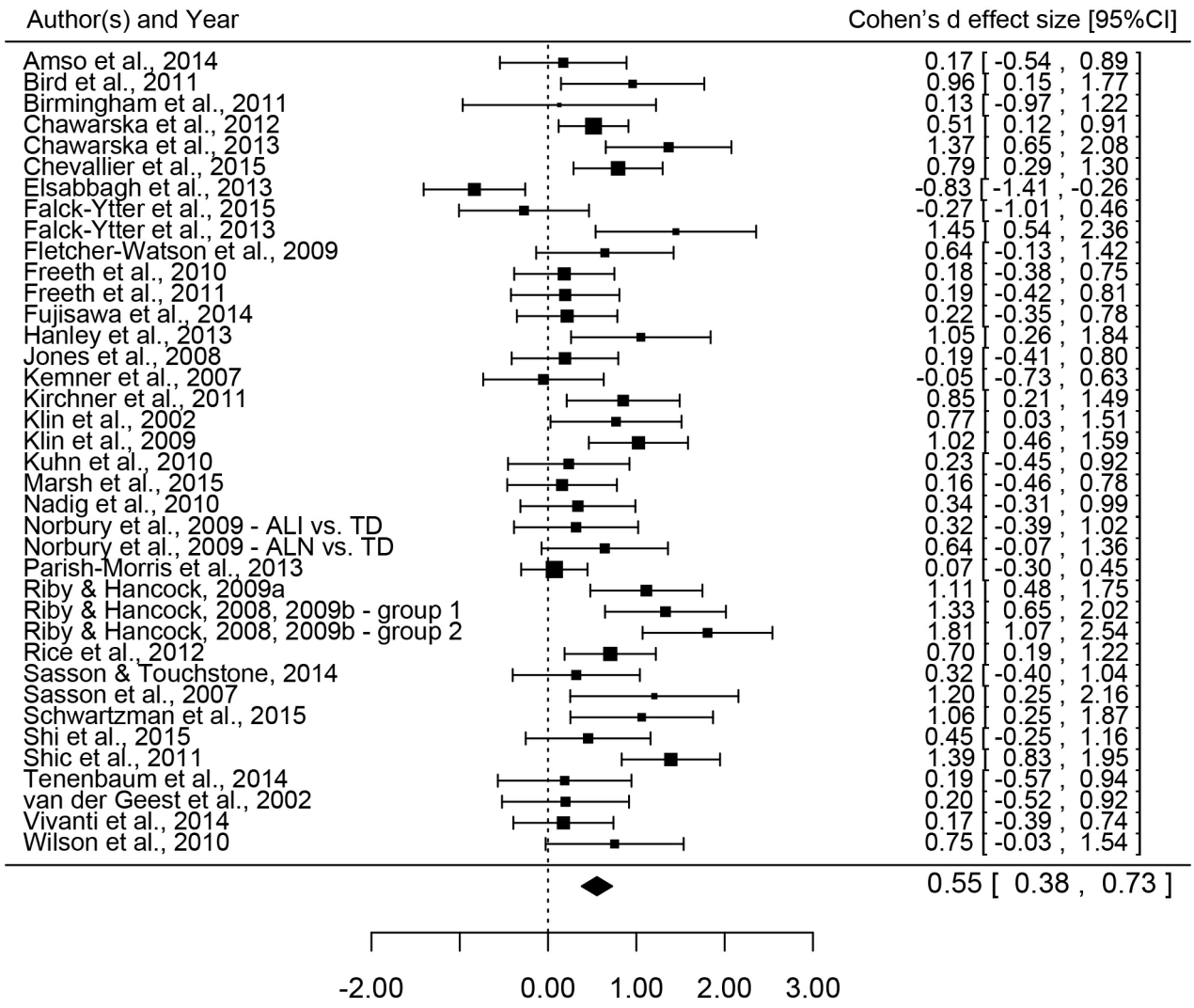
A. Clawson[1], *A. Kresse*[2], *E. J. Libsack*[2], *E. E. Neuhaus*[3], *C. M. Hudac*[4], *R. Bernier*[4], *E. H. Aylward*[2] *and S. J. J. Webb*[4], *(1)Brigham Young University, Provo, UT, (2)Seattle Children's Research Institute, Seattle, WA, (3)Seattle Children's Hospital, Seattle, WA, (4)University of Washington, Seattle, WA*

Background: Autism spectrum disorder (ASD) is a heterogeneous neurodevelopmental disorder more common in males than females. It is unclear to what extent impaired social processing in ASD differentially affects females relative to males. One way to examine the impact of social processing on behavior is through implicit learning in social and nonsocial contexts. Previous research suggests that youth with ASD display impaired implicit learning, suggesting poor behavioral control. No research has examined sex differences in implicit learning in ASD. Given that females with ASD may display reduced modulation to social information and experience greater functional impairment than males, females may display reduced implicit learning within social contexts.
Objectives: We examined sex differences in behavior (error rates, reaction times [RTs]) during an implicit learning task with social (emotive faces) or nonsocial (symbols) performance feedback. First, we examined implicit learning across trials and hypothesized that neurotypical controls would display increased accuracy and RT over time, while youth with ASD would not display behavioral modification across trials. We expected that females with ASD would display significantly reduced behavioral modification relative to males with ASD. Second, we examined the influence of feedback type on implicit learning. We hypothesized that females with ASD, but not males, would display reduced behavioral modification in response to social feedback relative to nonsocial feedback.
Methods: We collected data from 49 youth with ASD (21 female) and 32 neurotypical controls (15 female) ages 6-17. Behavioral data were collapsed into three blocks to examine learning across the task. Error rates and RTs were examined using Group (ASD, Control) x Sex (Female, Male) x Block (1^{st}, 2^{nd}, 3^{rd}) x Feedback (Social, Non-social) repeated measures ANOVAs.
Results: For error rates, the main effect of block was significant (F=7.3, p=.001), demonstrating expected increases in accuracy from Blocks 1-3. Main effects of Feedback, Group, and Sex were not significant (Fs<.94, ps>.34). The Block x Feedback x Group interaction was significant (F=6.03, p=.004). Youth with ASD displayed fewer errors for social than nonsocial feedback in Blocks 1-2, but more errors for social feedback in Block 3. Control youth displayed the opposite pattern, with more errors for social than nonsocial feedback in Blocks 1-2, but fewer errors for social feedback in Block 3. No other interactions were significant (Fs<2.6, ps>.08). For RTs, the main effect of block was significant (F=6.0, p=.004), with increasingly faster responses from the Blocks 1-2. Main effects of Feedback, Group, and Sex were not significant (Fs<.71, ps>.40) and no interactions were significant (Fs<2.92, ps>.06).
Conclusions: Youth with ASD and control youth displayed fewer errors and decreased RTs from the first to third block of the task, indicating intact implicit learning. Contrary to predictions, no Group or Sex differences in implicit learning were observed. However, when considering feedback type, youth with ASD made fewer errors to social feedback early in the task and more errors to nonsocial feedback late in the task than controls, possibly suggesting diminished sensitivity to social feedback. Differential implicit social learning in ASD may contribute to deficits in social processing.

37 **122.037** Social Attention in ASD: A Review and Meta-Analysis of Eye-Tracking Studies

M. Chita-Tegmark, *Boston University, Winchester, MA*

Background:
Determining whether social attention is reduced in Autism Spectrum Disorder (ASD) and what factors influence social attention is important to our theoretical understanding of developmental trajectories of ASD and to designing targeted interventions for ASD. Eye-tracking technology has facilitated research of social attention and results from experimental studies correlate with measures of social impairment and with autism symptom severity (Bird, Press, & Richardson, 2011; Chawarska, Macari, & Shic, 2012; Klin, Jones, Schultz, Vokmar & Cohen, 2002, Shic, Bradshaw, Klin, Scassellati, & Chawarska, 2011).
However, so far no consensus has been reached on whether social attention is fundamentally reduced or absent in individuals with ASD, with some studies showing significantly diminished attention to social information in ASD compared to typically developing (TD) controls (Klin et al., 2002; Kirchner, Hatri, Heekeren & Dziobek, 2011; Riby & Hancock, 2009; Riby, Hancock, Jones, Hanley, 2013; Rice, Moruchi, Jones, Klin, 2012; Shi et al., 2015; Shic, Bradshaw, Klin, Scassellati, & Chawarska, 2011), while other studies show no differences (Birmingham, Cerf & Adolphs, 2011; Freeth, Chapman, Ropar & Mitchell, 2010; Freeth, Ropar, Mitchell, Chapman, & Loher, 2011; van der Geest, Kemner, Camfferman, Verbate & van Engeland, 2002; Kemner, van der Geest, Verbaten, van Engeland, 2007; Kuhn, Kourkoulou, & Leekam, 2010; Marsh, Pearson, Ropar & Hamilton, 2015; Nadig, Lee, Singh, Bosshart & Ozonoff, 2010; Parish-Morris, Chevallier, Tonge, Letzen, Pandey & Schultz, 2013).
Objectives:
I conducted a meta-analysis examining data from 38 papers that used eye-tracking methods to compare individuals with ASD and TD controls. The goal for this meta-analysis was to search for quantitative answers to the following two questions: 1) Do individuals with ASD show overall diminished social attention? and 2) What are the factors that affect how they distribute their attention between social and non-social stimuli?
In my presentation, I will also show results from a more extensive meta-analysis project (which is currently in progress) investigating the visual processing of social stimuli and how ASD and TD controls distribute their attention differently towards the eyes, mouth, body and people's actions.
Methods:
In the meta-analyses mentioned above, I combined data from eye-tracking studies to calculate the overall effect size of the difference in social attention between individuals with ASD and TD controls. I also examined through linear meta-regression models the impact of eight factors on the difference in social attention between these two groups: age, non-verbal IQ matching, verbal IQ matching, motion, social content, ecological validity, audio input and attention bids.
Results:
Results show that individuals with ASD spend less time attending to social stimuli than typically developing (TD) controls, with a mean effect size of 0.55. Also, social attention in ASD was most impacted when stimuli had a high social content (showed more than one person).
Conclusions:
These meta-analyses provide an opportunity to survey the eye-tracking research on social attention in ASD and to outline potential future research directions, more specifically research of social attention in the context of stimuli with high social content.



38 **122.038** Social Cues Modulate Learning of Cue-Reward Association in Typically Developing Children and Adults: A Gaze-Contingent Learning Paradigm

***A. Vernetti**, T. J. Smith and A. Senju, Psychological Sciences, Birkbeck, University of London, London, United Kingdom*

Background: Attending to social signals is fundamental during social interactions, and failure to orient, attend and show preference for such signals is linked to atypical development of social cognition such as Autism. A possible mechanism underlying social orienting is the detection of the rewarding nature of social stimuli, as reward-related stimuli are shown to influence visual attention.
Objectives: To investigate the influence of associated reward on visual orienting to social and non-social stimuli in young typical developing children and adults, with the use of a novel gaze-contingent task to measure spontaneous orienting to these stimuli.
Methods: Sixty-four 3-4 year olds and sixty-four adults observed a stimulus display consisting of two peripherally presented dynamic cues and a centrally presented reward. Participants' eye movements were concurrently recorded with an eye-tracker, and the location of participant's fixation triggered the delivery of corresponding stimuli on-line. Fixation on each cue triggered a dynamic sequence of signals and subsequent delivery of a reward, which was a popular animated cartoon, or a penalty, a blank screen. Two different conditions were investigated. In a social condition, the videos of two persons were presented. An engaging person greeted and turned towards the centre of the screen while the other non-engaging person moaned and turned away from it. In a non-social condition, the videos of two dynamic spheres were presented. An engaging sphere was displaying an arrow associated with a winning jingle ("ding") and moving towards the centre of the screen while the other non-engaging sphere was displaying an arrow associated with a failing jingle ("dong") and moving away from it. Engaging cues triggered reward delivery for half the participants, and non-engaging cues for the other half of the participants.
Results: Both children and adults were able to learn the cue-reward association in all the conditions. Importantly, children learned the cue-reward association more rapidly and more efficiently in social and engaging condition than social non-engaging or non-social conditions. Similarly, adults learned the cue-reward association more rapidly and more efficiently in social and engaging condition than in social non-engaging condition. Unlike children, adults' performance did not differ between social engaging condition and in non-social conditions.
Conclusions: The results showed that the engaging nature of social cues facilitates both the speed and the efficiency of learning of cue-reward association, both in typically developing young children and in adults. It also demonstrated the utility of gaze-contingent learning paradigm to assess the role of social signal on a simulated social learning. Future research will benefit from this paradigm to study the relationship between social attention and learning in individuals with Autism.

39 **122.039** The Effect of Visual Perceptual Load on Auditory Detection Sensitivity in ASD

***J. E. Tillmann** and J. Swettenham, University College London, London, United Kingdom*

Background: According to the increased perceptual capacity account (Remington et al. 2009), individuals with ASD have an enhanced capacity for processing perceptual information. When the perceptual load of a task is high, capacity is exhausted in neurotypical controls and task-irrelevant stimuli are not processed. In contrast, individuals with ASD have spare capacity automatically processing task-irrelevant stimuli under conditions of high perceptual load. This has been demonstrated in the visual domain with studies measuring response competition effects (Remington et al, 2009), detection sensitivity (Remington, Swettenham & Lavie, 2012) and rates of inattentional

blindness (Swettenham et al. 2014). Recently, we have also demonstrated that increased perceptual capacity in ASD operates across sensory modalities. Increasing the perceptual load of a visual search task reduces awareness of an *unexpected* auditory stimulus to a lesser extent in children with ASD than in typically developing (TD) children (Tillmann et al. 2015).
Objectives: The current study investigated whether increasing the perceptual load in a visual search task has less of an effect on detection sensitivity for an *expected* (present on 50% of trials) auditory stimulus in ASD compared to TD individuals. Our previous study used an inattentional deafness paradigm, which involves awareness of a single, unexpectedly presented auditory stimulus, and a manipulation of perceptual load by altering the subtlety of a line discrimination task (Tillmann et al. 2015). Here we used a different measure of perceptual load (increasing visual search set-size) and asked participants to indicate the presence/absence of a tone on each trial, allowing us to measure detection sensitivity.
Methods: 20 TD adolescents and 19 adolescents with ASD matched for chronological age and non-verbal ability performed a visual search task (responding to target letter X or N in a search array) while simultaneously detecting presence/absence of an auditory tone embedded in noise (see Figure 1). Perceptual load was manipulated by increasing the number of additional visual stimuli in the search display (i.e. increasing the search set size). The intensity level of the auditory stimulus was just above each individual's pre-established auditory perceptual threshold, thus controlling for individual differences in perceptual sensitivity.
Results: When the perceptual load of the visual task was low (one or two items in the central search array), detection sensitivity for the auditory stimulus did not differ between groups. However, when the perceptual load was higher (four items in the search array) auditory detection sensitivity was significantly reduced in TD individuals compared to individuals with ASD, who maintained a high level of detection. At even higher levels of perceptual load, there was no difference in detection sensitivity between groups (see Figure 2).
Conclusions: The finding that auditory detection sensitivity in the ASD group was less affected by increasing the perceptual load of the visual task provides further support for the hypothesis that individuals with ASD have an increased perceptual capacity. We have also demonstrated that increased capacity affects processing across modalities, and that these effects cannot be explained by differences in response criteria (e.g. always responding "stimulus present").

Figure 1 Example trial with an auditory tone present in noise at set size four

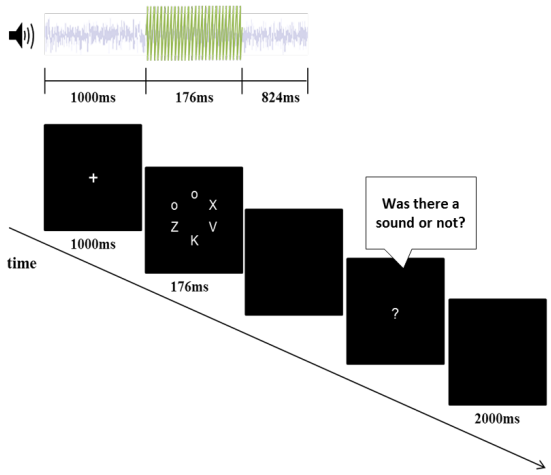
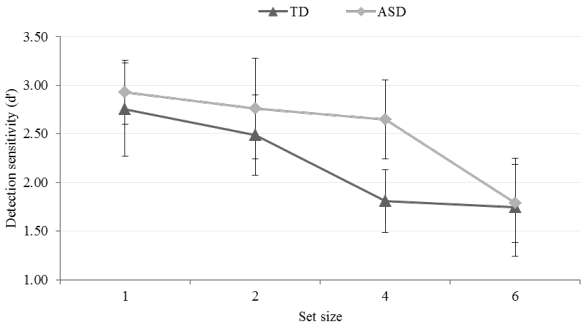


Figure 2 Detection sensitivity (d') as a function of set size and group (error bars: 95% CI)



40 **122.040** The Effects on Inhibition of Cognitive Remediation Therapy in Patients with Autism Spectrum Disorder

M. Hajri[1], *Z. Abbes*[1], *H. Ben Yahia*[1], *T. Brahim*[2], *S. Halayem*[1] *and A. Bouden*[1], *(1)psychiatric hospital Razi, Tunis, Tunisia, (2)University of Monastir, Monastir, Tunisia*

Background:
Executive impairments associated with Autism spectrum disorder (ASD) are nowadays well known. Cognitive remediation is a new promising technique designed to improve the neurocognitive abilities damaged in some disorders such as schizophrenia. C
Objectives: considering the overlap between ASD and schizophrenia, we aimed in our study to apply the cognitive remediation program CRT (Cognitive Remediation Therapy) for children and adolescents with ASD and to evaluate its effectiveness on planning.
Methods:
Cross-sectional study involving children and adolescents with ASD according to DSM-5.The CRT program was conducted at the rate of one session per week of 45 minutes each. Outcome measure was inhibition assessed either by Hayling Sentence Completion Task or Colors and Animals Attention Test (CAAT).
Results:
Of the 25 patients included, 18 had reached the end of the program. Among them, 16 patients achieved the neuropsychological assessments tests after CRT, thus constituting our final sample. Their average age was 10, 87 years. The mean number of sessions performed was 22, 38. Ten patients were assessed by the means of the CAAT, and six by the means of Hayling Sentence Completion Task.
As for patients who performed Hayling Sentence Completion Task, the latency for sentences in part A was shorter after completion of CRT (32,8 seconds) than before it (38,25 seconds). As for part B, the latency was longer after CRT (41 seconds) than at baseline (35 seconds). Patients gave more correct responses after the program (14,8) than before it (10,33).
Concerning the CAAT, patients showed improvement on interference score which increased from 4.1 before CRT to 5,8 after achievement of the program.
Conclusions:
Cognitive remediation can be a promising new modality in the treatment of ASD. Further research is needed to better document its effects and the optimal conditions required for setting it up.

41 **122.041** The 'Light from Above' Prior Is Intact in Children on the Autism Spectrum

A. E. Croydon[1], *T. Karaminis*[1], *L. E. Neil*[1], *D. C. Burr*[2] *and E. Pellicano*[1], *(1)Centre for Research in Autism and Education (CRAE), UCL Institute of Education, University College London, London, United Kingdom, (2)CNR Institute of Neuroscience, University of Florence, Pisa, Italy*

Background: Sensory information entering the retina is inherently ambiguous. The brain makes sense of it by anticipating or predicting the sensory environment based on prior knowledge. Some authors have proposed that this predictive process may be atypical in autism, in that internal assumptions, or *priors,* may be under-weighted or less utilized than in typical individuals (Pellicano & Burr, 2012).
A robust internal assumption used by adults is the light-from-above prior (Sun & Perona, 1998), in which shading patterns on an object are interpreted as if the light source is located above (and slightly to the left) of an object, even when shading information is consistent with alternative light source locations.
Objectives:
We investigated whether children with autism use prior information to estimate the shape of an object, that is, whether they show the so-called 'light-from-above prior' to the same degree as typical children.
Methods: A group of autistic children (n=17) and a group of typical children (n=27), all aged 7 to 13 years, and matched in terms of age and intellectual ability, took part. Following Andrews et al. (2012), children were asked to judge the shape of a 7 hexagon stimulus – whether it appeared concave or convex. Within the context of a developmentally-appropriate game, they decided whether a bee should fill the cell with honey (if the stimulus was perceived to be concave) or not (if perceived to be convex). Twelve orientations of the hexagon stimulus were presented in a randomised order. Children completed 120 trials across 3 blocks. The testing room was lit only by the computer monitor to minimise environmental lighting cues.
Results: The relation between the proportion of convex judgements ('no' answers in our game) and stimulus orientation was estimated for each child using a multivariate logistic regression. The light source location most consistent with those judgements was then calculated for each child following the procedure in Andrews et al. (2012). Children's assumed light source direction ranged from -30.37˚ to -43.12˚. There were no significant group differences, $t(42) = -1.04$, $p = 0.30$.
Conclusions: Contrary to our expectations (cf. Pellicano & Burr, 2012), we found no significant differences in assumed light source position between autistic and typical children. Children on the autism spectrum seem to use prior assumptions to make sense of 3-dimensional information to the same degree as typically developing children. Future research should examine whether this prior is as adaptable (i.e., modifiable with training) in autistic children, as it is in typical adults (Adams, et al., 2004, 2010).

42 **122.042** Thinking Fast and Slow: Implications for the Autism Spectrum

M. Brosnan[1], *C. Ashwin*[2] *and M. Lewton*[1], *(1)University of Bath, Bath, United Kingdom, (2)University of Bath, Bath, United Kingdom of Great Britain and Northern Ireland*

Background:
Reasoning in people with Autism Spectrum Disorder (ASD) has been characterised as being slower and more effortful than controls. People with ASD show a more circumscribed reasoning bias, and often take longer to make decisions. These differences can be understood using Dual Process Theory, which proposes two major types of processes. Type 1 processing is rapid, effortless, parallel, and often involves non-conscious processing, while Type 2 processing is slower, more effortful, sequential, and often conscious in nature. It is assumed Type 1 processes are the default response during reasoning, unless intervened upon by Type 2 processes. The most widely used behavioural assessment of Type 1/Type 2 processing is the Cognitive Reflections Test (CRT), which involves answering reasoning problems that have a rapid, effortless Type 1 response which can either be provided or supressed by a subsequent slower effortful Type 2 response (or a wrong response provided). This simple task is well-suited to test reasoning styles in people with ASD and higher autism traits.
Objectives:
To present the CRT to those high and low on autism traits and those with a diagnosis of ASD using two different CRT formats: (1) a 'fast' condition which required participants to respond as quickly as possible within 20 seconds and designed to encourage Type 1 processing, and (2) a 'slow' condition which required participants to wait 20 seconds before being able to respond to the question to encourage Type 2 processing. It was expected the higher autism traits group and those diagnosed with ASD would show greater Type 2 processing compared to those lower in autism traits and controls, but that this difference in reasoning would change based on the manipulation of time.
Methods:
In Study 1, participants from a typical population (62 male, 58 female) completed an assessment of autism traits and the CRT in either the fast or slow condition. Participants were assigned to either a high or low autism traits groups using a median-split of their degree of autism traits. In Study 2, 23 (16 male, 7 female) students with a diagnosis of ASD completed the CRT in either the fast or slow condition.
Results:
In Study 1, significantly less Type 1 and more Type 2 responses were provided by the higher autism traits group compared to the lower autism traits group and in the slow condition compared to the fast condition (there was no interaction). In Study 2, again, there were significantly more Type 2 responses in the slow condition and a trend ($p<.1$) for more Type 1 responses in the fast condition.
Conclusions:
Taken together, the results showed that Type 2 processing is more dominant in those with higher autism traits, consistent with the idea that reasoning in ASD is characterised as dominated by Type 2 processing. The significant differences between the fast and slow conditions highlights that reasoning style can be manipulated based on context. Both findings are consistent with Dual Process Theory and may have implications for developing supportive environments where slow and effortful reasoning are problematic.

43 **122.043** Training Attention in Students with ASD Using a Multiple Object Tracking Paradigm: A Pilot Study

D. Tullo[1,2], *J. Guy*[3], *J. Faubert*[4] *and A. Bertone*[1,2], *(1)Educational and Counselling Psychology, McGill University, Montreal, QC, Canada, (2)Perceptual Neuroscience Laboratory for Autism & Development, Montreal, QC, Canada, (3)McGill University, Montreal, QC, Canada, (4)Université de Montréal, Montréal, QC, Canada*

Background: The ability to pay attention is a primary predictor of academic achievement (Duncan et al., 2007), while inattention is associated with problem behaviors and poor academic performance (Barriga et al., 2002). A deficiency in the subcomponents of selective and sustained attention are characteristic of atypically developing populations; specifically, in children with Autism Spectrum Disorder (ASD; Koldewyn, et al., 2013). Consequently, several cognitive-based training approaches have been developed to reduce problems of attention by targeting the subcomponent processes (Sonuga-Barke et al., 2014). Cognitive training is commonly achieved through implicit practice via repeated performance on tasks (Willis & Schaie, 2009). Here, we used Multiple Object Tracking (MOT) paradigm as a method of cognitive training. The reasons for this are threefold: first, MOT is considered to be the best empirical measure of object-based visual attention (Scholl, 2009); second, it is non-verbal in nature; and third, it is accessible to children of different ages and levels of cognitive functioning.
Objectives: We aimed to assess the efficacy of a training program using a MOT paradigm in adolescents with ASD. We asked the following questions: (i) will the performance of participants with ASD improve significantly with training, and (ii) will increased performance on the MOT paradigm transfer to another test of attention (i.e., *near-transfer*; Redick et al., 2014)?
Methods: Nine high-school students diagnosed with ASD (aged 12-17), and 15 students diagnosed with a neurodevelopmental condition other than ASD (learning disorder) were pre-assessed on the Wechsler Abbreviated Scale of Intelligence (WASI-II) and the Conners Continuous Performance Task (CPT-3). An experimental group (ASD: n = 6 & non-ASD: n = 6) received the MOT cognitive training program, while an active control group (ASD: n = 4 & non-ASD = 8) was trained on *2048* (a puzzle-like, math game). Both groups trained three times a week, over a period of five weeks, for a total of fifteen MOT or *2048* training sessions. Performance on the MOT task was defined as the average speed at which the participant could track three of eight target items. Post-training performance on the CPT-3 was compared to pre-training scores to measure an effect of transfer; groups switched training tasks and followed the same routine and post-test schedules.
Results: MOT performance doubled from the first to the last (fifteenth) training session for both the ASD and non-ASD group. This increase was similar to that found in typically-developing adolescents (Tullo et al., 2015). Preliminary analyses revealed that the improvement on the MOT task did not transfer to the CPT-3 task; this was not surprising given our small group size.
Conclusions: Results demonstrate that our MOT training is accessible to adolescents with ASD of different ages and levels of cognitive functioning. Our findings illustrate that adolescents with ASD are able to train attention on a non-verbal task similarly to those without ASD and typically-developing adolescents. We are presently analyzing whether the outcome measure of attention, and verbal- and non-verbal cognitive functioning of the participants with ASD is related to the effect of near transfer.

44 **122.044** Verbal and Spatial Working Memories in Children with High-Functioning Autism Spectrum Disorder, and Their Relationships with Symptom Severity and Adaptive Function

Y. A. Lin[1] *and C. H. Chiang*[2], *(1)National Chengchi University, Taipei City, Taiwan, (2)National Chengchi University, Taipei, Taiwan (Province of China)*

Background: Whether children with autism spectrum disorder present a deficit in working memory, a component of Executive Function (EF), remains controversial in past literatures. In Baddeley's model (1986), working memory is depicted as two slave systems, the phonological loop and the visuospatial sketchpad, under a central executive system. Recently, Williams et al. (2005) reported spatial working memory (SWM) impairment in 8- to16-year-olds with high-functioning autism spectrum disorder (HFASD); while their verbal working memory (VWM) was found unaffected. The present study further examines if similar patterns also exist in younger children with HFASD, and if psychopathology of ASD is associated with the patterns of working memory.
Objectives: We aim to (1) examine the verbal and spatial working memories in young children with HFASD, to (2) explore working memory challenges encountered in their daily activities, and to (3) examine the correlation between the performance of two working memories and symptom severity.
Methods: We recruited 30 children aged 7–10 years with HFASD, and 27 control participants (TD) with matched Age, Verbal, Performance, and Full Scale IQ. Diagnosis was verified with ADI-R and ADOS. All HFASD children met diagnostic criteria for ASD in DSM-5. The VWM was measured by Digital Symbol subtest (including forward and backward digit span) from WISC-III, and SWM was measured by Spatial Memory subtest from Leiter-R. The BRIEF (Behavior Rating Inventory of Executive Functions) was completed by parents for daily life executive performance of their children. Parents were also interviewed by using the VABS-II (Vineland Adaptive Behavior Scales, 2nd Edition) to assess the adaptive function of their children.
Results: The results showed that HFASD shows statistically significant scores in all subscales of BRIEF compared to TD. The most salient disparity was found in working memory subscale ($F(1,55) = 41.512$, $p = .000$). Moreover, we found a significant difference between the HFASD and TD in SWM, whereas HFASD performed poorly ($F(1,55) = 7.628$, $p = .008$) compared to TD. Nevertheless, no difference was found in forward- or backward-VWM. A strong correlation between SWM and backward-VWM was found ($r = .652$, $p < .000$). Although no correlation was found in working memories and autistic symptom severity, we found HFASD with higher performance on SWM had better performance IQ ($F(1,28) = 6.230$, $p = .019$) as well as higher socialization domain in adaptive function ($F(1,28) = 4.860$, $p = .036$).
Conclusions: The present study suggests parents' reports of working memory deficit in their autistic children was the most challenging issue among all other EF components, which is different from past studies. When IQ and age is matched, children with HFASD show only spatial working memory deficit. It indicates a dissociation between verbal and spatial working memory in HFASD, supporting the conclusion made by Williams et al. (2005). Although the deficit may not be explained by the psychopathology in ASD, it is associated with decreased socialization domain in adaptive function. Possible influencing factors and the implications for intervention to the spatial working memory in HFASD children are also discussed in details.

45 **122.045** Working Memory and Emotional Processing Related to Autistic Behaviors

S. Taylor[1], *C. Dickter*[2] *and J. Burk*[2], *(1)College of William and Mary, Glen Allen, VA, (2)College of William & Mary, Williamsburg, VA*

Background:
Autism Spectrum Disorder (ASD) is a developmental disorder characterized by deficits in communication, social, and motor skills (CDC, 2013). Research has demonstrated that individuals with Autism Spectrum Disorder (ASD) have working memory deficits that affect both short-term storage of information and application of that information

(Baddeley, 1992).
Objectives:
This study aimed to examine if the working memory deficit that has been identified among a clinically diagnosed ASD population is also present in a neurotypical, non-diagnosed population that displays either a small number or large number of autistic behaviors. The study also examined whether adding an emotional component to a working memory task affects participants' performance.
Methods:
A non-clinically diagnosed sample consisting of college student participants with a high number (n = 42) or a low number (n = 43) of autistic behaviors, as measured by the Autism Quotient (AQ; Baron-Cohen et al., 2001), was used. Working memory was tested using different forms of the standard n-back task. The standard n-back task presents a series of letters and requires the participant to indicate if the letter shown matches a letter previously presented (Koshino et al., 2005). In the current study, there were three conditions in which participants press a key if the letter matches the one presented first (0-back) in the series, was the one before it (1-back), or was two before it (2-back). In addition to administering this task, we created a modified n-back task that presented a series of faces expressing emotions as stimuli instead of letters, allowing us to examine the interaction between emotion processing and working memory.
Results: There were no main effects or interactions on the letter n-back tasks. On the emotion n-back task, the reaction times (RTs) of participants with fewer autistic behaviors specific to the attention to detail subscale did not significantly vary based on which emotion was being displayed, while the RTs for participants higher on this subscale varied based on emotion; $F(3, 25) = 3.17$, $p = .04$. As can be seen in Figure 1, participants high on the AQ attention to detail subscale were significantly slower when a fearful face was shown compared to either a happy, $t(29) = 2.96$, $p = .01$, or angry face, $t(30) = 2.37$, $p = .03$.
Conclusions:
As most studies examining ASD and memory use children or adolescents and compare neurotypical and autistic subjects, the comparison of neurotypical, college-aged participants with varying levels of autistic behaviors sets this study apart from previous work. This study revealed that performance on the letter working memory task was not affected by the level of autistic behaviors, while performance on the working memory task using emotion stimuli was impaired in those with a higher level of autistic behaviors. This finding supports the idea that autistic behaviors are on a spectrum and that they can affect working memory in nondiagnosed populations.

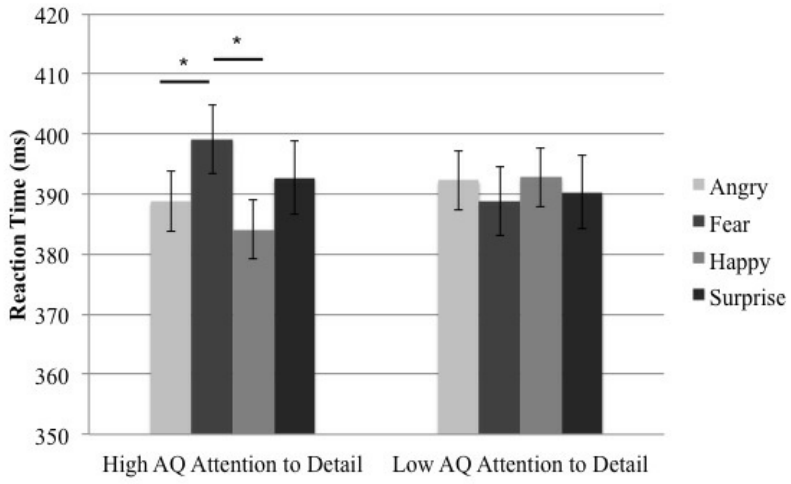


Figure 1. Reaction Time as a Function of Autistic Behaviors related to Attention to Detail and Emotion
Note. Error bars represent standard error. *denotes $p < .05$

Poster Session
123 - Diagnostic, Behavioral and Intellectual Assessment I
5:30 PM - 7:00 PM - Hall A

46 **123.046** A Machine Learning-Based Approach to Detecting Autism Spectrum Disorder from Unstructured and Semi-Structured Medical Records

T. Smith[1], *J. Yuan*[2] *and J. Luo*[2], *(1)601 Elmwood Ave, Box 671, University of Rochester Medical Center, Rochester, NY, (2)Computer Science, University of Rochester, Rochester, NY*

Background:
Currently, no laboratory test for ASD exists, and the process of diagnosing the disorder is highly complex and labor intensive, requiring extensive expertise. As a result, few centers offer ASD diagnostic evaluations, and these centers have lengthy waiting lists.
Objectives:
We tested the feasibility and potential utility of a novel method for identifying children who may have ASD: natural language processing (NLP) with machine learning. This method involves developing computer algorithms to process and understand human communication. Specifically, we sought (1) to extract unstructured and semi-structured information from medical records and (2) to create an algorithm that analyzes records obtained prior to the initial diagnostic evaluation and accurately predicts which children do or do not receive an ASD diagnosis when evaluated by an expert clinician.
Methods:
We examined medical records from 199 children, age 2-5 years (56 who were later diagnosed with ASD, 143 with other developmental concerns). The records included (1) the referral form from the primary care physician, (2) intake questionnaires completed by the child's parent and teacher, (3) school reports (when available), and (4) phone intakes by clinic social workers. Diagnosis was ascertained from the clinician's evaluation report. Medical forms were saved on a HIPAA-compliant server, de-skewed (rotated to a right angle), and de-identified (automatically blanking areas containing personal information). Optical character recognition software was then used to extract hand-written and typed information from records. The following models were used to identify lexical features in the records: (1) Bag-of-Words (BoW, occurrence of a word in a document), (2) N-Gram (occurrence of a phrase in a document), (3) Term Frequency-Inverse Document Frequency (Tf-idf, a statistical measure used to evaluate how important a word is to a document), (4) Latent Dirichlet Allocation (LDA, a measure of the probability that a word occurs within a topic), and (5) Distributed Representation (Doc2Vec, a measure of meaning that is represented by a pattern of activity across multiple sources). Finally, using lexical features obtained from records, we employed support vector machine algorithms to classify each child as possibly having ASD or not.
Results:
We successfully extracted information and identified lexical features from all medical records. With 150 lexical features, accuracy of classification was 66.3% for BoW, 67.8% for N-Gram, 66.8% for Tf-Idf, 78.4% for LDA, and 83.4% for Doc2Vec. Positive predictive value was 40.4% for BoW, 43.1% for N-Gram, 41.4% for Td-Idf, 58.0% for LDA, and 64.6% for Doc2Vec. Sensitivity was 41.1% for BoW, 44.6% for N-Gram, 42.9% for Tf-Idf, 83.9% for LDA, and 91.1% for Doc2Vec.
Conclusions:
This study demonstrates the feasibility of extracting information and identifying lexical features from unstructured and semi-structured medical records. The most successful classification system, based on Doc2Vec, showed promising levels of accuracy, positive predictive value, and sensitivity. Analyses that involve a larger dataset are needed to improve the classification rate. With further development, the proposed framework could simplify and shorten the process of diagnosing ASD.

47 **123.047** ADOS Diagnostic Utility in Children with Low Mental Age

L. E. Miller[1], *C. Cordeaux*[1] *and D. A. Fein*[2], *(1)University of Connecticut, Storrs, CT, (2)Psychology, University of Connecticut, Storrs, CT*

Background: Many individuals with autism spectrum disorders (ASDs) have comorbid intellectual impairment, with some children presenting with low mental age (LMA), defined here as cognitive functioning at or below a 12-month level. However, few diagnostic tools are recommended for use in children below age 12 months, with the utility

of using common tools in diagnosing ASD in children with concurrent LMA not yet demonstrated.
Objectives: This study aims to assess the accuracy of a common diagnostic tool, the Autism Diagnostic Observation Schedule (ADOS), in diagnosing ASDs in toddlers with comorbid LMA.
Methods: Participants were drawn from a larger study on the early detection of ASDs, in which they received a developmental evaluation at the approximate age of two years. Cognitive level and autism symptomatology were assessed by the Mullen Scales of Early Learning (MSEL) and ADOS, respectively. Diagnoses were assigned according to DSM-IV-TR criteria, using clinical best estimate judgment of symptoms based on observation, history, and testing. ASD-LMA was given as a research diagnosis to children meeting criteria for Autistic Disorder (AD) or Pervasive Developmental Disorder, Not Otherwise Specified (PDD-NOS) who also demonstrated age-equivalent scores ≤ 12 months in MSEL Visual Reception, Expressive Language, and Receptive Language domains. The current study used Chi square tests to determine level of agreement between ADOS classification (i.e., Autism/AD, Autism Spectrum/PDD-NOS, Non-Spectrum) and clinical best estimate DSM-IV-TR diagnosis (i.e., AD, PDD-NOS) in children with ASD-LMA.
Results: 43 children (33 males; mean age 24.9 ± 4.45 months) were evaluated and diagnosed with ASD-LMA. 43 age-, gender-, and ethnicity-matched children meeting criteria for an ASD without concurrent LMA served as comparison. Independent-samples *t*-tests revealed significant group differences on all MSEL domains (all p's < .001), with the ASD-LMA group showing greater impairment as expected. Groups did not significantly differ on ADOS severity (p = .162). Agreement between ADOS classification and DSM-IV-TR diagnosis was slight but non-significant in the ASD-LMA group ($X^2(1) = 2.030$, p = .154, Cohen's kappa = .154). In the ASD-LMA group, the ADOS correctly classified all children as having an ASD but over-estimated severity level in 25.6% of children. 93.0% of children were classified by the ADOS as having AD, resulting in a non-significant Chi square. By comparison, agreement in the ASD group was significant, likely related to a greater spread in ADOS scores ($X^2(2) = 14.353$, p = .001, Cohen's kappa = .372). However, the ADOS misclassified 16.3% of children as not having an ASD. Overall, both groups showed similar percent agreement (ASD-LMA group = 72.1%, ASD group = 67.4%).
Conclusions: This study was designed to determine the utility of a commonly-used assessment tool (i.e., ADOS) in diagnosing ASDs in children with comorbid LMA. Overall, results support the use of the ADOS in children with LMA. However, since it appears to over-estimate symptom severity, the ADOS may not be useful in distinguishing between AD and PDD-NOS in children with LMA, especially when used at age two years. Thus, it is important to use testing data in combination with clinical best estimate judgment.

48 **123.048** Adaptive Behavior Profiles in Girls with Autism: A Comparison to Previously Published Profiles in Boys

C. A. Saulnier[1], *K. Koenig*[2], *B. Naqvi*[3], *J. M. Moriuchi*[4] *and A. Klin*[5], *(1)Marcus Autism Center, Children's Healthcare of Atlanta and Emory University School of Medicine, Atlanta, GA, (2)Yale Child Study Center, New Haven, CT, (3)New York University, New York, NY, (4)Psychology, Emory University, Atlanta, GA, (5)Department of Pediatrics, Emory University School of Medicine, Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, GA*

Background:
The vast majority of research on adaptive behavior profiles in individuals with autism spectrum disorders (ASD) has been conducted on boys. Studies using the *Vineland Adaptive Behavior Scales* have shown Socialization skills to be most impaired, followed by Communication and then Daily Living Skills (Bolte & Poustka, 2002; Carter et al., 1998). In boys with ASD without cognitive impairment, adaptive skills tend to fall substantially below both IQ and age, with age being negatively correlated with adaptive behavior, suggesting a widening gap with age (Klin et al., 2007; Kanne et al., 2010).
Objectives:
This study compares a sample of girls with ASD evaluated at the Yale Child Study Center with a sample of boys of the same age range evaluated at Yale and published by Klin et al. in 2007. In the Klin study, 84 boys ages 8 to 18 years (Mean=12.4) of average intelligence (FSIQ=99.8; VIQ=104.7; NVIQ=94.5) exhibited significant adaptive deficits, with their Socialization Standard Scores on the Vineland falling more than 3 standard deviations below chronological and mental age (Mean=52.0). Age was negatively correlated with adaptive functioning, with older boys exhibiting a greater gap between cognition and adaptive behavior than younger boys. With the current study, our aim is to examine if girls with ASD exhibit similar profiles.
Methods:
Participants included 48 girls with ASD that received diagnostic evaluations through the Yale Developmental Disabilities Clinic. The sample was restricted to girls between the ages of 8 and18 years to match the Klin et al. sample (Mean Age=11.47; SD=2.63). IQ measures included the *Differential Ability Scales, Second Edition* and a combination of the Wechsler Scales for children for adults. The *Vineland Adaptive Behavior Scales, Expanded Form*was used to assess adaptive behavior. Similar to the boys in the 2007 paper, girls evidenced stronger Verbal IQ scores than Nonverbal (VIQ=94.76, SD=27.83; NVIQ=83.57, SD=23.95), with a Full Scale Mean of 85.94 (SD=25.25).
Results:
Results revealed significant delays in all adaptive areas with the following Vineland Mean Standard Scores: Communication=64.77 (SD=22.59); Daily Living Skills=53.02 (SD=21.66); and Socialization=56.65 (SD=15.0). Age Equivalent (AE) scores for Socialization were lowest, with a Mean Interpersonal AE=3.73 years (SD=2.25) – quite similar to the sample of boys in 2007 (Mean AE=3.2, SD=1.6). Pearson correlations indicated that Nonverbal IQ was related to more areas of adaptive functioning (Comm r=.56, p<.01; DLS r=.48, p<.01; Soc r=.34, p<.05) than Verbal IQ (Comm r=.62, p<.01). Age was negatively correlated with adaptive Socialization skills (r= -0.31, p<.05), consistent with results in boys.
Conclusions:
Results highlight the similarities in adaptive behavior profiles in girls compared to well-established profiles in boys. Though current studies are questioning if diagnostic profiles of girls could be qualitatively different than those in boys, our findings suggest that perhaps differences in symptomatology could be independent from more consistent cognitive and adaptive profiles. The substantial gap between cognition and adaptive functioning is similarly striking, as is the significant correlation between age and socialization skills suggesting that this gap widens with age. Implications for informing intervention will be discussed.

49 **123.049** An Examination of Cognitive and Adaptive Trends in Children with Autism Spectrum Disorder; A Comparison of Girls and Boys

A. Platner[1], *K. M. Stiles*[2], *N. Bhuiyan*[1], *C. Deguire*[2,3], *S. E. Gillespie*[1] *and S. Hoffenberg*[1], *(1)Marcus Autism Center, Children's Healthcare of Atlanta, and Emory University School of Medicine, Atlanta, GA, (2)Marcus Autism Center and Children's Healthcare of Atlanta, Atlanta, GA, (3)Georgia School of Professional Psychology, Argosy University, Sandy Springs, GA*

Background: Despite the difference in prevalence of girls and boys with ASD, little research has investigated variations in developmental patterns between genders (Halladay et al., 2015). Whereas earlier research demonstrated significant gender discrepancies in developmental profiles for children with ASD, more current literature suggests comparable developmental profiles between girls and boys, although these findings lack consensus (Zwaigenbaum et al., 2012). Better understanding of gender differences will result in improved methods of detection and treatment.
Objectives: This study seeks to compare the developmental and adaptive profiles of girls and boys with ASD.
Methods: All children had a confirmed ASD diagnosis and were seen at an autism center, which serves a diverse geographic and socioeconomic population. Assessments included: (1) parent interview (2) assessment of cognitive/developmental abilities using the Mullen Scales of Early Learning or Differential Abilities Scales-2nd Edition, (3) adaptive assessment using the Vineland Adaptive Behavior Scales, 2nd Edition, Survey Interview, and (4) ASD assessment using the Autism Diagnostic Observation Schedule. Expressive and receptive language scores on the Mullen were averaged to obtain an overall verbal score. Developmental/cognitive scores were converted to z-scores to compare group means. Subsequently, a verbal domain (VD) was created by combining Mullen overall verbal scores and DAS-II verbal scores. Similarly, Mullen visual reception and DAS-II nonverbal scores were merged to create a nonverbal domain (NVD). Differences in measure values between the genders were considered for the raw values and after adjusting for age via general linear regression.
Results: Participants included 204 (49 female and 155 male) children between the ages of 21 and 151 months, with girls and boys having comparable mean ages, 49.3 (SD 20.4) and 51 (SD 21.7) months, respectively. Groups were similar with regard to race and ethnicity. There were no differences between genders on the Vineland-II domain or subdomain scores, with the exception of Domestic DLS which was higher in girls when adjusted for age (14.4 (SE 5.9) versus 11.3 (SE 5.0), p= 0.048). Moreover, there were no significant differences between genders on the DAS-II GCA, Verbal, and Spatial domains; however, boys scored significantly higher than girls on the DAS Non-Verbal domain after adjusting for age (83.4 (SE 40.2) versus 70.2 (SE 31.2); p=0.012). There were no significant differences between genders on the Mullen. When DAS-II and Mullen scores were taken together for both genders, there were no significant differences between overall IQ scores or the verbal/language scores. However, similar to the DAS-II data, boys scored higher than girls on the NVD (Z-Score:-1.9 (SD 1.4) versus -2.3 (SD 0.9); p=0.016).
Conclusions: This study supports the current literature suggesting that there are few differences in adaptive profiles between girls and boys with ASD. However, results of this study indicate that boys' nonverbal abilities were significantly better than girls. These findings highlight the importance of understanding diagnostic profiles of girls and boys with ASD in order to create the most beneficial treatment plan and intervention for each child. Further research should examine a larger sample size as well as children across different ages and developmental levels.

50 **123.050** An Investigation of the 'Female Camouflage Effect' in Autism Using a New Computerized Test Showing Sex/Gender Differences during ADOS-2

A. Rynkiewicz[1,2], *B. Schuller*[3,4,5], *E. Marchi*[3], *S. Piana*[6], *A. Camurri*[6], *A. Lassalle*[7] *and S. Baron-Cohen*[7], *(1)Department of Psychiatry, Medical University of Gdansk, Gdansk, Poland, (2)Centrum Diagnozy, Terapii i Edukacji SPECTRUM ASC-MED, Gdansk, Poland, (3)Machine Intelligence & Signal Processing Group, Technische Universität München, Munich, Germany, (4)Department of Computing, Imperial College London, London, United Kingdom, (5)Chair of Complex & Intelligent Systems,*

University of Passau, Passau, Germany, (6)Casa Paganini-InfoMus Research Centre DIBRIS, University of Genoa, Genoa, Italy, (7)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom

Background: Autism is diagnosed more frequently in males than in females. Females with autism may have been under-identified due to a male-biased understanding of autism but also females' camouflaging. This study presents an innovative computerized technique to objectively evaluate the nonverbal modality of communication (gestures) during two demonstration tasks of *ADOS-2*. We describe a new technique allowing automated coding of non-verbal mode of communication (gestures) and offering the possibility of objective, evaluation of gestures, independently of human judgment. This technique was used during two demonstration activities of *ADOS-2* (Autism Diagnostic Observation Schedule, Second Edition) and automatically measured participants' gestures, allowing computation of a *"Gestures Index"* (GI). This GI was compared between males and females with autism.
Objectives: To test if females with autism have a higher GI compared to males with autism.
Methods: High-functioning Polish girls (n=16) and boys (n=17) with autism or Asperger syndrome, aged 5-10, with an IQ average or above, and with fluent speech were assessed during two demonstration activities of Module 3 of *ADOS-2*, administered in Polish, coded using Polish codes. Children were also assessed with Polish versions of the *Reading the Mind in the Eyes* and *Faces Tests*. Parents provided information on the author-reviewed Polish research translation of *SCQ* (Social Communication Questionnaire, Current and Lifetime) and Polish version of *AQ* (Autism Spectrum Quotient, Child).
Results: Girls with autism had a higher GI than boys with autism during two demonstration activities of *ADOS-2*. Girls with autism made significantly more mistakes than boys with autism on the *Faces Test*. Current communication skills as reported by parents on the *SCQ* were significantly better in boys with autism than in girls. Both girls and boys with autism had improved in their social and communication abilities during their life. The number of stereotypic behaviours only significantly diminished in boys but not girls during their life.
Conclusions: Girls and boys with autism differ on the non-verbal communication dimension. The automatic analysis of their gestures shows that girls with autism present longer and faster gestures. Girls present longer gestures in shorter time. The study raises questions about parent-report screening measures such as the *SCQ*. As parents are not supervised when completing the *SCQ*, it is unclear whether they take into consideration non-verbal communication (gestures) when they judge their children's communication skills, or only their verbal communication. The results of the present study contribute to further understanding of the under-diagnosis of autism in girls.

51 **123.051** Applicability of the Autism Spectrum Screening Questionnaire Parent Form to 5-Year-Old Children

M. Adachi[1], *N. Takayanagi*[1], *S. Yasuda*[1], *S. Yoshida*[1], *M. Kuribayashi*[1], *A. Osato*[2], *T. Masuda*[3], *M. Tanaka*[3], *M. Saito*[2] *and K. Nakamura*[4], *(1)Research Center for Child Mental Development, Hirosaki University, Hirosaki, Japan, (2)Graduate School of Medicine, Hirosaki University, Hirosaki, Japan, (3)Faculty of Education, Hirosaki University, Hirosaki, Japan, (4)Hirosaki University Graduate School of Medicine, Aomori, Japan*

Background: The study of High-Functioning Autism Spectrum Disorder(HF-ASD) has reported that secondary maladjustment such as school refusal in school age is one of the serious problems of them. The Autism Spectrum Screening Questionnaire(ASSQ; Ehlers, Gillberg, & Wing, 1999) was developed to screen school children for HF-ASD. Although the ASSQ consists of only 27 items, it has shown both validity and reliability, with good sensitivity and specificity in clinical settings(Ehlers et al., 1999). The ASSQ could be appropriate for use as a population screening, as it short, it's easy for parents and teachers to complete. Although the ASSQ has been psychometrically tested in only 7-16-year-old children, an application for younger children than 7-year-old is also expected to make early detection of HF-ASD and prevent secondary maladjustment of them. From the clinical necessity, the ASSQ has been used in younger children than 7-year-old in clinical setting without standalization data(Kopp & Gillberg, 2011), therefore earlier application possibility of the ASSQ should be examined urgently.
Objectives: The purpose of our study was twofold: first, to study psychometric properties of the ASSQ before school age, and second, to evaluate the sensitivity, specificity, positive predict value(PPV) and negative predict value(NPV) on the ASSQ.
Methods: This study was conducted as a part of a larger study-the Hirosaki Five years check-up(HFC) study-assessing mental health among children in Hirosaki(*n*=2571). We sent ASSQ and other questionnaires to the parents of all children aged 5 in this city. The response rate was 74.6%(*n*=1919 boy=1002). In the HFC study, children were screened by multi-aspects in their difficulties; communication, behavior, motor skill, daily adaptation of children and their parent's stress. If children had showed higher score than cut-off scores in at least one screening, they were invited to additional assessments and the diagnostic interview by child psychiatrists. The children who met the DSM-5 criteria for a diagnosis of ASD were diagnosed as ASD(*n*=55, boy=35).
Results: The internal consistency for the entire ASSQ was good, with Cronbach's alpha of .853. The results of confirmatory factor analysis confirmed that the factor structure was the same for 5-year-old as it was for school-aged children(RMSEA=.050). The receiver operating characteristic(ROC) analyses were performed to assess the discriminant power of the ASSQ in distinguishing ASD from non-ASD cases, and it demonstrated favorable accuracy of identification of ASD(AUC=.91:95%CI=.85-.95). The present study suggested that using cut-off score of > 8 provided the most efficient screening with sensitivity of .85 and specificity of .90. For the cut-off of 9, PPV was .22, NPV.99.
Conclusions: The current study demonstrates the possibility that the ASSQ could identify ASD in the 5-year-old children with a certain degree of accuracy. Although NPV was excellent, showing that only few children fell below the cut-off scores, PPV was low. This problem has been also pointed out by the study of the school age(Mattila et al., 2009). Therefore, it should be emphasized that the ASSQ is a screening instrument, not a diagnostic instrument; all screening-positive children have to undergo diagnostic examinations.

52 **123.052** Are African American Girls with ASD More or Less Impaired Than Boys? It May be All about IQ

C. A. Saulnier[1], *J. Berman*[2], *G. Kneeland*[1], ***L. Pascarella***[1] *and B. Bostian*[1], *(1)Marcus Autism Center, Children's Healthcare of Atlanta and Emory University School of Medicine, Atlanta, GA, (2)Children's Healthcare of Atlanta, Atlanta, GA*

Background:
The field of autism has a tremendous need to better understand sex differences and the profiles of girls with autism spectrum disorders (ASD). To date, the largest phenotypic study investigating sex differences found that girls with ASD had significantly lower cognitive and adaptive skills than boys with ASD, and significantly more externalizing behaviors (Frazier, Georgiades, Bishop, & Hardan, 2014). Though there were more than 2000 individuals in the study, the sample was predominantly high functioning and roughly 75% White/non-Hispanic. Few studies have directly investigated sex differences within and across racial groups.
Objectives:
This study investigates sex differences in phenotyptic presentations in a sample of African American individuals with autism, including differences in cognition, autism symptomatology, and adaptive behavior.
Methods:
Participants included 97 African American individuals with autism (26 female and 71 male) ages 3-18 years (mean=7.78 years, SD=3.79). Measures included the *Differential Ability Scales, 2nd Edition* (DAS-II)*; the Mullen Scales of Early Learning, the Autism Diagnostic Observation Schedule, 2nd Edition* (ADOS-2)*; the Autism Diagnostic Interview, Revised* (ADI-R)*, and the Vineland Adaptive Behavior Scales, 2nd Edition, Survey Form* (Vineland-II).
Results:
Fifty-five percent of the sample had cognitive scores below 70 and 50% of mothers had a maternal education below college level. ANOVA analyses revealed no significant differences on IQ, ADOS, ADI-R, or Vineland-II scores between males and females for the full sample. However, when the sample was grouped by High IQ (IQ>70) and Low IQ (IQ<70), significant differences emerged. For the Low IQ group, there was a trend for girls having significantly lower verbal IQ scores [F(1,38)=3.32, p=.076], with a mean Verbal IQ of 36.10 (SD=9.63) compared to 45.40 (SD=15.07) for boys. Girls also had significantly lower Vineland Socialization scores (Mean=58.00, SD=6.25) than boys (Mean=65.32, SD=11.18) F(1,51)=4.66, p<.05. For the High IQ group, there were no significant differences in cognition, but girls had significantly higher Vineland Socialization score than boys (Girls Mean=75.46, SD=8.24; Boys Mean=67.00, SD=11.07) F(1,40)=6.06, p<.05. No significant differences were observed across samples in levels of autism symptomatology on the ADOS or ADI-R. However, regardless of sex, the Low IQ group had significantly higher ADOS CSS scores than the High IQ group [F(1,84)=4.35, p<.05].
Conclusions:
Results from the overall sample of African American school-aged individuals with ASD revealed no significant sex differences in cognition, autism symptomatology, or adaptive behavior. Sex differences emerged when the sample was split by cognitive level. Girls with ASD with cognitive impairment had significantly lower verbal abilities and adaptive socialization scores than boys, but girls without cognitive impairment had significantly higher adaptive socialization scores than boys – contrary to prior research. Of note, 58% of boys and 46% of girls fell into the Low IQ group, highlighting the discrepancies in percent of cognitive impairment in our African American sample compared to national estimates (e.g., CDC, 2012 prevalence of 38%). These findings suggest that cognition could play a stronger role in potential sex differences in ASD compared to, for example, symptom severity in African American individuals. Limitations and implications for further research will be discussed.

53 **123.053** Assessment Across Wide Age and Ability Ranges: Use of the Peabody Picture Vocabulary Test As a Proxy for Verbal IQ

K. Krasileva *and V. Hus Bal, Department of Psychiatry, University of California San Francisco, San Francisco, CA*

Background:
Children with Autism Spectrum Disorder (ASD) span the full range of verbal and nonverbal cognitive ability. A single study may implement multiple different cognitive instruments, including use of tests outside the standardized age range to derive estimates for children with Intellectual Disability (ID). Completing full cognitive batteries

requires significant time and expense that can be prohibitive to studies ascertaining large samples (e.g., genetic consortiums).
The Peabody Picture Vocabulary Test – 4thEdition (PPVT4) is a measure of receptive vocabulary designed for use with children and adults (Dunn & Dunn, 2007). It takes 10-15 minutes to administer and can be used as a proxy for verbal IQ in individuals who cannot complete full IQ assessments (Karns et al., 2011). Recent studies have demonstrated strong associations between PPVT4 and tests of nonverbal cognitive abilities in youth with Down Syndrome, ID or typical development (Phillips et al., 2014) and minimally verbal children with ASD (Plesa-Skwerer, 2015). No studies have yet investigated the convergent validity of the PPVT4 and other cognitive measures in children with ASD across the full range of abilities.
Objectives:
To compare the PPVT4 to measures of verbal (VIQ) and nonverbal IQ (NVIQ) in children and adolescents with ASD.
Methods:
Participants were 4-17 year-olds with ASD from the Simons Simplex Collection who completed the PPVT4 and a full cognitive battery (N=2420; 86% male). Verbal and nonverbal estimates were derived from a hierarchy of tests, most often the Differential Abilities Scale or Mullen Scales of Early Learning. Pearson correlations were calculated to examine associations between PPVT4 and VIQ and NVIQ. Children were divided by age (4-5, 6-12, 13-17), language (ADOS Module), cognitive level (VIQ<70 vs. >70; NVIQ<70 vs. >70) and test type (e.g., DAS, Mullen). Fisher r-to-z transformation was used to compare correlations across groups. PPVT4-VIQ differences were computed; differences greater than 15 points were considered discrepancies.
Results:
PPVT4:VIQ correlations were very strong (r=0.70-0.95, p<0.0001) across age, language, verbal and nonverbal abilities, and test type. The majority of children (77%) had PPVT4 scores within 15 points of their VIQ estimate. Only 4% had PPVT4<VIQ, whereas the remaining 20% had PPVT4 that exceeded VIQ by more than 15 points. A somewhat higher proportion of minimally verbal children (i.e., ADOS Module 1, 26%) had PPVT4>VIQ profiles compared to verbal children (19%, ADOS Module 2-4; X2=9.587, p=0.008). Notably, PPVT4:NVIQ correlations were also strong (r=0.80), though somewhat reduced in children with VIQ>=70 (r=0.54) compared to VIQ<70 (r=0.68, z=5.02, p<0.0001).
Conclusions:
Across children of varying ages, language and ability levels, the PPVT4 showed good convergent validity with VIQ estimates derived from multiple instruments. Further analyses are needed to understand the 20% for which the PPVT4 may overestimate verbal abilities. Nonetheless, these results suggest that the PPVT4 provides a good proxy for VIQ. This is particularly relevant for genetic studies ascertaining large samples across the full range of abilities, as using the PPVT can significantly reduce costs and allow time spent with participants to be dedicated to collection of other phenotypic measures.

Table 1
Sample descriptives and PPVT:IQ correlations by age, cognitive and language groups

	Descriptives [Mean (Std Deviation)]					Pearson *r**	
	N	Age	VIQ	NVIQ	PPVT4	PPVT:VIQ	PPVT:NVIQ
Entire Sample	2420	9.08 (3.56)	79.34 (30.23)	85.70 (25.40)	84.80 (29.03)	0.925	0.803
Age							
4-5 years	541	4.93 (0.58)	80.25 (25.91)	86.99 (22.79)	85.63 (25.03)	0.896	0.769
6-12 years	1470	8.92 (1.89)	79.76 (29.81)	86.13 (25.22)	85.16 (28.69)	0.924	0.805
13-17 years	409	15.14 (1.44)	76.64 (36.32)	82.45 (28.85)	82.43 (34.56)	0.947	0.825
Cognitive level							
VIQ<70	781	9.48 (3.61)	43.15 (17.59)	60.35 (20.91)	52.74 (20.55)	0.833	0.675
VIQ>=70	1639	8.89 (3.52)	96.59 (16.72)	97.78 (17.08)	100.08 (17.87)	0.795	0.538
NVIQ<70	581	9.56 (3.77)	42.62 (22.03)	49.66 (13.71)	50.23 (22.66)	0.856	0.668
NVIQ>=70	1839	8.93 (3.48)	90.95 (22.10)	97.09 (15.79)	95.72 (21.20)	0.864	0.584
Language level							
ADOS Mod 1	399	8.12 (3.51)	36.97 (20.35)	53.55 (21.27)	45.24 (21.59)	0.822	0.710
ADOS Mod 2	550	7.30 (3.18)	69.28 (22.51)	79.92 (21.44)	75.03 (21.65)	0.897	0.711
ADOS Mod 3&4	1471	10.01 (3.38)	94.60 (21.07)	96.59 (18.85)	99.18 (20.43)	0.842	0.623

*all correlations significant at p<0.0001

54 **123.054** Assessment of Intellectual Functioning at Age of Diagnosis: Testability and Comparison of Available Tests

V. Courchesne[1], *C. Jacques*[2], *D. Girard*[3], *M. Descamps*[3], *L. Mottron, M.D.*[4] *and I. Soulières*[3], *(1)University of Montreal, Montreal, QC, Canada, (2)Universite du Quebec en Outaouais, Gatineau, QC, Canada, (3)University of Quebec in Montreal, Montreal, QC, Canada, (4)Centre d'Excellence en Troubles Envahissants du Développement, Montréal, QC, Canada*

Background: DSM-5 autism diagnosis now requires specifying the level of intellectual functioning. An assessment of adaptive behavior and IQ is therefore necessary at time of diagnosis. However, few IQ tests are available at this age and assessment of young autistic children bears many challenges (Akshoomoff, 2006; Rutter, 1986). In addition to this, there is a lack of studies regarding the use of IQ tests in preschool autistic children.
Objectives: To document the testability of young autistic, developmentally delayed and typically developing children. To compare the cognitive profile of these 3 groups on available IQ tests.
Methods: 40 autistic, 40 typically developing (TD) and 25 developmentally delayed (DD) children aged from 2 to 5 years old will be tested using the MSEL, Wechsler Preschool and Primary Scales of Intelligence (WPPSI-IV), Leiter-3, Raven Color Progressive Matrices (puzzle form) (RCPM). To date, 27 autistic, 27 TD and 12 DD children were assessed. Assessment sessions typically lasted 1h, but where shortened if the child could not remain attentive throughout the whole hour. We computed a testability ratio (number of tests completed/ number of assessment sessions) and registered the number of sessions necessary to complete each test. Finally, the performance on the completed tests was compared within subjects to determine the cognitive profile of each group depending on the test used.
Results: Within groups comparisons indicated that there was no significant difference between the number of sessions necessary to complete any of the tests in any of the three groups. Between group comparison indicated that tests including verbal assessment (MSEL and WPPSI-IV) required significantly more assessment sessions in autistic compared to TD children (all *p*s<.05), while it was not the case for the RCPM and Leiter-3 (all *p*s> .05). Neither Autistic nor TD group differed from DD group on this measure (all *p*s >.05). Also, the testability ratio was significantly lower in the autistic group compared to the TD group (p <.05), thus indicating that the number of tests completed by assessment session was lower in the autistic group. Other group comparisons were non-significant. Furthermore, the same ratio was significantly higher among participants who did not complete the study compared to those who did in the three groups (p<.0005). Finally, MSEL was significantly lower than Leiter-3 (p<.05) and RCPM (p<.01) in autistics, Leiter-3 was significantly lower than RCPM (p<.05) in DD and MSEL was significantly lower than RCPM (p<.05) in TD. All other tests did not differ (all *p*s>.05). Performance on the MSEL was the lowest in all groups.
Conclusions: MSEL, a test that is often used to assess intelligence level at age of diagnostic, seem to underestimate the potential of all groups. Even though non-verbal tests might increase testability and be easier to administer, assessment of young autistic children remains particularly challenging. Both the lack of knowledge about the validity of the available tests at age of early diagnosis and the difficulty to assess young autistics children leads us to question the relevance of assessing intellectual potential at such a young age.

55 **123.055** Automated Quantification of Stereotypical Motor Movements Occurring in Autism Spectrum Disorder

R. Kim[1], *Y. Kang*[2] *and H. Kim*[3], *(1)Science, Horace Mann School, Bronx, NY, (2)Peddie School, Hightstown, NJ, (3)Trinity School, New York, NY*

Background: The prevalence of autism spectrum disorder (ASD) has risen significantly in the last ten years, and today roughly 1 in 68 children have been diagnosed. Stereotypical motor movements exhibited by patients with autism—which include spinning, body-rocking, and hand-flapping—tend to alienate people and render social interaction difficult. Despite the growing number of individuals affected by autism, an effective, accurate method of automatically quantifying such movements remains unavailable.
Objectives: The focus of this research is to utilize Kinect v2, software developed by Microsoft to detect body movements, as a means of objectively and systematically tracking these movements.
Methods: The Kinect camera was used to film 12 actors, each performing the three movements. MATLAB and Visual Gesture Builder (VGB), a program that generates data on gesture detection, were used to analyze the skeletal structures in these recordings, after which the validity and reliability of the data were tested by comparing the outputs to that of manual grading.
Results: It was concluded that VGB analysis is a more accurate method of automatically quantifying the stereotypical motor movements than MATLAB.
Conclusions: Our findings suggest that Kinect is a potentially useful tool for automatically quantifying motor symptoms in patients with autism.

56 **123.056** Before Our Eyes: “Frankness” of the ASD Behavioral Presentation As a Research Construct

A. de Marchena[1] *and J. Miller*[2], *(1)Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (2)Center for Autism Research, Children's Hospital*

of Philadelphia, Philadelphia, PA

Background:
Many individuals with ASD have a distinctive behavioral presentation that is recognizable within moments, a phenomenon we call “frankness” (i.e., frankly ASD). Clinicians have informally discussed this phenomenon for decades; however, it has never been delineated as a research construct, and thus has essentially gone unstudied. This is unfortunate, because if frankness is indeed a reliable, quantifiable behavioral phenomenon, its measurement could have both clinical and scientific utility. In the clinic, frank referrals might be triaged to expedited evaluations; in the lab, frankness could serve as a clinical correlate for basic research. Individuals with frank presentations may differ in important ways (e.g., underlying biology or response to treatment) that cannot be tested until frankness itself can be measured.
Objectives:
To survey the clinical community about frankness to develop hypotheses on how to operationalize and quantify frankness as a research construct.
Methods:
We created a 13-item frankness questionnaire. Clinicians with experience and qualifications to diagnose ASD were invited to participate; 151 eligible clinicians, from a range of disciplines (psychology, pediatrics, neurology, and psychiatry) responded. The questionnaire included demographic information about respondents, and covered several specific topics related to frankness, including familiarity with the phenomenon, estimates of the proportion of individuals with ASD who are frank and the speed at which frankness impressions are formed, and what behavioral features might be associated with frank presentations. Data were both quantitative and qualitative, so we used a mixed methods analytic approach (Creswell et al., 2011).
Results:
An overwhelming majority (97%) of clinicians who diagnose ASD were familiar with frankness. Clinicians estimated that 40% of the ASD population has a frank presentation. In general, clinicians formed these impressions quickly; 52% reported that they observe frankness within 10 minutes of patient interaction (and 74% within 20 minutes). These factors (i.e., proportion of cases deemed frank; speed of forming frankness impressions) varied with clinician experience: clinicians who had made more ASD diagnoses considered a greater proportion of cases frank, and formed their impressions more quickly, $F(2,101)=3.2$, $p=.045$. Clinicians reported on a number of specific behaviors that contribute to their impressions of frankness, including impaired reciprocity, quality of eye contact, atypical vocal prosody, presence of motor mannerisms, and atypical gait or posture, among others.
Conclusions:
Although unstudied empirically, “frank” presentations of ASD are highly familiar to diagnosing clinicians, suggesting a critical need for more research. Frank presentations appear to be based on a range of behaviors, including some that are central to the clinical characterization of ASD (e.g., impaired reciprocity), and others that are completely absent from the official symptomatology (e.g., atypical gait or posture). Clinicians report detecting frankness rapidly, especially when they have more experience diagnosing ASD, suggesting that expert clinicians may refer to an internal prototype that is refined over time. For our next steps, we plan to move beyond clinicians’ anecdotal reports, to test the hypotheses developed here (e.g., speed of frankness impressions, behaviors contributing to frankness) during real-world clinical evaluations and diagnosis.

57 **123.057** Can Primary Health Professionals' Input to Parent Reports Improve the Ability to Detect Children with ASD?

***K. Ebishima**, A. Stickley and Y. Kamio, National Center of Neurology and Psychiatry, Japan, National Institute of Mental Health, Tokyo 187-8553, Japan*

Background: Prior studies have demonstrated the effectiveness of detecting autism spectrum disorder (ASD) using parent-report questionnaires such as the M-CHAT at community-based health check-ups at age 18-24 months. However, one of the concerns about ASD screening based on parental reports is a high false negative rate.
Objectives: The aim of this study was to examine whether primary health professionals’ input to parent reports would improve the ability to detect children who are later diagnosed with ASD.
Methods: Our sample comprised 1220 children who received a 24-month health check-up that included the Japanese version of the M-CHAT (M-CHAT-JV) at a health center in Tokyo in 2008-2010. The M-CHAT-JV rating was threefold: “parent report only (M only)”, “parent report under public health nurse instruction (M+PHNi)”, and “parent report combined with PHN observation (M+PHNo)”. Diagnostic evaluation was done according to DSM-IV-TR together with ADI-R, ADOS, CARS, SRS and other developmental assessments repeatedly during age 2-5.
Results: Seventeen children were diagnosed with ASD. The number of screen-positives was 58, 34, and 55 using M only, M+PHNi, and M+PHNo, respectively. In addition to 13 children with ASD identified by M only, 2 children were newly identified by M+PHNi and 4 children by M+PHNo. A comparison between M only screen-positives (N=13) and screen-negatives (N=4) showed no significant differences in autism measurements at age 2, while M only screen-negatives scored significantly higher on the ADI-R RRB domain at age 3. M only screen-negatives tended to have higher DQs.
Conclusions: This study suggests that face-to-face instruction by public health nurses may decrease screen-positives and detect more children who were not identified by M only, while their quick behavioral observation may also help identify a greater number of children with ASD without decreasing screen-positives. Optimal ASD screening should be chosen considering a community’s resources and needs.

58 **123.058** Caregiver and Teacher Correspondence on Ratings of Problem Behaviors for Children with Autism Spectrum Disorder Receiving Community Mental Health Care

***N. Stadnick**[1,2], D. Loreaux[1,3], C. Chlebowski[1,2,4] and L. Brookman-Frazee[1,2,4], (1)Psychiatry, University of California, San Diego, San Diego, CA, (2)Child and Adolescent Services Research Center, San Diego, CA, (3)Department of Psychiatry, Child and Adolescent Services Research Center, San Diego, CA, (4)Autism Discovery Institute at Rady Children’s Hospital – San Diego, San Diego, CA*

Background: Children with autism spectrum disorder (ASD) are served in multiple service settings (Brookman-Frazee et al., 2009), and have significant psychiatric comorbidity, particularly with disruptive behavior disorders (Simonoff et al., 2009). Multi-informant assessment of behavior problems is important to inform appropriately tailored treatment for children with ASD. Informant agreement is weak to moderate for behavior problems in children with ASD (Stratis et al., 2015). Factors shown to impact caregiver-teacher agreement broadly include educational setting and child clinical and sociodemographic characteristics (Berg-Nielsen et al., 2012; Pearson et al., 2012).
Objectives: This study: 1) examined the correspondence between the severity of caregiver and teacher ratings of problem behaviors in a sample of school-aged children with ASD receiving community mental health (MH) services, and 2) identified child characteristics associated with informant correspondence.
Methods: Data were drawn from baseline assessments of an ongoing randomized community effectiveness trial of AIM HI (“An Individualized Mental Health Intervention for ASD”), a clinical intervention targeting challenging behaviors in children with ASD conducted in community and school-based MH settings. This sample included 138 children ($M = 9.05$ years; 79% male) with existing ASD diagnoses, their primary caregivers, and teachers. Caregiver report of behavior problems was obtained using the Eyberg Child Behavior Inventory (ECBI; Eyberg & Pincus, 1999), which includes 36 items rated on a 7-point Intensity Scale that is converted into a *t*-score. Teacher report of behavior problems was obtained using the Sutter-Eyberg Student Behavior Inventory-Revised (SESBI-R; Eyberg & Pincus, 1999). Overall agreement between caregiver and teacher ECBI/SESBI-R Intensity scores was calculated first through the intraclass correlation coefficient (ICC). Intensity *t*-scores were then dichotomized into clinically significant versus non-clinically significant. Agreement was calculated using the kappa statistic followed by the McNemar test to compare the proportion of children whose problem behaviors were rated as clinically significant. Follow-up logistic regression analyses were conducted with child age, gender, ethnicity, ASD severity (as measured by the comparison score from the ADOS-2, Lord & Rutter, 2002), educational placement, and diagnostic comorbidity (as measured by an adapted MINI-KID, Sheehan et al., 1998) as predictors of agreement.
Results: Informant agreement on the severity of problem behaviors was poor, overall, as shown by the ICC of 0.16 on the ECBI/SESBI Intensity Scale. Poor agreement remained when examining clinically significant levels of problem behaviors, $\kappa = .19$, which falls below standards for fair agreement ($\kappa = 0.4$; Cohen, 1960). The proportion of caregiver ratings (62%) was significantly higher than the proportion of clinically significant teacher ratings (40%) ($p < .001$). Regression analyses indicated that older child age was associated with less agreement (OR = 0.79, $p < .05$) while greater number of non-ASD psychiatric disorders (OR = 1.31, $p < .05$) was associated with greater agreement.
Conclusions: Caregiver-teacher agreement of problem behaviors was poor in this sample of children with ASD receiving community MH services. Child age and degree of psychiatric comorbidity were associated with informant agreement of clinically significant problem behaviors. Findings have implications for optimally using multi-informant assessment to tailor MH care for children with ASD.

59 **123.059** Characteristic Features of Autism in the Nigerian Population

***T. A. Fagbayi**[1], J. E. Okpuzor[2] and A. Lesi[3], (1)University of Lagos, Lagos, Nigeria, (2)University of Lagos, Nigeria, Nigeria, (3)Department of Pediatrics, College of Medicine, University of Lagos, Lagos, Nigeria*

Background:
The African continent is yet to benefit from the advances made in autism research. This is partly due to misconception about the disorder and its aetiology and mostly due to lack of public awareness even amongst health care givers and the elite is not exonerated. Recently, in Nigeria the awareness of autism has increased tremendously especially in urban cities such as Lagos, however a lot still need to done on the proper description of the Nigerian autistic population so as to allow for tailored management.
Objectives:
The present study aims to describe the clinical presentations of individuals with autism in Nigeria.

Methods:
A content validated and researcher developed questionnaire, the Autism Phenotype Questionnaire (APQ) was designed highlighting characteristic features of autism. The APQ consists of 26 semi-structured items/questions divided into two sections. The first section comprises of questions on demographic data while the second section consists of 9 sub-categorical autistic features with a total of thirty-eight options each treated as a variable. A total of five special centers (4 private and 1 government owned) participated in the study and parents, care givers and attending therapists were the respondents of the study. All participants had been previously diagnosed with ASD using the DSM-1V (APA, 2000). Statistical analyses were done using IBM SPSS version 20.
Results:
With a Cronbach's alpha of 0.69, the APQ was deemed reliable for the study. A total of 110 dully filled questionnaire analyzed. Observed mean age was 9.14±5.92 years with an age range of 3-32 years and male: female ratio of 2.36:1. A total of 87.27% (96/110) of the cases had other unaffected siblings. The highest percentage age distribution was observed in the 5-9 years age group (50 %; mean ± SD - 6.852±1.459) this is a reflection of the late presentation to clinics of individuals with autism by their families and thus late diagnosis. Of all the associated features, sensory abnormalities (Self Stimulatory Sensory Behaviour) had the least percentage presentation (50%), followed by Self Injurius behaviour (SIB-58.2%), Sensitivities (80.9%), Tantrums (87.3%) and Self Stimulatory Motor Behaviour (89.1%). No significant difference was observed in the frequencies of reported features by gender and age-group classification with the exception of sensory impairment ($F = 4.264$. $df = 1$ $p = 0.039$) between gender.
Conclusions:
The late age of diagnosis of autism in Nigeria and other African countries could be as a result of the late help-seeking nature of affected families often due to societal stigmatization. We propose that the APQ can be utilized as a screening tool for autism in Nigeria as it is suitable for the average age of clinical presentation.

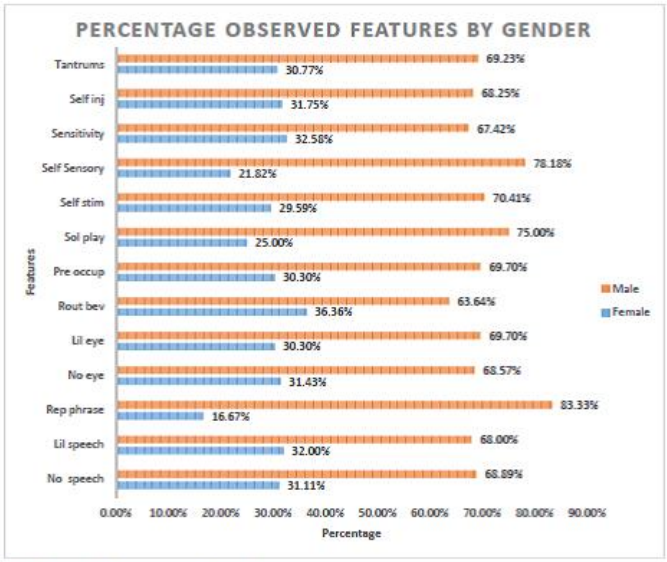


Table: Overall Percentage of Each Sub-category.

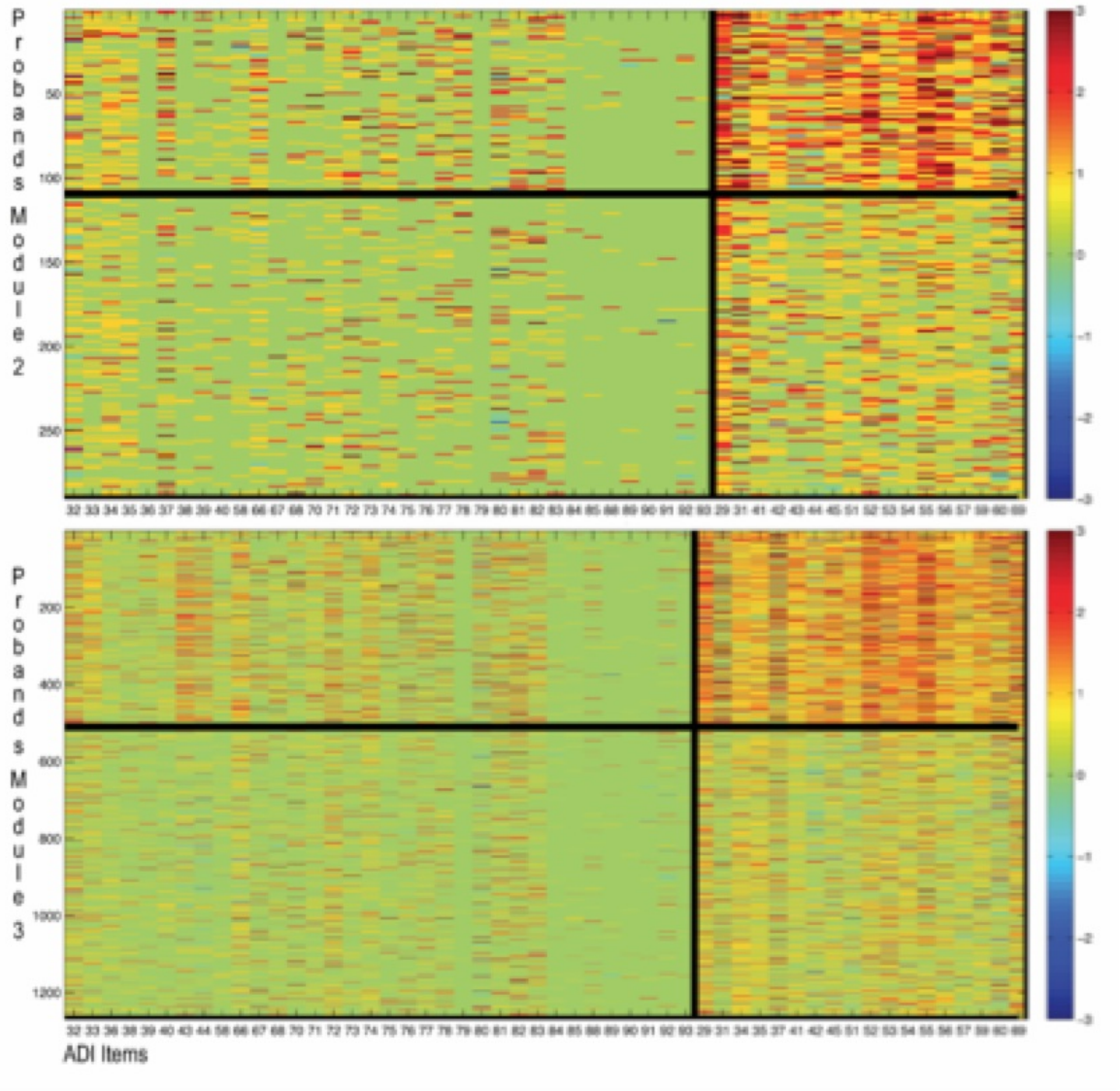
Section	Overall Percentage (%)
Speech	98.2
Eye Contact	91.8
Restricted Interest & Behaviour	93.6
Self Stimulatory Motor Behaviour	89.1
Self Stimulatory Sensory Behaviour	50.0
Sensitivities	80.9
Self Injurious Behaviour	58.2
Tantrums	87.3
Other Features	70.9

60 **123.060** Clinical Implications of the ADI As a Measure of Development in Children with ASD

***N. Navot**, S. J. J. Webb and R. Bernier, University of Washington, Seattle, WA*

Background:
Predicting future Autism Spectrum Disorder symptom level and developmental trajectory, is a primary goal for facilitating service development and supporting families. However, the heterogeneity within ASD and resulting prognostic opacity creates difficulties for clinicians seeking to provide quality information. Published longitudinal studies suggest several developmental trajectories of improving/worsening in symptom level. The Autism Diagnostic Interview was designed to provide a framework for collecting both the developmental history and current functioning within a diagnostic framework. Although not designed to examine symptom change over time, analyses with the ADI collected at one time point in large samples may illuminate changes in symptom presentation.
Objectives:
We describe autism symptom trajectories derived from individual item ADI-R data among 1629 verbal Simons Simplex Collection (SSC) children from age 6 to 16 years. Focusing on differences between current and 4-5 year functioning, we used cluster analytic approaches to grouping symptoms according to their change over time and compared the different clusters among participants with different levels of language.
Methods:
Data were obtained from the SSC. Only verbal participants that received ADOS Module 3 and Module 2 were included. Data were first analyzed for baseline age differences. For each item, current value as function of age at time of interview was plotted. Second, we created a *difference score (DS)* at the item level. For each item, the past score (PS) was subtracted from the current score resulting in a *difference score*(e.g., PS = 3; current = 1; DS = 2). To identify clusters of items that show similar patterns in DS or PS, we ran a double-way clustering on the DS and PS matrix: this allows clustering of the probands based on the ADI item values, as well as clustering of items based on proband values. We use K-means with K=2 for clustering. The different clusters of symptom level were compared between module 2 and Module 3 participants.
Results:
Our analyses show that several patterns of change over time can be detected from a single time point administration of the ADI-R. Most prominent, there is significant improvement in symptoms from 4-5 to current functioning. However, despite individual change, there is little difference in the degree of improvement by current age (72-192 months); older children did not demonstrate "more change" or were "more improved" than younger children in this age range. Clustering analysis reveals subgroups among ADI items, characterized by a different level of severity of symptoms and level of change over time. Those subgroups were different among Module 2 and Module 3 participants. Thus, pattern of severity of symptoms can provide important information about eventual language outcomes (i.e. whether the child will be appropriate for a Module 2 or 3 at age 6 to 16 years).
Conclusions:
Our analyses suggest that the ADI, when used with verbal children after the age of 6 years, may also provide the parent with prognostic information about the pathways that could be expected for particular symptoms and the probability of improvement of certain symptoms at various stages of development.

Figure 3 *Difference Score (DS)* Cluster Matrix for Module 2 probands (top) and Module 3 probands (bottom). The columns represent different ADI items and the lines represent individual probands. Black line marks the separation between clusters. Colors represents 7 {(-3)-(+3)) possible DS values



61 **123.061** Clinician Confidence, Child Characteristics and Accuracy: Screening for Autism Spectrum Disorder in Toddlers

D. Hedley[1], *N. Brewer*[2], *R. E. Nevill*[3], *M. Uljarevic*[4], *E. Butter*[5] *and J. A. Mulick*[6], *(1)School of Psychology and Public Health, La Trobe University, Melbourne, Australia, (2)Flinders University, Adelaide, SA, Australia, (3)The Ohio State University, Columbus, OH, (4)Olga Tennison Autism Research Centre, La Trobe University, Bundoora, Australia, (5)Nationwide Children's Hospital, Westerville, OH, (6)Pediatrics, The Ohio State University, Columbus, OH*

Background:
Professionals on the front line of identifying ASD make critical decisions that are likely to have long-term consequences for children and families. While screening instruments are available it has been suggested that experienced clinical judgment is more reliable in detecting ASD. Clinicians must account for factors such as family history, environment, comorbidity and differential diagnoses that cause overlaps in symptoms which can obscure diagnostic boundaries, and must integrate this information to identify probable diagnostic status which then informs important clinical decisions. Yet, little is known about the interplay between clinician and child factors that might influence these decisions, which potentially, may have a profound impact on prognosis.
Objectives:
Our aim was to examine the relationship between confidence and accuracy (CA) for clinicians' judgments and to assess the potential contribution of developmental and behavioral profiles to the CA relationship during developmental screening. Specifically, we explored a) the relationship between clinician confidence and accuracy of predicted diagnosis and b) the influence of child characteristics on clinicians' confidence.
Methods:
Participants were 125 children aged under 14-39 months (M = 28.62, SD =5.41) who presented for screening at a hospital child development center due to developmental concerns. One-hour long screening interviews were conducted by healthcare professionals. Following the screening interview professionals completed a questionnaire regarding whether or not they thought the child has ASD. Clinicians provided a risk estimate and a Likert scale was used to generate a confidence score. Diagnostic status and assessment results were retrieved from medical record review.
Results:
Experienced healthcare workers exhibited good sensitivity in identifying ASD. We identified a small but positive correlation between confidence and accuracy, r_τ (119) = .24, p = .003, with diagnosticity highest at confidence levels of 90-100%. Regression analysis identified parent report of unusual behaviors as the only significant predictor of clinician confidence (t = 2.376, p = .02, β = .395).
Conclusions:
Despite good sensitivity in clinician prediction of diagnosis, this sensitivity appears to come at the cost of over-classification of children who did not receive an ASD diagnosis. We identified a small but positive CA relationship in referred children, with diagnosticity for positive identifications highest in the 90% to 100% confidence band. The CA relationship was less well calibrated for negative identifications. Parent report of unusual behaviors was found to be the only significant predictor of clinician confidence, however this is not surprising in the light of the fact that a wide range of restricted and repetitive patterns of behaviors has been consistently reported among the earliest infant predictors of a later ASD diagnosis.

62 **123.062** Combining ASD-Specific Screening Tools to Capture Red Flags in 12 Month Old High-Risk Siblings

M. Lewis[1], *N. R. Brane*[1], *B. Kotlar*[1], *E. J. Wang*[2] *and A. M. Wetherby*[3], *(1)Marcus Autism Center, Atlanta, GA, (2)Pediatrics, Emory University, Atlanta, GA, (3)Florida State University Autism Institute, Tallahassee, FL*

Background:
The American Academy of Pediatrics recommends screening toddlers for ASD at 18 & 24 months. Closely monitoring children at higher risk (e.g. having a sibling with ASD) is especially critical (CDC, 2014) as approximately 20% of younger siblings are at an increased risk for developing ASD (Ozonoff, 2011), therefore requiring intensified developmental surveillance. By using a combination of screening tools as early as 12 months in a high-risk population with consideration for home and clinic settings, providers may identify subtle delays and ASD specific red flags at an earlier age. According to DSM-5 criteria, persistent deficits in social communication and social interaction occur across multiple contexts. Employing multi-source screening at 12 months may provide comprehensive yet efficient means to initiate earlier ASD intervention for infants deemed high-risk.
Objectives:
To examine how combination of clinical assessment, home observation, parent report and ASD-specific screening can be used in a complementary fashion to detect red flags starting as early as 12 months, ultimately testing a downward extension of current AAP guidelines in a high-risk sample.
Methods:
High-risk 12-month olds were assessed as part of a federally-funded longitudinal study examining siblings. Assessment batteries included 4 samples of early social behavior with consideration for multiple settings: a communication assessment, a video-recorded home observation, parent report measure, and an ASD-specific screening tool. The CSBS (Wetherby & Prizant, 2001) was used to assess communication development, the Systematic Observation of Red Flags of ASD (SORF; Wetherby & Woods, 2004), an ASD-specific screening tool, was used to rate symptomatology within CSBS and home observations. The Early Screening for Autism and Communication Disorders (ESAC; Wetherby, Woods & Lord, 2012), parent questionnaire, was used to collect information on early social communication and presence of repetitive behaviors. Using previous research collected from ESAC and SORF in 18-24 month-olds, cut-offs were determined, where a positive screen for 12-month siblings on at least 2 of 4 measures led to eligibility for an experimental intervention. Within our study, 17 (20 projected by May 2016) high-risk infants were deemed eligible for intervention based on positive screening utilizing these four measures. Comparisons between measures used to assess qualification for intervention were analyzed using the Chi-Squared test and Wilcoxon Two-Sample test.
Results:
Measures conducted in the clinic by highly trained clinicians were more likely to positively identify early ASD signs than the measure conducted in the home or parental report at the 5% significance level ($p<.005$). Of 17 infants who qualified for the intervention study 76% (n=12) qualified based on the CSBS and 100% (n=17) qualified based on the clinic SORF compared to 41% based on the ESAC (n=7) and 50% on the home SORF (n=8).
Conclusions:
Findings suggest that while the CSBS is examining communication, its structured tasks involving object temptations may reveal subtle social delays in high-risk 12-month olds to a trained clinician. Applying an ASD-screening tool to rate the communication sample of the CSBS, closely examining social behaviors and emerging repetitive behaviors, may expose earlier symptomatology and provide more quantitative assessment of red flags.

63 **123.063** Comparing Motor Abilities Using a Standardized Clinical Assessment (BOT-2) and Parent Report Questionnaires (MABC-2 and DCDQ) in Children with Autism Spectrum Disorder (ASD)

E. Bakshipour[1], *M. Kaur*[2], *S. Izadi-Najafabadi*[2], *S. Srinivasan*[2] *and A. N. Bhat*[2], *(1)Physical Therapy, University of Delaware, Newark, DE, (2)University of Delaware, Newark, DE*

Background:
Autism Spectrum Disorder (ASD) is a multisystem disorder characterized by impairments in social communication skills and the presence of restricted and repetitive behaviors (American Psychiatric Association, 2013). Additional comorbidities include gross-motor (GM) and fine-motor (FM) impairments as well as cognitive/behavioral impairments (Srinivasan & Bhat, 2013). Invariably, there are discrepancies between parent and clinician estimates about the level of functioning of children with ASD. A comparison of motor functioning using parent and clinical estimates could highlight the gap in the understanding of functional capacities of children with ASD between the two stakeholders.
Objectives:
We aimed to compare parent and clinician perspectives regarding functional performance within the FM and GM domains in children with ASD using parent questionnaires and standardized clinical assessments.
Methods:
Thirty-seven children with ASD aged between 5 and 12 years participated in this study. We administered various FM and GM subtests from the Bruininks-Oseretsky Test of Motor Proficiency- 2nd Edition (BOT-2) and report the FM and GM composite performance. Parents of the participating children completed two motor questionnaires - Movement Assessment Battery for Children-2 (MABC-2) and Developmental Coordination Disability Questionnaire. Both questionnaires provide normative data on overall motor delays. Significant motor delays were scores below the 15th-18th percentile depending on the measure.
Results:
Based on BOT-2 data, 50% of the ASD sample had significant FM delays and 59.1% of the ASD sample had significant GM delays. Based on MABC-2 data, 75% of the ASD sample scored in the red zone (i.e.; below the 15th percentile) in terms of FM & GM performance. Based on DCDQ data, 84% of the ASD sample met criteria for a Developmental Coordination Disorder (DCD).
Correlations between BOT-2, MABC, and DCDQ indicated that both gross (r=0.78) and fine motor (r=0.61) scores of MABC-2 strongly correlated with those of DCDQ. However, both MABC-2 and DCDQ scores did not correlate with BOT-2 scores across GM and FM domains.
We also analyzed the percent of parents that agreed with the clinician's estimate of FM and GM delays. In general, 55% of the parents completely agreed and 18% of the parents partially agreed with the clinician's assessment of FM and GM delays in the ASD sample. In contrast, 27% of the parents disagreed and either overestimated or underestimated the motor skill performance of their children.
Conclusions:
A subset of parents' did not accurately assess their children's abilities as they were clearly off compared to clinician estimates. Parents of children with ASD are perhaps more concerned about their child's social skills and they may not pay enough attention to their motor skills. Strong correlation between the MABC and DCDQ confirms that parental perception of their children's motor function remains constant. Secondly, the skills assessed in the parent questionnaires are more functional in nature than the standard activities of BOT-2. Clinical measures such as the BOT-2 may not adequately assess motor functioning required for completing activities of daily living. Clinicians need to consider the use effective functional assessments to better evaluate functional motor performance of children with ASD.

64 **123.064** Correlations Between ADOS-2: Module 4 Comparison Severity Scores and Standardized Assessment Measures: A Preliminary Examination in Adults with Autism Spectrum Disorder

M. J. Morrier[1], *O. Ousley*[2], *M. J. Segall*[3], *E. Andari*[4], *J. F. Cubells*[5] *and L. J. Young*[4], *(1)1551 Shoup Court, Emory University, Atlanta, GA, (2)Psychiatry and Behavioral Sciences, Emory University School of Medicine, Decatur, GA, (3)Emory Autism Center, Atlanta, GA, (4)Emory University, Atlanta, GA, (5)Emory University School of Medicine, Atlanta, GA*

Background: The recent update to the *Autism Diagnostic Observation Schedule*(ADOS-2) included a comparison severity score (CSS) to use as a quantifiable measure of ASD severity independent of one's age and language functioning (Hus & Lord, 2014; Lord et al., 2012) to standardize the ADOS-2 total algorithm score for use as a dimensional measure of change. A recent article by Hus and Lord (2014) provided a revised algorithm and CSS scores for adults with ASD using Module 4. Comparison severity scores are reported in social affect (SA); restricted, repetitive behaviors (RRB); and Total ADOS-2 algorithm (Total) scores. This study examined the correlation between the CSS scores and individual characteristics of adults with ASD, as measured by standardized assessments of social responsivity reported by self and others, IQ, and memory. All measures were completed as part of an eligibility assessment for the Conte Center for Oxytocin and Social Cognition at Emory University.
Objectives: To examine the correlation between standardized measures and ADOS-2: Module 4 CSS scores in order to determine which measure might be the best predictor of CSS scores.
Methods: Twenty-two male adults with ASD participated (*M* age = 27 years, 1 month, *SD* = 4 years, 1 month; *M* WASI-II Full Scale = 115.48, *SD* = 39.79). Standardized measures included the SRS-2 Social Communication and Interaction (SCI), Restricted Interests and Repetitive Behavior (RRB), and the Total SRS-2 *t*-scores from the self and other reports; standard scores for WAIS-II Verbal Comprehension, Perceptual Reasoning, and Full Scale-4. WMS-IV scaled sores on the Logical Memory Immediate, Logical Memory Delayed, Visual Reproduction Immediate and Visual Reproduction Delayed subtests. CSS scores were determined from Hus and Lord (2104) article. To facilitate comparison across assessments, all standard scores with the exception of ADOS-2 CSS scores were converted to *z*-scores by using the formula (score-mean)/standard deviation.
Results: Bivariate correlations indicated that only IQ scores predicted the CSS scores. In particular, we found a negative correlation between both sub-domains of IQ (Verbal Comprehension and Perceptual Reasoning) and the SA CSS ($r = -.642$, $p < .01$; $r = -.531$, $p < .01$, respectively). Negative correlations were also found for IQ sub-domains

and the Total CSS (r = -.513, $p < .01$; r = -.442, $p < .05$, respectively). All other measures did not correlate with the CSS.
Conclusions: Our preliminary and exploratory results indicate that the CSS score of the ADOS-2: Module 4 is associated with intellectual abilities in adults with ASD. Our findings suggest that CSS or ADOS-2 scores are not necessarily reflecting only social functioning, but are also related to an individual's intellectual characteristics. Further replications are needed on a larger sample. To optimize use of the ADOS-2 CSS scores as measures of change, researchers may need to control for intellectual ability in psychopharmacological and behavioral intervention studies that target core ASD symptoms.

66 **123.066** Early Detection of ASD: A Meta-Analytic Study on the M-CHAT and Other Tools Used for Universal Toddler Screening

ABSTRACT WITHDRAWN

Background:
Great efforts are being focused on developing instruments for early detection. However, there is no agreement about the best instrument. In addition, some scientists and clinicians have questioned early universal screening, until an adequate instrument with good psychometric properties is available[1]
The two versions of the Modified Checklist for Autism in Toddlers (M-CHAT and M-CHAT-R/F) are the most internationally used ASD screening instruments[2] and when including the follow-up interview procedure have a high positive predictive value [3,4]. However, no meta-analytic study has provided information on the M-CHAT and other tools.
Objectives:
This study aims to describe and synthesize the psychometric properties of the ASD screening tools, at an international level, applied in general population at early ages. The main objective is to analyze if there are statistically significant differences from the M-CHAT and M-CHAT-R/F and other screening tools.
Methods:
A systematic literature review of peer-reviewed publications was conducted to identify studies published from January 1992 through April 2015. CINHAL, ERIC, PsycINFO, PubMed and WOS databases were searched. Effect size will be calculated using the hierarchical summary ROC (HSROC) model.
A hierarchical Cluster Euclidean distance using HJ-Biplot scores-Linkage Ward has been calculated based on data sensitivity, effectiveness of each screening tools and several similarity coefficients which evaluate the concordance between the results of the screening tool (Jaccard, Sokal and Sneath, Ochaiai and Sokal, Michener).
Results:
From the identified 1423 non-duplicate citations screened, 20 papers were selected for qualitative review (using Quadas-2). Fourteen studies were eligible for inclusion. The agreement between judges was adequate, kappa=0.643, p<.01.
As a preliminary finding we can differentiate two clusters; the first one shows a high concordance and is comprised of 11 studies. In this cluster are the majority of the studies done with the M-CHAT. In the second cluster we find studies with significant discrepancy between the results of the test and the reference standard.
Conclusions:
Many researchers around the world are working to establish good ASD screening practices.. The results of this study will help us to have a better understanding about the effectiveness of the different procedures for the early detection.
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67 **123.067** Emotional and Behavioural Problems in Children with Neurodevelopmental Disorders: Using Cross-Disorder Phenotypes to Identify Informative Subgroups

S. Georgiades[1], *E. Duku*[1], *P. Szatmari*[2], *E. Anagnostou*[3], *P. D. Arnold*[4], *J. P. Lerch*[5], *R. Nicolson*[6], *S. W. Scherer*[7], *T. Bennett*[1], *A. Dupuis*[8], *A. Charach*[9,10], *J. Crosbie*[8], *J. A. Reitzel*[11], *G. Hall*[1], *N. Soreni*[1], *M. Woodbury-Smith*[1], *J. Beyene*[1], *C. Chrysler*[1], *M. Chalupka*[1], *A. D. Greco*[1], *C. Russell*[1], *I. O'Connor*[1], *L. Colli*[1], *S. Al Balkhi*[1] *and R. Schachar*[9], *(1)McMaster University, Hamilton, ON, Canada, (2)Centre for Addiction and Mental Health, Toronto, ON, Canada, (3)University of Toronto, Toronto, ON, Canada, (4)University of Calgary, Calgary, AB, Canada, (5)Mouse Imaging Centre, Hospital for Sick Children, Toronto, ON, Canada, (6)University of Western Ontario, London, ON, Canada, (7)Centre for Applied Genomics (TCAG), Hospital for Sick Children, Toronto, ON, Canada, (8)The Hospital for Sick Children, Toronto, ON, Canada, (9)Psychiatry, The Hospital for Sick Children, Toronto, ON, Canada, (10)Psychiatry, University of Toronto Faculty of Medicine, Toronto, ON, Canada, (11)McMaster Children's Hospital/McMaster University, Hamilton, ON, Canada*

Background: Autism Spectrum Disorder (ASD), Attention Deficit Hyperactivity Disorder (ADHD), and Obsessive Compulsive Disorder (OCD) are childhood-onset neurodevelopmental disorders (NDDs) linked to deficits in brain development and function. Accumulating evidence suggests there is notable clinical and genetic overlap among the three NDDs, lending support to the idea of common, cross-disorder aetiologies. Despite the evidence, our current psychiatric classification paradigm continues to treat these NDDs as distinct diagnostic entities. Such a categorical approach may be limiting our research to identify homogeneous subgroups of children who share similar profiles, irrespective of their primary NDD diagnosis. An alternative approach that identifies dimensional phenotypes that cut across conventional NDD diagnostic categories can inform treatment processes and the search for common cross-disorder aetiologies. Two clinical phenotypes in NDDs that warrant close attention and may be suitable for such cross-disorder investigations are emotional (internalizing) and behavioural (externalizing) problems.
Objectives: To use the phenotypes of emotional and behavioural problems to identify informative subgroups of children across conventional NDD diagnostic categories (ASD/ADHD/OCD).
Methods: The sample consisted of 784 children with NDDs (319 ASD, 329 ADHD, 136 OCD; 74.9% males; mean age: 10.7 years) participating in the Province of Ontario Neurodevelopmental Disorders (POND) Network project. To identify subgroups, data on the Child Behavior Checklist (CBCL 6-18) syndrome scales – Anxious/Depressed, Withdrawn/Depressed, Somatic Complaints, Social Problems, Thought Problems, Attention Problems, Rule-Breaking Behavior, and Aggressive Behavior – were used in Hierarchical Clustering analysis. The optimal number of clusters was selected using the scree-plot criterion. Derived clusters were characterized using sex ratio, the child's age, social communication deficits (Social Communication Questionnaire; SCQ), obsessive compulsive behaviours (Toronto Obsessive Compulsive Rating Scale; TOCS) and adaptive behaviours (Adaptive Behavior Assessment System; ABAS-2)
Results: A 2–cluster solution provided the best fit to the data. Compared to those in Cluster 1, children in Cluster 2 (43% of sample) scored higher (within borderline or clinical range) on all CBCL syndrome scales ($p < .001$ for all) and total problems score (mean: 71.6 compared to 57.4; $p < .001$). The two clusters did not differ in terms of sex ratio or the child's age. The proportion of children from each primary diagnostic category in Cluster 2 was 45.5% of ASD, 45.9% of ADHD, and 30.1% of OCD. Within Cluster 2, children with ASD scored higher on the SCQ (mean ASD: 22.2 > ADHD: 10.2 and OCD: 7.7; $p < .001$) and had the lowest scores on the ABAS (mean ASD: 60.7 < ADHD: 75.7 and OCD: 80.1; $p < .001$). Children with OCD had the highest scores on the TOCS (mean OCD: 20.6 > ASD: -11.6 > ADHD: -19.9; $p < .001$).
Conclusions: Study findings suggest that emotional and behavioural problems are useful phenotypes for the identification of informative subgroups of children with NDDs that may benefit from cross-disorder treatments. At the same time, notable within-subgroup variability suggests that primary diagnostic categories (ASD/ADHD/OCD) provide useful information on unique phenotypes (e.g., social communication deficits, obsessive compulsive behaviors, and adaptive behaviors) requiring disorder-specific treatments. This work has the potential to inform research on the shared and unique aetiologies in NDDs.

68 **123.068** Factor Analysis of the Childhood Autism Rating Scale in Two-Year-Olds with ASD

E. Moulton[1], *M. Barton*[2] *and D. A. Fein*[2], *(1)University of Connecticut, Storrs, CT, (2)Psychology, University of Connecticut, Storrs, CT*

Background: The Childhood Autism Rating Scale (CARS) (Schopler, 1980) is a 15-item observation-based rating scale designed to accurately differentiate children with autism from those with developmental delays without features of autism. The CARS is a commonly used component of ASD diagnosis, yielding a single total score (15 to 60) that is reflective of overall symptom severity. Given that symptom severity varies across domains for children with ASD, the utility of the CARS may be extended by understanding factors that underlie its total score. At present, few factor analyses have been conducted on the CARS, and results are mixed.
Objectives: The current study seeks to extend existing research on the factor structure of the CARS utilizing a well-characterized sample of two-year-old children with a DSM-IV ASD diagnosis.
Methods: Developmental and diagnostic evaluations were conducted at approximately 26 months following positive screening on an autism-specific screener (MCHAT(-R)). The Autism Diagnostic Observation Schedule (ADOS), Mullen Scales of Early Learning (Mullen), Vineland Adaptive Behavior Scales (VABS II), and Childhood Autism Rating Scale (CARS) were completed. Diagnosis was assigned based on the clinical judgment of experienced clinicians. Children were included in the current study if they received

a diagnosis of Autistic Disorder (AD) or Pervasive Developmental Disorder, Not Otherwise Specified (PDD-NOS) (N=289). 217 (77.8%) children were male, and the sample was predominantly white (N=204, 73.1%). A factor structure evaluation of the CARS was conducted using principal axis factor analysis with promax rotation. Factors were retained utilizing the Kaiser criterion (1960). Items were considered to load on a factor if their loadings were .40 or above in the pattern matrix.
Results: CARS scores ranged from 20.0 to 48.5 (*M*=32.26, *SD*=5.22). Mullen Early Learning Composite (ELC) standard scores ranged from 41 to 120 (*M*=59.72, *SD*=12.01), with 71.6% of children demonstrating ELC scores of 70 or below (N=207). Principal axis factor analysis revealed three factors that accounted for 52.39% of the common variance among CARS items. The first factor is labeled *Social-Communication* and includes Relating to People, Imitation, Listening Response, Verbal Communication, Nonverbal Communication, General Clinician Impressions and Level/Consistency of Intellectual Response. The second factor is labeled *Emotion Regulation* and includes Emotional Response, Adaptation to Change and Fear/Nervousness. The third factor is labeled *Stereotyped Behaviors and Sensory Sensitivities* and includes Body Use, Object Use, Taste/Smell/Touch Response and Use, and Activity Level.
Conclusions: Factor analysis of the CARS in a sample of approximately two-year-old children with ASD and a broad range of intellectual abilities revealed three factors: *Social-Communication*, *Emotion Regulation*, and *Stereotyped Behaviors and Sensory Sensitivities*. These factors are conceptually meaningful, and are consistent with our current understanding of ASD as a multidimensional construct. Factors found in the current study are similar to those found in previous investigations conducted with four-year-olds with ASD, with some important differences that may reflect differences in symptom presentation between children of different ages. Utilizing age-appropriate factor scores, in addition to the CARS total score, may extend the utility of the CARS as a measure of ASD symptom severity.

69 **123.069** Feasibility of Developing an Algorithm to Derive Ratings of Social Communication Functioning (ACSF:SC) from ADOS Data

S. J. Gentles[1], *B. M. Di Rezze*[1,2], *P. Rosenbaum*[1], *L. Zwaigenbaum*[3], *M. J. C. Hidecker*[4], *S. Georgiades*[5] *and E. Duku*[5], *(1)CanChild Centre for Childhood Disability Research, McMaster University, Hamilton, ON, Canada, (2)School of Rehabilitation Science, McMaster University, Hamilton, ON, Canada, (3)University of Alberta, Edmonton, AB, Canada, (4)Communication Disorders, University of Wyoming, Laramie, WY, (5)McMaster University, Hamilton, ON, Canada*

Background: Modeled on the internationally recognized Gross Motor Function Classification System for cerebral palsy, our group developed and validated the Autism Classification System of Functioning: Social Communication (ACSF:SC). This descriptive classification system—based on WHO's International Classification of Functioning, Disability, and Health (ICF) framework—contrasts with traditional severity metrics by assessing abilities rather than deficits. The ACSF:SC allows parents or professionals to categorize children aged 3 to 5 into one of five meaningfully distinct levels of social communication functioning ability. It may be possible to extract relevant descriptive levels of social communication abilities from standardized tools routinely used in autism assessment and research (e.g., the Autism Diagnostic Observation Schedule [ADOS]). Being able to derive ACSF:SC ratings from such instruments would allow abundant earlier data to be translated into our unique validated indicator of children's level of social communication functioning, immeasurably increasing the value of such data for research purposes. Importantly, such ratings would enable the examination of longitudinal trajectories of social communication abilities among children with autism.
Objectives: We aim to develop an algorithm to derive ACSF:SC ratings from ADOS data. As part of this work, we will evaluate the reliability of ADOS-derived ACSF:SC ratings at progressive stages of algorithm development.
Methods: Preliminary results were obtained using a mini-Delphi method (i.e., a small group face-to-face multiple-round consensus method): first, to identify items from the ADOS that correspond to the ACSF:SC construct of social communication, and second, to map the scores available within each relevant ADOS item to ACSF:SC ratings to determine the range of ACSF:SC levels covered. We plan an expanded Delphi method exercise (70% agreement criterion) involving our interdisciplinary team (n=6).
Results: In preliminary work, three team members identified 15 relevant items from ADOS Module 2 corresponding to the ACSF:SC construct of 'social communication'; we also mapped the scores available within each relevant ADOS item to corresponding ACSF:SC ratings, determining the spread of ACSF:SC levels covered by that item. 100% consensus was reached after 2 rounds. Together all relevant ADOS items provided full coverage of the 5-level range of the ACSF:SC. Based on preliminary examination, some relevant ADOS items appear more information-rich, suggesting that weighting and possibly other 'if-then' conditions may be required in a final algorithm to convert relevant ADOS item scores to an overall ACSF:SC rating.
Conclusions: We describe methods for deriving a classification of social communication functioning from ADOS data. Preliminary results suggest this is definitely feasible. We will also present findings of the expanded Delphi method, and initial version of the algorithm to be developed using anonymized ADOS assessment data. This algorithm will be validated by assessing the correlation of the ADOS algorithm-derived ratings with paired ACSF:SC ratings from an existing dataset. The methodology outlined may provide a template for developing additional algorithmic means of deriving ICF-based functioning ratings in autism (beyond social communication) from data routinely collected by commonly used instruments like the ADOS—extending opportunities for secondary data analysis. A valid algorithm will enable longitudinal examination of social communication abilities.

70 **123.070** Gender Differences in the Age at Diagnosis of ASD

A. M. Petrou[1], *H. McConachie*[2], *D. Wilde*[1], *M. Johnson*[2] *and J. R. Parr*[2], *(1)Institute of Neuroscience, Newcastle University, Newcastle Upon Tyne, United Kingdom, (2)Institute of Health and Society, Newcastle University, Newcastle Upon Tyne, United Kingdom*

Background:
Autism spectrum disorders (ASD) are more common in boys than girls. Several studies have shown gender differences in cognitive and clinical manifestations of ASD (Holtman et al., 2007) and in the prevalence of co-existing conditions (Hartley & Sikora, 2009) and motor difficulties (Carter et al., 2007). Girls are more likely than boys to have received a diagnosis if they also present with a learning disability than if they just present with ASD alone (Mandy et al., 2012; Van Wijngaarden-Cremers et al., 2013). Recently, there has been a growing awareness of ASD in girls, and a recognition that under-diagnosis is common.
Objectives:
To investigate gender differences in the age at ASD diagnosis: i) whether girls' age at diagnosis has reduced, compared to boys', across two age cohorts; ii) whether age at diagnosis differed between girls and boys diagnosed aged < 60 months or ≥ 60 months; and iii) whether certain ASD characteristics were associated with earlier diagnosis in girls.
Methods:
Data were available from two large representative UK databases: The Database of Children with Autism Spectrum Disorder Living in the North East (Dasl^{n}e) and the Autism Spectrum Database-UK (ASD-UK; Warnell et al., 2015). Age at diagnosis was first examined for 641 boys and 111 girls enrolled in Dasl^{n}e by Year of Birth across two time periods (1996-1999 and 2002-2005). Age at diagnosis was then examined for 2573 boys and 541 girls by Age at Diagnosis Group (< 60 months and ≥ 60 months) from Dasl^{n}e and ASD-UK, and the correlates between ASD characteristics, gender and age at diagnosis were examined (ASD severity measured by Social Communication Questionnaire (SCQ); learning (intellectual) disability; DSM-IV ASD diagnosis).
Results:
There was no overall significant gender difference in age at diagnosis comparing Year of Birth age cohorts (1996-1999: boys, median =58.4 months vs. girls, median =81.9 months; 2002-2005: boys, median =54.4 months vs. girls, median =62.6 months, $F(1, 748)=1.64$, $p=.20$). However, age at diagnosis for children who received their diagnosis aged ≥ 60 months was significantly lower for boys (median =90.8 months) than for girls (median =101.4 months) ($t(340)=-4.00$, $p<.001$). There was no difference between the ASD severity of girls and boys who were diagnosed aged < 60 months ($t(803)=.20$, $p=.84$) or those aged ≥ 60 months ($t(615)=1.15$, $p=.25$) (data from ASD-UK only). Girls who received their diagnosis aged ≥ 60 months were more likely than boys to have a learning (intellectual) disability ($X^2(N=1358)=13.33$, $p<.001$) and a diagnosis of autism than another type of ASD diagnosis ($X^2(N=1358)=12.15$, $p<.001$).
Conclusions:
Girls diagnosed with ASD at 5 years or older were, on average, diagnosed later than boys. Their age at diagnosis did not decrease significantly over the time period considered. Girls in this older group did differ in some ASD characteristics when compared with boys. Clinicians and researchers need to understand the qualitative differences in autism characteristics in girls and boys, how these differences impact on age at diagnosis, and whether specific characteristics can be used to identify girls with ASD at an earlier age.

71 **123.071** How Do Test-Taking Behaviors Influence WISC-4 Scores?

R. Tanabe[1] *and S. Okada*[2], *(1)Graduate school of Eduction, Hokkaido university, Sapporo-Shi, Japan, (2)faculty of education, Hokkaido university, sapporo-shi, Japan*

Background: Wechsler Intelligence Scale for Children-IV (WISC-IV) is one of the most reliable and widely used assessment tools in the world (Wahlstrom et al., 2012). Recently, many studies focused on the profiles of clinical data and identified the common characteristics in each clinical group (Wechsler, 2010). However, some researchers have stressed the importance of comprehensive assessment including ecological validity since there are differences in terms of WISC profiles even among children with ASD and ADHD (Oakland et al., 2012 Dairoku et al., 2011).According to Oakland et al. (2012), WISC-IV four domain scores are influenced by 3 test-taking behaviors such as "Avoidance", "Inattentiveness", and "Uncooperative mood". Furthermore, other studies revealed that characteristics such as ADHD and ASD are related to these scores (Okada et el., 2010, Oliveras-Rentas et al, 2012). Therefore, it is evident that WISC-IV scores are influenced by various factors such as test-taking behaviors, ASD and ADHD. Okada et al. (2015) reviewed the existing test-taking checklist and created new checklist called Test-taking behaviors checklist (TBC). It comprises "Emotional state", "Attentiveness", "Cooperative mood", "Comprehensive state", "Social interaction", and "Flexibility", and they proposed that "Social interaction" and "Flexibility" are related to behaviors of children with ASD during the test.
Objectives: To examine the impact of test-taking behaviors on FSIQ (Full-Scale IQ) and four domain scores of WISC-IV.

Methods: WISC-IV, TBC, Pervasive Developmental Disorders Autism Society Japan Rating Scale (PARS) , and Attention Deficit-Hyperactivity Disorder Rating Scare (ADHD-RS) were administered to 74 children (5-16year old), who visited counseling room, medical institution, etc. In Japan, PARS and ADHD-RS are used to assess ASD / ADHD symptoms.
Results: Firstly, from principal component analysis and internal consistency analysis by Cronbach's coefficient alpha, five scales except "Flexibility" of TBC are tested reliable for principal components score. However, "Flexibility " is not appropriate for the calculation of scores. Secondly, we created models, comprising "Emotional state", "Attentiveness", "Comprehensive state", and "Social interaction" that influence FSIQ and four domain scores. In these models we proposed that "Attentiveness" and "Comprehensive state" relate to age, PARS relates to "Social interaction", and ADHD-RS relates to "Attentiveness". The results of structural equation modeling (SEM) revealed that all models fit significantly and "Comprehensive state" is correlated with WISC-IVscores in all models. In addition, "Social interaction" and "Attentiveness" are moderately correlated with PARS /ADHD-RS.
Conclusions: In this study, the models were created with reference from previous studies, investigated analysis on the impact of FSIQ and the four domain scores of WISC-IV. Consequently, we found that test-taking behaviors influenced these scores to a small extent and "Comprehensive state" relates to all of these scores. Meanwhile, it revealed that "Social interaction" and "Attentiveness", which were supposed to relate to PSI/WMI, did not relate these index scores. We will discuss the interpretation-system from the perspective of the impact of test-taking behaviors.

72 **123.072** In the "Gray" Zone: Exploring the Diagnostic Course of Young Children with Unclear Presentation at Initial ASD Referral

F. van der Fluit[1], *M. Vu*[1], *S. W. Duvall*[1] *and L. Huang-Storms*[2], *(1)Oregon Health & Science University, Portland, OR, (2)Institute on Development and Disability, Oregon Health & Science University, Portland, OR*

Background: The benefits of early identification of autism spectrum disorder (ASD) and subsequent intervention have been well-documented in the existing literature. As a result, there has been an increasing interest in earlier evaluation and diagnosis of children with symptoms concerning for ASD. However, given the overlap of ASD with other developmental conditions (e.g., language disorder, developmental delay, behavioral difficulties), accurate identification can be difficult, especially in young children.
Objectives: To examine the diagnostic course of young children referred for ASD evaluation who did not clearly meet diagnostic criteria at initial evaluation.
Methods: Subjects include young children who were referred to a large, tertiary care medical center for an interdisciplinary evaluation of suspected ASD. All children included did not receive an ASD diagnosis at initial evaluation; however, all were deemed high-risk due to remaining prominent concerns for ASD and re-evaluation in 6-12 months was recommended. Only those children who returned for this recommended follow-up were included (n = 5). A descriptive review of diagnostic course and child characteristics was conducted.
Results: The average age at which children completed initial evaluation was 38 months (SD = 17.79 months; range = 27-69 months). All children received either a language disorder (n =1) or global developmental delay diagnosis (n = 4) at initial evaluation. A diagnosis of Disruptive Behavior Disorder was also provided for 2 children. Some qualitative factors which may have contributed to the difficulty of diagnosis at first evaluation included: very young age, behavioral profiles including isolated strengths, lack of early intervention or other treatment, and limited information about early development. Follow-up evaluation occurred on average 10.75 months after initial evaluation (SD = 3.40, range = 6-14 months). The average age at which children completed follow-up evaluation was 47 months (SD = 18.52 months; range = 37-80 months). All 5 children were diagnosed with ASD at follow-up; a developmental delay diagnosis remained appropriate for the 4 children previously categorized as such. Continued data collection will allow for assessment of additional relevant contextual factors. Further investigation of social communication difficulties captured by the administrations of the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) will be presented.
Conclusions: It appears initial sub-threshold concern for ASD manifested more clearly at re-evaluation in the children included in the present investigation, given that all children ultimately received an ASD diagnosis. Gaining insight into the factors related to delayed diagnosis in these young children with unclear initial symptoms may help inform clinical practice.

73 **123.073** Informant Discrepancies in the Assessment of ASD Symptoms of High-Functioning Children with ASD Using the SRS-2

J. P. Donnelly[1], ***A. K. Jordan***[2], *M. L. Thomeer*[1] *and C. Lopata*[1], *(1)Institute for Autism Research, Canisius College, Buffalo, NY, (2)University at Buffalo, SUNY, Buffalo, NY*

Background: Presentation of ASD characteristics can vary across contexts and in the presence of different raters. Rating scales used to assess such behavior across settings by multiple raters (e.g., parents and teachers) may reflect these influences, potentially complicating assessment, treatment planning and evaluation. The Social Responsiveness Scale (2nd Edition, SRS-2) is a rating scale designed to assess ASD-related symptoms including social-communication deficits and circumscribed and repetitive behaviors and interests. To date, parent-teacher discrepancies on this scale have not been comprehensively examined.
Objectives: The current study was conducted to comprehensively investigate discrepancies between parent and teacher ratings on the SRS-2 for children with HFASD.
Methods: *Participants.* Two informant groups (parents and teachers) provided 240 ratings of ASD-related symptoms on the SRS-2; child inclusion criteria – short-form IQ factor score >70; receptive or expressive language score ≥ 80; and score meeting ASD criteria on ADI-R. *Outcome Measure.* Parent and staff ratings – *Social Responsiveness Scale, 2nd edition (*SRS-2; assesses ASD features). *Procedures.* Parent and teacher raters completed the SRS-2 as part of a battery of pretest (baseline) measures. Each child was rated by one parent and one teacher. Rating forms were checked, scored and entered by independent research assistants. Data analyses included (a) sample means vs. estimated population means, (b) parent vs. teacher means, (c) classification accuracy of parent and teacher scores, (d) inter-rater agreement and consistency (ICCs, Pearson correlations, Bland-Altman plot, and regression), (e) examination of potential moderators of parent-teacher discrepancies.
Results: Both parent and teacher SRS-2 Total ratings were significantly higher than population means with large effect sizes ($t(119) = 24.77$, $p < .001$, $d = 2.47$; ($t(119) = 21.30$, $p < .001$, $d = 2.07$), respectively). Parents rated significantly higher than teachers for the SRS Total and four of five treatment subscales ($d = .25$-$.37$). Parent-teacher agreement was higher for the moderate and severe clinical severity categories. The parent-teacher reliability was low-to-moderate (ICC =.22 - .47, $r = .13$ -.33). The Bland-Altman plot of Total scores shows no systematic trend across difference scores and means. No significant moderators (age, IQ, language scores) were found.
Conclusions: Both informant groups provided ratings of elevated ASD symptoms for children, with significantly higher scores reported by parents than teachers. Differences appeared to be systematic, consistent across the range of scores, and not moderated by the child, parent, or teacher variables examined. Systematic informant discrepancies affect screening outcomes, diagnostic determinations and outcome assessments. Screening may be most effective when viewing any elevated parent or teacher score as potentially important. Diagnostic determinations and response to treatment uses may be more greatly affected. Evaluators should seek additional information from raters when substantial discrepancies are observed in order to help determine reasons for disagreement (e.g., understanding of items, perceptions of symptoms, true variability of symptoms across settings). Evaluators might benefit from considering different thresholds for each informant group when considering a diagnosis. Treatment providers should consider targeting different symptoms across settings if actual differences in behaviors and symptoms across settings are indicated.

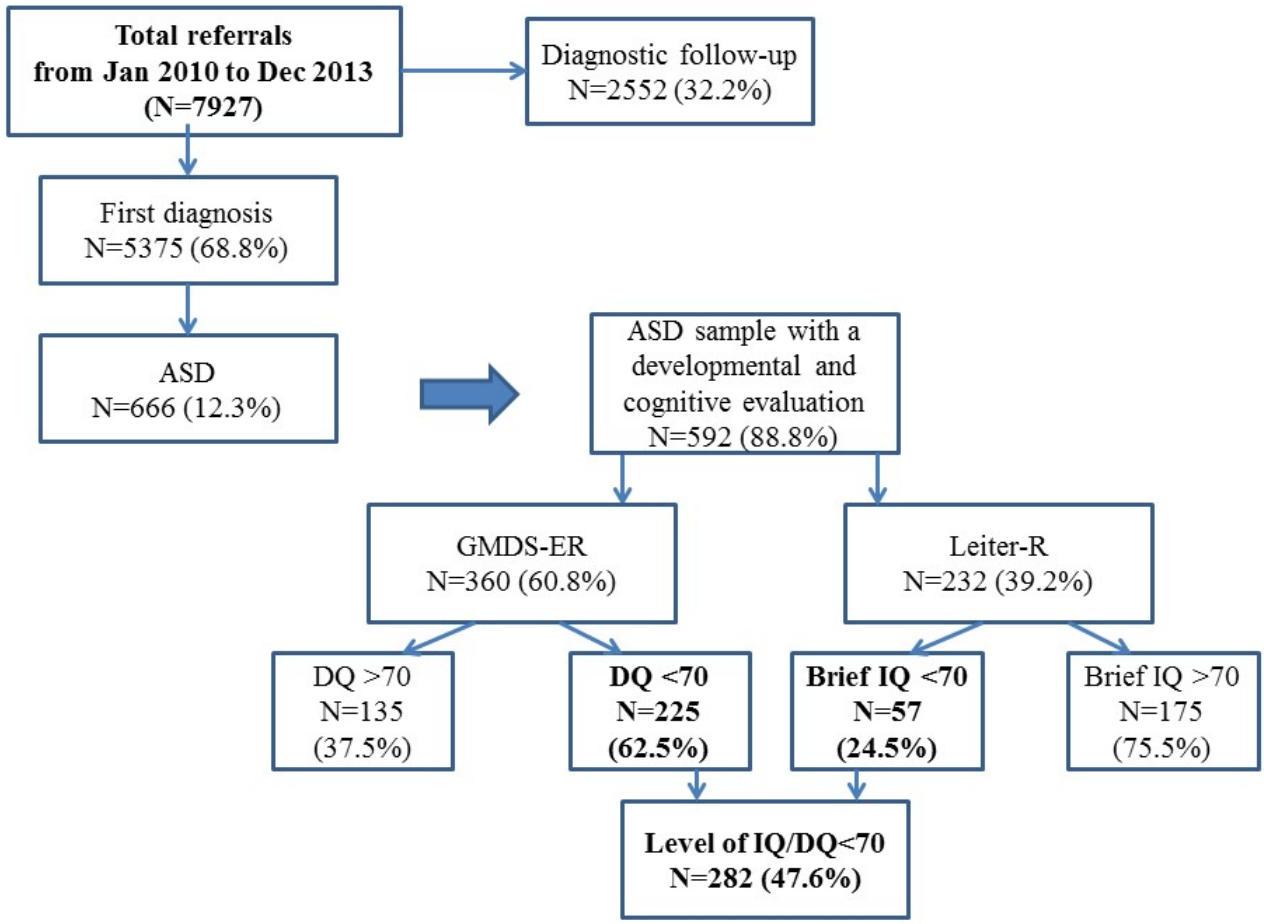
74 **123.074** Intellectual Disability in Autism Spectrum Disorder: Investigation of Prevalence in an Italian Sample of Children and Adolescents

V. Postorino[1,2], *L. M. Fatta*[2], *V. Sanges*[2], *G. Giovagnoli*[2,3], *L. De Peppo*[2,4], *S. Vicari*[5] *and L. Mazzone*[6], *(1)Department of Pediatrics, Marcus Autism Center, Emory University, Atlanta, GA, (2)Department of Neuroscience, I.R.C.C.S. Children's Hospital Bambino Gesù, Rome, Italy, (3)Neuroscience Department, L.U.M.S.A., Libera Università Maria SS. Assunta, Rome, Italy, (4)Department of Neuroscience, L.U.M.S.A., Libera Università Maria SS. Assunta, Rome, Italy, (5)Children Hospital Bambino Gesù, Rome, Italy, (6)Department of Neuroscience, I.R.C.S.S. Children's Hospital Bambino Gesu', Rome, Italy*

Background: Studies published so far have reported highly variable rates of Intellectual Disability (ID) prevalence in Autism Spectrum Disorder (ASD), ranging from 16.7% to 84%. It is worth to note that most of these studies investigated the epidemiology of ASD in general, and not specifically the prevalence of ID in ASD. Moreover, studies on the prevalence rates of comorbid ID in ASD in Italy are still lacking. In fact, to our knowledge so far only one study conducted in Italy investigated the co-occurrence of ASD and ID. In more detail, La Malfa et al. assessed the prevalence of Pervasive Developmental Disorder (PDD) in an Italian sample of 166 residents with ID, and reported a PDD rate in people with ID of 39.2%. Therefore, new insights on the prevalence of ID in ASD in this country are needed in order better understand the rates of comorbidity and their implication for treatment.
Objectives: The aim of the present study was to investigate the prevalence of ID analyzing developmental and cognitive test data (Griffiths Mental Developmental Scale-Extend Revised- GMDS-ER and the Leiter International Performance Test-Revised-Leiter-R) in a large sample of children and adolescents with ASD referred to an Italian National Children Hospital tertiary referral center from January 2010 to December 2013.
Methods: All patients referred to the Child Neuropsychiatry Unit for a diagnostic assessment were included in the present study. All of them underwent a complete diagnostic evaluation throughout a multidisciplinary team. The ASD diagnosis were based on clinical assessment, and in the majority of cases were corroborated by the ADOS-G. To assess the developmental and cognitive ability we used the GMDS-ER and the Leiter-R. Indeed, children's adaptive skills were assessed through the Vineland Adaptive Behavior Scale-Survey Form (VABS-SF).
Results: Recruitment procedure and participation rates are depicted in Figure 1. A total of 7927 patients referred for a diagnostic assessment (n=5375 for a first diagnosis, n=2552 for a diagnostic follow-up). Of them, 666 subjects were diagnosed with an ASD. 592 subjects with ASD performed a developmental or cognitive evaluation (n=360 the GMDS-ER, n=232 the Leiter-R). A total of 282 (47.6%) reported a DQ/Brief IQ <70. All of these subjects reported equivalent age below their chronological age in the VABS-SF skill domains.
Conclusions: To our knowledge, this study is the first epidemiological survey on the prevalence of ID in a large sample of Italian individuals with ASD, documenting the rates of a country for which these data were missing. Shedding light on the epidemiology of ID in ASD is a crucial issue for clinicians and researchers in order to better define methodological and conceptual problems that needs to be further addressed. In fact, underestimate intelligence ability in individuals with ASD could affect their opportunity in everyday life. Finally, given that researchers have reported that IQ is one of the good predictor of outcome, a reliable measurement of intelligence ability in autism is essential

in order to help clinicians to choose the most appropriate intervention and treatment strategy.

Figure 1. Recruiment procedure and participation rates.



75 **123.075** Longitudinal Stability and Change of Self-Reported Anxiety in Youth with ASD

H. K. Schiltz[1], *L. E. Swain-Lerro*[2], *M. C. Zajic*[2], *N. S. McIntyre*[2], *L. Springer*[3] *and P. C. Mundy*[4], *(1)Human Development, University of California at Davis, Davis, CA, (2)University of California at Davis MIND Institute, Davis, CA, (3)University of California at Davis, Davis, CA, (4)Education and Psychiatry, University of California at Davis, Sacramento, CA*

Background: Heterogeneity is a feature of Autism Spectrum Disorders (ASD). Co-occurring disorders such as anxiety further contribute to this variability (Gillott, Furniss, & Walter, 2001). However, concerns with ASD-specific challenges (e.g. language and cognitive skills) raise questions about the reliability of self-report of internalizing disorders such as anxiety as a tool for research with this population (Grondhuis & Aman, 2012). To address these questions, the stability and change of self-reported anxiety symptoms were examined in children with ASD compared to children with Attention Deficit Hyperactivity Disorder (ADHD) or typical development (TD) across a 15-month period of growth.

Objectives: 1) To examine diagnostic group differences across multiple dimensions of anxiety symptoms. 2) To compare diagnostic groups on test-retest self-report reliability. 3) To examine group differences in change of anxiety symptoms over time.

Methods: One hundred twenty-five 8- to 16-year-old children with ASD, ADHD or TD provided two sets of self-report on March's Multidimensional Anxiety Scale for Children (MASC; 1997, 2013) approximately 15 months apart. ASD was confirmed using the ADOS-2 and ADHD symptoms were confirmed with the Conners Parent Report scale. The mean ages of the ASD, ADHD, and TD groups were 11.4, 12.2, and 11.5 years, respectively. The mean IQs of the groups were 101, 100, and 115, respectively, and IQ was a covariate in analyses where appropriate.

Results: The groups differed on the MASC Total Anxiety and Physical Symptoms scales at both time points (TP, Table 1). The groups differed on the Anxiety Disorder index and Separation Anxiety at TP2. Post hoc analyses revealed the ASD group was higher on Total Anxiety than the TD group and higher on the Physical Symptoms than both the ADHD and TD groups at TP1. Post hoc analyses also revealed that the ASD group was higher on Total Anxiety and Physical Symptoms than both comparison groups at TP2. They were also higher on Separation Anxiety and the Anxiety Disorder Index than the ADHD group at TP2 (Table 1).

There was evidence of stability across the 15-month interval for self-report of Total Anxiety, Physical Symptoms, and Separation Anxiety in all groups (Table 2). Social Anxiety and the Anxiety Disorder index displayed evidence of stability in the ASD and TD groups.

Report of Physical Symptoms increased across time significantly for all groups (Table 1), but this increase was greatest for the TD group; $F(2,115)=3.42$, $p=0.04$. Total Anxiety also increased for the ASD and TD groups. The anxiety disorder index increased only for the ASD group; $F(1, 56) = 8.12$, $p =. 006$.

Conclusions: The results support the hypothesis that self-report in this subgroup of children with ASD provides meaningful information about trait-like individual differences in anxiety, and that school-aged children with ASD appeared to be at greater risk for significant increases in clinical levels of symptoms of an anxiety disorder than did children in the comparison groups. These observations bolster the need for more research on proactive monitoring and treatment of anxiety disorders in children with ASD.

Table 1: Time 1 and 2 MASC Data

	ASD (N= 57)		ADHD (N=28)		TD Controls (N=40)	
Variables	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Total Anxiety[ade]	**57.74**	**61.02**	54.50	54.54	**51.80**	**55.35**
	(10.17)	**(12.24)**	(11.53)	(12.36)	**(8.37)**	**(9.14)**
Physical Symptoms[abde]	**54.27**	**61.98**	**49.54**	**54.39**	**46.92**	**57.45**
	(9.67)	**(9.63)**	**(9.51)**	**(11.23)**	**(7.49)**	**(9.21)**
Harm Avoidance	53.54	53.44	52.86	50.61	53.93	52.27
	(10.08)	(8.65)	(11.75)	(7.79)	(9.05)	(5.45)
Social Anxiety	55.65	54.28	56.46	53.43	51.35	51.85
	(12.03)	(11.24)	(11.63)	(11.94)	(8.28)	(8.18)
Separation Anxiety[e]	61.54	57.95	55.00	51.79	54.67	54.32
	(12.67)	(11.69)	(12.01)	(12.47)	(10.65)	(8.46)
Anxiety Disorder Index[e]	**55.05**	**59.95**	54.43	53.25	54.02	56.52
	(11.53)	**(11.48)**	(10.07)	(10.31)	(9.46)	(8.41)

Notes: Mean (Standard Deviation)

Time 1 significant ($p<0.05$) group differences: a=HFA vs TD b=HFA vs ADHD c= ADHD vs TD

Time 2 significant ($p<0.05$) group differences: d=HFA vs TD e=HFA vs ADHD f= ADHD vs TD

Bolded numbers indicate significant change ($p<0.05$) from Time 1 to Time 2

Table 2: Correlations from Time 1 to Time 2

Variables	ASD	ADHD	TD Controls
MASC Total Anxiety	0.56**	0.52**	0.46**
MASC Physical Symptoms	0.64**	0.62**	0.53**
MASC Harm Avoidance	0.48**	0.38	0.20
MASC Social Anxiety	0.43**	0.35	0.40*
MASC Separation Anxiety	0.34*	0.58**	0.53**
MASC Anxiety Disorder Index	0.37**	0.24	0.33*

Note: * = $p \leq 0.05$, ** = $p \leq 0.01$

Controls: Full IQ

76 **123.076** Need a New DSM-5 ASD Assessment? Just AASC?

C. L. Hebert, *Spectrum Psychological Associates, Virginia Beach, VA*

Background:
The under-identification of high-functioning autism (HFA) in school age children is an ongoing problem, especially more able students with high-functioning autism (Wilkerson, 2010). Lost time due to under-identification or failing to provide needed services will diminish the developmental potential of children with ASD (Pool & Hourcade, 2011). More than half the children with autistic impairments, at the same levels as those with an ASD label, are not identified even though they have the same needs for support in educational settings (Russell et al., 2010).
Objectives:
The need to assess individuals with high-functioning autism is well demonstrated (Barnhill, 2007). A simple pre-screening assessment, with input from both a parent and an educator, would provide a method for identifying individuals in need of evaluation. The objective of this research is to design an assessment that is both DSM-5 compliant and easy to use.
Methods:
This study looks at existing data consisting of participant demographic data and item responses to the 272 question Ellis Functional Assessment (EFA) for high-functioning autism. The EFA is a measurement assessment that examines areas of functional difficulty for people with high-functioning autism. There were 538 participants in the

original study. The data set was later expanded to include 740 participants.
This data was analyzed using exploratory factor analysis to assess how many latent variables are included in the assessment. This information was used to design a short 15 to 25 question assessment pre-screen students for referral to the child study team for evaluation to receive special educational services for autism spectrum disorders. This assessment targets identifying students at the high-functioning end of the spectrum.
Confirmatory factor analysis (CFA) was used to test the model which was specified in advance to run the analysis (Thompson, 2010). The goal of CFA is to test a specific model or hypothesis (the shortened assessment) (Osborne, 2008).
Results: **:** The results for the final model of this confirmatory factor analysis produced a model with χ^2 = 8730.610, df = 655 (p < .001) and resulted in CFI = 1.00, NFI= 1.00 and RMEA = .243. After examining the Modification indices, the parameters with indices over 80 were freed and the resulting model was then analyzed. This produced a model with $\chi 2$ =3294.790, df = 627 (p < .001) and resulted in CFI = 1.00, NFI= 1.00 and RMEA = .104. This represents a significantly better fit ($\chi 2$ = 5435.82, df = 28, p < 0.00001). The assessment was also evaluated for internal reliability. This resulted in a Cronbach's Alpha = .941, indicating internal reliability.
Conclusions:
These five identified factors, covered the majority of the variance in the model and covered the most important aspects of ASD identified in literature. These factors cover all of the elements used for diagnosis in DSM-5. Because of the data in the EFA included behavior from early childhood the third requirement of DSM-V, symptoms must be present in the early developmental period is satisfied. The AASC is a valid, reliable screening instrument for Autism Spectrum Disorders.

77 **123.077** Parental Developmental Concerns of at Risk Underserved Young Children

*Y. Janvier[1], **J. Harris**[2], C. N. Coffield[3], M. Jimenez[4] and M. Zuniga[2], (1)Children's Specialized Hospital, Toms River, NJ, (2)Children's Specialized Hospital, Fanwood, NJ, (3)The Boggs Center on Developmental Disabilities, Rutgers Robert Wood Johnson Medical School, New Brunswick, NJ, (4)Children's Specialized Hospital, New Brunswick, NJ*

Background: Significant disparities have been identified among poor and minority children in the identification and treatment of ASD. Various factors may contribute to these disparities in identification. The first step in identification is to recognize a concern. While healthcare providers are in an excellent position to recognize developmental and autism-specific concerns, numerous studies have shown that they do not consistently screen for developmental concerns including autism and even when developmental concerns are identified by health care providers the majority of the children are not linked to services. Child care providers do not consistently screen development and very few screen for autism. Reliance on parents to recognize and express developmental concerns depends on parental awareness of red flag behaviors and the receptiveness of providers to listen to and act upon the expressed parental concern.
This study examined parental concerns for an at risk group of young children from low income, racial or ethnic minority and/or Spanish-speaking families.
Objectives: To better understand what concerns drive parents of young underserved children to seek developmental evaluation
Methods: The data was collected as part of a larger study to validate a new autism screening tool designed for use in a young underserved population. Subjects were 24 to 60 months and either were Medicaid or non-insured, non-white, Hispanic or whose primary language in the home was Spanish. Subjects were drawn from hospital-based developmental clinics and from Federally Qualified Health Centers. At risk for ASD status was based on parent/caregiver or healthcare provider concern about child's language, social, and/or behavioral development. Parents of subjects completed the new autism screening tool (Developmental Check-In-DCI), Modified Checklist for Autism in Toddlers-Revised (M-CHAT-R), Social Communication Questionnaire (SCQ), a medical history form, adaptive behavior measure (ABAS) and demographic information. The children were evaluated using the Mullen Scales of Early Learning and the ADOS--2. Clinical diagnosis was determined by licensed, experienced clinicians (developmental pediatrician, psychologist or advanced practice nurse based on patient history, observations and ADOS-2. Parental developmental concerns presented here were extracted from the DCI item "Do you have any concerns about your child's development or behavior? If so, please describe".
Results: Data will be analyzed using modified grounded theory in which themes are allowed to emerge from the data rather than imposed by the research staff. Parent responses will be read and coded. We will use the constant comparative method in which data is compared iteratively. Themes will be identified attending to factors such as repetition, emphasis and connections. We will compare themes across demographic characteristics as well as severity, clinical diagnosis of ASD, and setting.
Conclusions: The results of this study will provide important information about how parental concerns relate to autism screening and evaluation outcome among traditionally underserved young children. This information may then help to better train healthcare providers to recognize and solicit parental concerns, as well as to inform autism awareness campaigns aimed at low income, racial or ethnic minority or non-English-speaking communities.

78 **123.078** Predictive Factors in Special Education Eligibility for Children with ASD

***L. J. Dilly**[1] and C. Hall[2], (1)Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, GA, (2)Marcus Autism Center, Children's Healthcare of Atlanta, and Emory University School of Medicine, Atlanta, GA*

Background: As prevalence rates of autism spectrum disorders (ASD) in the United States reach 1 in 68 (1.5%), public schools are increasingly challenged with educating children with ASD through special education programs (Baio, 2014). Within the U.S., less than .5% of children ages 3-21 are eligible for special education services in the area of ASD (OSERS, 2014). Therefore, approximately 2 out of 3 children with a health diagnosis of ASD are not receiving special education services specific to their disability. This is consistent with findings that children with an ASD health diagnosis often do not have a ASD special education eligibility (Pinborough-Zimmerman et. al, 2012). Little is known about characteristics of children receiving special education versus those who do not. Related to health diagnoses of ASD, children with more severe symptoms have been identified as having younger age of diagnosis (Jo et. al, 2015; Mandell, 2005). In addition, identification rates of ASD are generally higher in white, non-Hispanic males (Baio, 2014; Pettygrove et al., 2013).
Objectives: This study examined the rate of special education eligibility for children diagnosed with ASD as well as factors that predict if a child diagnosed with an autism spectrum disorder receives special education services. It was predicted that children with more significant adaptive delays would receive special education services at higher rates. Higher levels of special education eligibility were also expected for white, non-Hispanic males.
Methods: Data from a clinical sample of 285 children ages 3-21 who were diagnosed with ASD at a regional autism center was used. Data from record review including information regarding age(M = 4.8; SD =2.27), race (White N = 111, Black N = 117; Hispanic N = 35; Other N =9), gender (male N = 256; female N = 24), and adaptive behavior scores. The overall adaptive composite scores from the Vineland-II and the ABAS-II were combined for use in the analyses (M = 69.0,SD =12.48). Chi-square and binary logistic regression analyses were used to consider the effect of race, gender, and adaptive abilities on special education eligibility.
Results: Within the sample, 67% of children diagnosed with ASD received special education services. Gender was not predictive, but minority status trended towards significance, with minority children having higher rates of IEP placement than Caucasian children (X^2 (1, N =272) = 3.49, p =.06). Children's adaptive abilities were predictive of special education eligibility (Wald = 5.27, p<.05)
Conclusions: Consistent with previous studies, many children diagnosed with ASD did not receive special education services. Gender was not predictive of special education eligibility, though there was a trend towards minority children being more likely to have special education eligibility than Caucasian children. This trend is interesting given that previous studies have found a later age of diagnosis for children from diverse racial backgrounds. Higher rates of special education eligibility among minority children may reflect the extent to which children have more universal access to special education services than clinical diagnostic services. Results also indicate that children with more significant impairment receive special education services.

79 **123.079** Predictors of Parent-Teacher Agreement on Emotional and Behavioral Problems and Autism Symptoms in Youth with ASD and Their Typically Developing Siblings

***E. A. Stratis**[1,2] and L. Lecavalier[1], (1)The Ohio State University, Columbus, OH, (2)The Kennedy Krieger Institute, Baltimore, MD*

Background: It is often desired to elicit information from multiple informants when conducting psychological assessments of children. However, agreement between informants is imperfect, typically falling in the moderate range. Discrepancies between informants reflect, in part, contextual variations in children's behavior. For typically developing (TD) youth, several variables predict these discrepancies, including child and parent demographic characteristics. Despite being widely studied in TD youth, few consistent predictors have been identified. Additionally, limited information is available regarding predictors of informant agreement in youth with autism spectrum disorder (ASD).
Objectives: This study evaluated the magnitude of parent-teacher agreement on emotional and behavioral problems and symptoms of ASD, while also considering a number of demographic and clinical features as predictors of agreement. Comparisons were made across youth with ASD and their TD siblings.
Methods: Data from 618 families in the Simons Simplex Collection were utilized for this project. All of these families had complete parent and teacher ratings for both the child with ASD and the TD sibling. The Achenbach System of Empirically Based Assessment (ASEBA) was used to measure behavior and emotional problems and the Social Responsiveness Scale (SRS) was used to measure ASD symptoms. Magnitude of agreement was investigated utilizing Pearson and Intraclass Correlations. Predictors of agreement were considered in hierarchical regression analyses, utilizing three types of parent-teacher discrepancy scores as outcome variables.
Results: For children with ASD, parent-teacher agreement fell in the moderate range (r ranging .26 to .36) with no significant differences across type of problem assessed (externalizing behavior, internalizing behavior, ASD symptoms). For TD siblings, agreement also fell in the moderate range (r ranging .22 to .33), and agreement was significant higher for externalizing problems than internalizing problems and ASD symptoms.
Predictors of agreement varied across children with ASD and TD siblings. For children with ASD, child IQ, parent reported emotional and behavioral problems, and parent and teacher report of ASD symptoms predicted parent-teacher agreement on the ASEBA scales. On the SRS, child IQ, child receptive language, clinician rated ASD

symptoms, adaptive behavior, and parent and teacher reported emotional and behavioral problems were significant predictors of parent-teacher agreement. For TD siblings, parent and teacher reported ASD symptoms, and parental race and education were the only consistent predictors of parent-teacher agreement on the ASEBA scales. On the SRS, child sex, child race, parent and teacher rated emotional and behavioral problems, parental education, and parental broader autism phenotype characteristics were predictors of parent-teacher agreement.
Conclusions: This study highlights that the magnitude of parent-teacher agreement is similar across children with ASD and TD children, although patterns of agreement vary across these populations. Further, the factors that influence parent-teacher agreement on emotional and behavioral problems and ASD symptoms may vary across children with ASD and TD children. This implies that past research in TD children cannot be simply extended to children with ASD, and further research is needed to clarify what factors are associated with informant agreement in children with ASD to identify when the use of multiple informants is the most critical.

80 **123.080** Principal Pathogenetic Components in Autism Spectum Disorder: A Validation Study

C. Brogna[1], *R. Sacco*[2], *S. Bruccheri*[1], *A. Costa*[1], *G. Barbieri*[1], *G. Ferrarelli*[1] *and A. M. M. Persico*[3,4], *(1)Child and Adolescent Neuropsychiatry Unit & Laboratory of Mol. Psychiatry and Neurogenetics, University Campus Bio-Medico, Rome, Italy., Rome, Italy, (2)Univ. Campus Bio-Medico, Rome, Italy, (3)Child and Adolescent Neuropsychiatry Unit, Lab of Molecular Psychiatry and Neurogenics, University Campus Bio-Medico, Rome, Italy, (4)Mafalda Luce Center for Pervasive Developmental Disorders, Milan, Italy*

Background: Applying principal component analysis (PCA), we previously described four pathogenetic components: I) “circadian and sensory dysfunction”, II) "immune dysfunction”, III) “neurodevelopmental delay", and IV) "stereotypic behavior” (Sacco et al., 2010). These four pathogenetic components subsequently defined four patient clusters: a) ICS (immune abnormalities and some circadian and sensory issues); b) CS (major circadian and sensory dysfunction, with little or no dysimmunity); c) S (prominent stereotypies) and (d) M (patients with a mixture of all four components associated with developmental delay).
Objectives: To replicate and to extend these results using an independent sample.
Methods: PCA followed by correlation analysis was performed on 19 clinical and family history variables in an independent sample of 192 ASD patients admitted to our Unit subsequently to the previous recruiting period (Sacco et al., 2010). This sample includes 163 males and 29 females, mean age 10.6 years (SD ± 6.8), belonging to 163 simplex and 29 multiplex Italian families.
Results: PCA revealed a component structure similar, but more complex compared to the previous structure, now encompassing five components which altogether explain 50% of the total variance. These include: 1) a “developmental delay” component, including various developmental milestones (non verbal and verbal language development, social smile onset, independent walking, acquisition of bladder and bowel control). These variables were also related to a positive history of obstetric complications and/or repeated spontaneous abortions in the mother; 2) a “lower functioning” component including intellectual disability, motor and/or verbal stereotypies, self-injurious behaviors; 3) a “mixed” component including sleep disorders, abnormal pregnancy duration, history of regression and hypotonia; 4) an “allergic” component including allergies in the patient, history of obstetric complications and/or repeated spontaneous abortions in the mother, level of verbal language development, and hyperactivity; 5) an “autoimmune” component including a family history positive for autoimmune diseases, history of any infectious disease at autism onset (i.e., recurrent otitis, upper airway infections, etc), excessive pain tolerance.
Conclusions: This validation study confirms the existence of the “Developmental delay” and “Immune” components, which seemingly represent consistent patterns in the ASD clinical phenotype in addition to the “low functioning” component. Interestingly, the former “Immune” component from Sacco et al. (2010) splits here into two components, one “allergic” and one “autoimmune”, suggesting two different pathways underlying the dysimmune endophenotype in ASD. Despite an extreme and long-recognized clinical heterogeneity, the autistic phenotype can be partly, yet consistently dissected on the basis of simple clinical and family history variables, allowing future investigations over patient clustering, biomarker identification, developmental trajectories, therapeutic outcomes and strategies.

81 **123.081** Qualitative Study on Functioning and Disability in ASD -the Development of WHO ICF Core Sets

S. Mahdi[1], *S. Bolte*[2], *A. Fallman*[1] *and J. Hattestrand*[1], *(1)Karolinska Institutet, Stockholm, Sweden, (2)Department of Women's and Children's Health, Pediatric Neuropsychiatry Unit, Karolinska Institutet, Stockholm, Sweden*

Background: The International Classification of Functioning, Disability and Health (ICF) was initiated by the World Health Organization (WHO) to provide a comprehensive and universally accepted framework for the description of health-related functioning. The ICF is based on a bio-psycho-social model of functioning, comprising over 1600 categories related to various components of health, specifically; *Body functions, Body structures, Activities, Participation* and *Environmental factors.* Not all are, however, applicable to a certain health condition. It is therefore the process has been initiated to develop ICF Core Sets for Autism Spectrum Disorder (ASD); lists of generally-agreed-upon ICF categories pertinent to individuals with a certain health condition. From these core sets diagnostic instruments can be derived for broad research and clinical use.
Objectives: This study is the third in a series of four international empirical investigations to develop ICF Core Sets for ASD. The objectives of the current study were twofold: First, to use a qualitative approach to capture the perspectives of individuals with ASD, their parents, professional caregivers, teachers, and representatives from interest organizations on functioning and disability in ASD. Second, to identify the meaningful concepts mentioned by the different stakeholders, number and link them to the ICF-CY (Children and Youth-version of the ICF).
Methods: Participants (N = 33) were recruited in Sweden from clinics and organizations related to ASD. They were then asked to take part in group discussions/individual interviews pertaining to functioning and disability in ASD. Seven questions were administered and meaningful concepts were extracted from their responses and then linked to the ICF-CY by three independent researchers. Group discussions/individual interviews are also being done internationally, but these have not yet been included in the analysis as the data collection process is still ongoing.
Results: Thirty-three transcriptions were included in the analysis and 1649 meaningful concepts contained in these transcriptions were linked to 146 ICF-CY categories. To include the most relevant ICF-CY categories related to ASD, only those that were identified in at least 5 % of the transcriptions were reported. This left 109 categories for the final results, of which 33 were related to *Body functions*, 3 were related to *Body structures*, 40 were related to *Activities and Participation*, and 33 were related to *Environmental factors*. The five most frequently identified categories were *products and technology for personal use in daily living (73 %), higher-level cognitive functions (70 %), sound (64 %), dispositions and intra-personal functions (61 %)* and *immediate family (55 %).*
Conclusions: The broad variety of ICF-CY categories identified in the Swedish study site attests to the complexity of ASD and underlies the potential value of the ICF-CY as a framework to capture an individual's functioning in different life-domains. The current study, which will be completed once results from other international study sites have been included, will in combination with three additional studies (systematic literature review, expert survey and clinical study) provide the scientific basis for defining the ICF Core Sets for ASD for multi-purpose use in basic and applied research and every day clinical practice of ASD.

82 **123.082** Screening for Autism Spectrum Disorders in Very Low Birth Weight Preterm Infants

V. R. Lederman[1], *A. L. Goulart*[2] *and J. S. Schwartzman*[3], *(1)Universidade Presbiteriana Mackenzie, Sao Paulo, Brazil, (2)Pediatrics, Universidade Federal de São Paulo/ Escola Paulista de Medicina, São Paulo, Brazil, (3)Universidade Presbiteriana Mackenzie, Sao paulo, Brazil*

Background: Very low birth weight preterm infants are a high-risk group for ASD, although there is no agreement about the rate. ASD signs can be detected earlier in infancy, but screening that population in different moments can lead to different results, due to developmental delays that may be present.
Objectives: to screen very low birth weight preterm infants for ASD signs between 18 and 24 month of corrected age, and reassess the sample, 12 month later in order to verify the permanence or not of the ASD signs.
Methods: 60 families of very low birth weight preterm infants between 18 and 24 month of corrected age answered the M-CHAT questionnaire (Robins et al, 2001). After 12 months, the same families answered de ABC questionnaire (Krug et al, 1980).
Results: Screening the very low birth weight preterm infants at 18 to 24 month found a rate of 6,7% of positive results for ASD. A second screening, performed one year later found a rate of 5,2% of positive results, although not all the same children of the first evaluation presented those signs: in the first screening with M-CHAT, girls and boys had positive screening for ASD signs, and in the second screening, with the ABC questionnaire, only boys. Comparison of the positive screening results in both moments, show a low degree of agreement between the questionnaires, Fisher test, p=0,196, Kappa agreement coefficient =0,241 (p=0,063). Positive-screening children were evaluated by diagnosis protocol, and 3,5% of our sample met de DSM-5 (2013) criteria for ASD
Conclusions: : Very low birth weight preterm infants are an ASD risk group; although the rates can be lower than former reports. Screening at age of 18 months allows identification of developmental delays, independently of a future ASD diagnosis. However, a single screening at this age, can lead to false-positive results, due to developmental delays common to the premature condition. A second screening, around 30 month of age is recommended, which also guaranties inclusion of regressive ASD cases.

83 **123.083** Sensory Processing Profile and Autistic Symptoms As Predictive Factors in Neurodevelopmental Disorder Diagnosis

M. Glod[1], *D. M. Riby*[2], *E. Honey*[3] *and J. Rodgers*[4], *(1)Newcastle University, Institute of Neuroscience, Newcastle Upon Tyne, England, United Kingdom, (2)Department of Psychology, Durham University, Durham, United Kingdom, (3)CNDS, Northumbria Tyne and Wear NHS Foundation Trust, Newcastle Upon Tyne, United Kingdom, (4)Newcastle University, Newcastle Upon Tyne, United Kingdom*

Background: Unusual sensory responses have been consistently reported as common in autism spectrum disorder (ASD) and were recently included in the diagnostic criteria. Sensory difficulties are also common among individuals with other neurodevelopmental disorders, including Williams syndrome (WS, a genetic condition characterized by developmental delays, learning disabilities and cardiovascular problems). Cross-syndrome comparisons of sensory atypicalities and the evaluation of their

syndrome-specificity, however, have rarely been undertaken. This analysis would enable us to determine whether there are unique syndrome-specific sensory signatures, which in turn may assist with differential diagnosis and tailored interventions.
Objectives: The aims of this study were: (a) to examine and compare the sensory profiles in three groups of children and adolescents; those with a diagnosis of ASD without learning disabilities (LD), ASD with learning disabilities and those with WS; (b) to investigate whether autistic symptoms, including sensory processing scores can predict a group membership.
Methods: Parents of 21 children with ASD and LD, 22 parents of children with ASD (no LD) and 18 with WS, aged between 4 and 16 years were recruited. Parents completed the Sensory Profile (SP; Dunn, 1999) to provide information about their child's sensory experiences and the Social Responsiveness Scale – second edition (SRS-2; Constantino & Gruber, 2012) to assess the degree of social impairment in their child.
Results: No significant differences were found in sensory processing scores between the three groups. Regression analyses were undertaken with sensory quadrants (Low Registration, Sensory Sensitivity, Sensation Seeking, and Sensory Avoiding) and SRS-2 total score as factors. Multinomial logistic regression was not possible due to similarities between the ASD groups. Binary logistic regression models were run for WS and ASD without LD; and WS and ASD with LD individually. Models significantly predicted group membership. In the WS and ASD no LD model Low Registration (β=.345, S.E.=.158, p=.029), Sensory Sensitivity (β=.383, S.E.=.193, p=.048) and SRS-2 total score (β=.178, S.E.=.078, p=.022) were significant predictors in the model, while in the WS and ASD with LD model there were only two significant predictors: Low Registration (β=.201, S.E.=.092, p=.028) and SRS-2 total score (β=.154, S.E.=.057, p=.007).
Conclusions: The findings suggest that sensory profiles of children and adolescents with WS and ASD are very similar. High rates of general sensory atypicality generally, therefore, are not autism-specific, but are a common neurodevelopmental characteristic that do not reliably distinguishing between WS and ASD groups. Low Registration and Sensory Sensitivity related behaviours might, however, be more specific to ASD. Further work is needed to explore behaviours within the sensory profiles that can discriminate between neurodevelopmental disorders and which therefore should be included in diagnostic classifications.

84 **123.084** Stability and Change for Toddlers with Autism Spectrum Disorder before Age 2: A 1.5-Year Follow-up

C. C. Wu[1], *Y. M. Hou*[2] *and C. H. Chiang*[3], *(1)Department of Psychology, Kaohsiung Medical University, Kaohsiung, Taiwan, (2)Chia-Yi Christian Hospital, Chiayi City ,Taiwan, Taiwan, (3)National Chengchi University, Taipei, Taiwan (Province of China)*

Background: Autism spectrum disorder (ASD) is thought as an innate neurodevelopmental disorder and characterized by impaired social communication and social interaction, as well as restricted and repetitive patterns of behavior and interest. Once thought to be a rare condition, ASD has recently emerged dramatically. The prevalence of ASD increases significantly beyond than 1 in 100 children (APA, 2013; Baird et al., 2006; Centers for Disease Control and Prevention, 2014). The increasing prevalence rate is due to improved awareness of ASD and service availability, and also highlights the importance of the early identification. Knowing the importance of early identification, the American Academy of Pediatrics (AAP) has recommended that all toddlers should receive screening for autism before age 2 (Johnson et al., 2007).
Objectives: A diagnosis of children with ASD appears to be stable in children as young as age 3. However, few studies examined stability and change of diagnosis for young children with ASD, especially for toddler before age 2. In this current study, longitudinal design was used to examine stability and change of diagnosis for toddlers with ASD before age 2.
Methods: There were 98 participants who had all administrated both of the Screening Tools for Autism in Two-Year-Olds, Taiwan version (T-STAT) (Chiang et al., 2013) and Autism Diagnostic Observation Schedule (ADOS) (Lord et al., 1999) between 17 and 24 months of age (Time 1, mean chronological age = 21 months) and received diagnostic and developmental reassessment between 35 and 46 months of age (Time 2, mean chronological age = 40 months). At Time 2, all participants were assessed and diagnosed according to DSM and with reference to developmental history and current concerns from parents, results of cognitive and adaptive function measures, observations of the child, and the results of ADOS by a multidisciplinary team that included senior child clinical psychologists with Ph.D. degree and senior child psychiatrists.
Results: Based on classification of the T-STAT (cutoff = 2.25), the results showed that the sensitivity and specificity are .89 and .81, respectively. In addition, positive predictive value (PPV) is .88 and negative predictive value (NPV) is .92. However, based on classification of the T-STAT (cutoff = 2.50), the results showed that the sensitivity and specificity are .87 and .83, respectively. In addition, PPV is .82 and NPV is .88. Based on classification of the ADOS (Time 1), the results showed that the sensitivity and specificity are .91 and .90, respectively. In addition, PPV is .89 and NPV is .92.
Conclusions: The results of this current study showed that reliable diagnosis of toddlers with ASD could be made before age 2 and have good short-term stability. In addition, the results of the current study showed that both the T-STAT and ADOS are promising tools to differentiate toddlers with ASD and toddlers with developmental delayed before age 2.

Table 1 Classification between screening tools (Time 1) and clinical diagnosis (Time 2)

	clinical diagnosis (Time 2)	
screening tools (Time 1)	ASD group (n = 46)	DD group (n = 52)
T-STAT (cutoff = 2.25)		
ASD group	41(89.1%)	10(19.2%)
DD group	5(10.9%)	42(80.8%)
T-STAT (cutoff = 2.50)		
ASD group	40(87%)	9(17.3%)
DD group	6(13%)	43(82.7%)
ADOS (module 1)		
ASD group	42(91.3%)	5(9.5%)
DD group	4(8.7%)	47(90.4%)

85 **123.085** Standardized ADOS-2 Toddler and Module 1 Severity Scores in a Clinical Sample

D. Hedley[1], *R. E. Nevill*[2], *M. Uljarevic*[3], *E. Butter*[4] *and J. A. Mulick*[5], *(1)Olga Tennison Autism Research Centre, La Trobe University, Melbourne, Australia, (2)The Ohio State University, Columbus, OH, (3)Olga Tennison Autism Research Centre, La Trobe University, Bundoora, Australia, (4)Nationwide Children's Hospital, Westerville, OH, (5)Pediatrics, The Ohio State University, Columbus, OH*

Background:
The ADOS-2 is a comprehensive assessment instrument which forms part of the recommended "gold standard" for the assessment of Autism Spectrum Disorder (ASD). While the instrument is primarily designed to classify cases of ASD based on raw scores, it is also possible to derive an algorithm of symptom severity from total scores. Standardized *calibrated severity scores* (CSS) provide a metric of the severity of autism-specific symptoms and behaviors and, unlike raw scores, are reasonably independent of factors such as IQ (particularly Verbal IQ), language and age. Severity scores were formally introduced for Modules 1-4 in the ADOS-2 revision. Recently, Esler et al. (2015) calculated total and domain CSS for the ADOS-2 Toddler Module, but the algorithm has yet to be verified in an independent sample.
Objectives:
Our aim was to examine the reliability and clinical utility of the ADOS-2 CSS for the Toddler Module in an independent clinical sample. A sample of children assessed with Module 1 were included for comparison purposes. Specifically, we focused on the application of ADOS-2 CSS algorithms in children aged 3 years and under.
Methods:
The sample consisted of 176 children (male = 88.1%; M_{age} = 32.21 months, *SD* = 6.23, range = 17-46 months). Of the 176 assessments, 125 received a diagnosis of ASD

(71%), 44 (25%) received non-spectrum diagnoses and seven (4%) children did not receive any medical diagnosis. Participants received extensive developmental and diagnostic assessments. Final diagnostic status was based on best estimate clinical (BEC) judgement involving DSM-5 criteria, parent interview, and assessment results including the ADOS-2. The final sample included 80 Toddler Module assessments (non-Verbal, NV = 62; some words, SW = 18) and 107 Module 1 assessments (NV = 70; SW = 37).
Results:
The CSS was more stable than raw scores across age and language as evidenced by fewer significant differences between scores across modules. Younger non-verbal participants scored higher than other groups, however effect size was reduced for the CSS compared to total and domain raw scores. The CSS was highly correlated with the clinician completed CARS2-ST, but not with the parent completed Autism Spectrum Rating Scale (ASRS). Neither gender nor chronological age were found to be associated with raw scores or the CSS. Linear regression indicated that verbal DQ was a significant predictor for raw scores but not the CSS. Auditory comprehension and Child Behavior Checklist (CBCL) externalizing behavior were significant predictors of total and domain raw scores and the CSS. Raw and CSS RRB scores were significantly influenced by nonverbal DQ and auditory comprehension.
Conclusions:
Our findings are consistent with previous research suggesting that, in clinical populations, ADOS-2 standardized scores are less influenced by participant characteristics than raw scores. These results offer support for the introduction of the Toddler Module CSS into clinical practice.

86 **123.086** Teachers Are Important Too! Incremental Validity of BASC-2 TRS in Predicting DSM-5 Autism Spectrum Disorder Severity Ratings

K. S. Ellison, *M. B. Bundy, D. B. Wygant and J. S. Gore, Psychology, Eastern Kentucky University, Richmond, KY*

Background: The DSM-5 conceptualizes the diagnostic criteria of autism as existing along a dimensional framework. Diagnosing clinicians must identify severity levels based on the amount of support needed in the areas of Social Communication (SC) and Restricted/Repetitive Behaviors (RRB). One clinician method for ascertaining a summary of client behavior is the broadband behavior-rating scale. Receiving behavior rating input from multiple informants is imperative; allowing for data to be gathered beyond what can be obtained from a single informant and for behavior to be represented as it occurs in multiple contexts (Kamphaus et al., 2000). The Behavior Assessment System for Children, Second Edition (BASC-2), one widely utilized instrument, is a multidimensional measure assessing internalizing and externalizing behaviors as well as adaptive functioning.
Objectives: The current investigation evaluated and compared how both parents and teachers view and report behaviors of individuals with ASD utilizing the BASC-2 Parent Rating Scale (PRS) and Teacher Rating Scale (TRS).
Methods: This research used archival data from university clinic records. The sample contained 67 individuals with ASD (59 males and 8 females) with age ranging from 26 to 217 months. Two expert reviewers confirmed that participants met DSM-5 ASD criteria and assigned severity ratings. .
Results: We tested whether teacher ratings would account for incremental variance above and beyond parent ratings of rationally selected BASC-2 Subscales (Adaptability, Aggression, Atypicality, Functional Communication, Social Skills and Withdrawal) in predicting the Severity Ratings for SC and RRB. We examined hierarchical regression analyses in which the parent ratings were entered in the first block of the regression model and the teacher ratings were added second as predictors of SC and RRB (see Table 1 and 2 respectively). Overall, teacher ratings enhanced the parent ratings of Adaptability, Atypicality, Functional Communication, Social Skills and Withdrawal when predicting the severity of SC. Teacher ratings augmented the parent ratings of Atypicality, Functional Communication, and Withdrawal when predicting the severity of RRB. The order of predictors was reversed to determine if this pattern would be replicated. Results yielded a significant incremental addition of the parent ratings to the teacher ratings of Functional Communication and Social Skills in predicting SC; this result was also evident for Functional Communication, Social Skills, and Withdrawal in predicting the severity RRB.
Conclusions: Predominately, teacher reports accounted for more predictive variance in our sample; teachers are providing incremental information above what is provided by parents. This is not to say that parents are unnecessary in the assessment process. As previous research demonstrates, parent-completed behavior ratings are a necessary and integral part to understanding a child's behavior (Bergeron et al., 2008). The results indicate that having teachers rate a child with ASD on the BASC-2 is necessary *in addition to* having the parents rate the same child. Both the BASC-2 PRS and TRS had unique predictive variance for particular scales. This information shows that both parents and teachers provide their own unique data when rating individuals with ASD. Teachers have important, additional viewpoints that should be utilized.

Table 1.
Predicting Social Communication Severity Ratings

	Order of Predictors: PRS, TRS				Order of Predictors: TRS, PRS	
BASC-2 Scales	*r*	R^2	ΔR^2	Final β	R^2	ΔR^2
Adaptability						
PRS	-.12	.02		-.07	.08	.01
TRS	-.27	.08	.06*	-.25*	.07	
Aggression						
PRS	-.09	.01		-.12	.01	.01
TRS	.04	.01	.01	.08	.01	
Atypicality						
PRS	.28	.08		.09	.20	.01
TRS	.44	.20	.12*	.39*	.19	
Functional Comm.						
PRS	-.48	.23		-.27*	.32	.05*
TRS	-.52	.32	.10*	-.37*	.27	
Social Skills						
PRS	-.45	.20		-.31*	.28	.08*
TRS	-.45	.28	.08*	-.32*	.20	
Withdrawal						
PRS	.24	.06		.16	.15	.02
TRS	.35	.15	.09*	.31*	.13	

Note. PRS = Parent Rating Scale, TRS = Teacher Rating Scale, Comm. = Communication, *p <.05.

Table 2.
Predicting Restrictive/Repetitive Behavior Severity Ratings

	Order of Predictors: PRS, TRS				Order of Predictors: TRS, PRS	
BASC-2 Scales	*r*	R^2	ΔR^2	Final β	R^2	ΔR^2
Adaptability						
PRS	-.09	.01		-.06	.03	.00
TRS	-.15	.03	.02	-.14	.02	
Aggression						
PRS	-.08	.01		-.12	.02	.01
TRS	.08	.02	.01	.15	.01	
Atypicality						
PRS	.31	.10		.14	.19	.01
TRS	.42	.19	.09*	.35*	.17	
Functional Comm.						
PRS	-.51	.23		-.35*	.31	.09*
TRS	-.48	.31	.06*	-.28*	.23	
Social Skills						
PRS	-.38	.14		-.30*	.17	.07*
TRS	-.31	.17	.03	-.19	.10	
Withdrawal						
PRS	.32	.10		.24*	.19	.05*
TRS	.36	.19	.09*	.30*	.13	

Note. PRS = Parent Rating Scale, TRS = Teacher Rating Scale, Comm. = Communication, *p < .05.

87 **123.087** Team Evaluation: A Streamlined Method for the Clinical Assessment of Autism Spectrum Disorder

J. Gerdts[1], *J. Mancini*[2], *T. Ward*[3], *S. Trinh*[4], *M. Thompson*[5], *C. Rhoads*[5], *K. Oshiro*[5], *J. Han*[4] *and R. Bernier*[4], *(1)Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA, (2)Seattle Children's Autism Center, Seattle, WA, (3)Seattle Pacific University, Seattle, WA, (4)University of Washington, Seattle, WA, (5)University of Washington Autism Center, Seattle, WA*

Background: Diagnostic evaluations for autism spectrum disorder (ASD) are generally either multi-disciplinary or single discipline (often with a psychologist). While these evaluations are comprehensive, they likely contribute to long waiting lists across the country since they generally include multiple visits on separate days, possibly several weeks apart. This presents an opportunity to examine the essential features of diagnostic evaluations to create a streamlined process for some families and thereby alleviating wait times. At the Seattle Children's Autism Center (SCAC), we have developed an interdisciplinary team evaluation approach involving a series of appointments with two providers, allowing two families to be seen in a single day. Thus, it may be a viable option for decreasing cost and improving wait times.
Objectives: To explore and compare family satisfaction, evaluation hours, and diagnostic outcomes in team evaluations versus more traditional ASD diagnostic evaluation methods. We also examined team members' diagnostic confidence ratings.
Methods: Following an initial visit with a SCAC pediatric nurse practitioner, patients were triaged to one of three ASD evaluation tracks: multi-visit evaluation with a

psychologist (*"Psychology"),* visit with a physician generally preceded by speech-language testing *("MD Confirm"*), or interdisciplinary team evaluation described above ("*Team"*). See Figure 1 for visit information about tracks and Figure 2 for *Team* evaluation template. Medical records were reviewed from 346 *Team*, 60 *MD Confirm*, and 92 *Psychology* evaluations conducted in 2014-2015.

Results: In *Team* evaluations, 61% of cases were diagnosed with ASD, 29% were not diagnosed with ASD, and 10% required further information in order to come to a diagnostic decision. Clinician confidence ratings were available for 23% of cases and were highly correlated ($r = .83$, $p < .001$), with 63% of ratings being identical and 32% within 1 point. After excluding *Team* patients who required further information to come to a decision, ASD diagnostic rates were similar across evaluation models (*Team*: 68%, *MD*: 73%, *Psych:* 72%, $\chi^2(2) = 0.89$, $p = .64$). The *Team* model required, on average, 4 fewer billing hours compared to *Psychology* and approximately the same number of hours as *MD Confirm*. Family satisfaction data were collected on a random sampling of patients seen in the three tracks. Results of family surveys suggested the majority of families were satisfied with their experience (M=8.88 out of 10) and scores did not differ across diagnostic tracks, $F(2,62) = 0.32$, $p = .73$.

Conclusions: ASD Interdisciplinary Team Evaluations shortened billing time and resulted in diagnostic determination in 90% of patients. Family satisfaction and overall rate of ASD diagnosis were similar across ASD evaluation methods, and comparable to a previous report of a 61% ASD diagnostic rate in a different diagnostic center (Monteiro et al., 2015). A focused team approach to ASD clinical diagnosis appears sufficient for many patients and may decrease the number of hours required for evaluation, while maintaining consistency in diagnostic rates and without detriment to family satisfaction. Thus, incorporating the *Team* model into diagnostic centers may decrease billing costs and improve clinic wait times.

Figure 1. SCAC Diagnostic Evaluation Flowchart

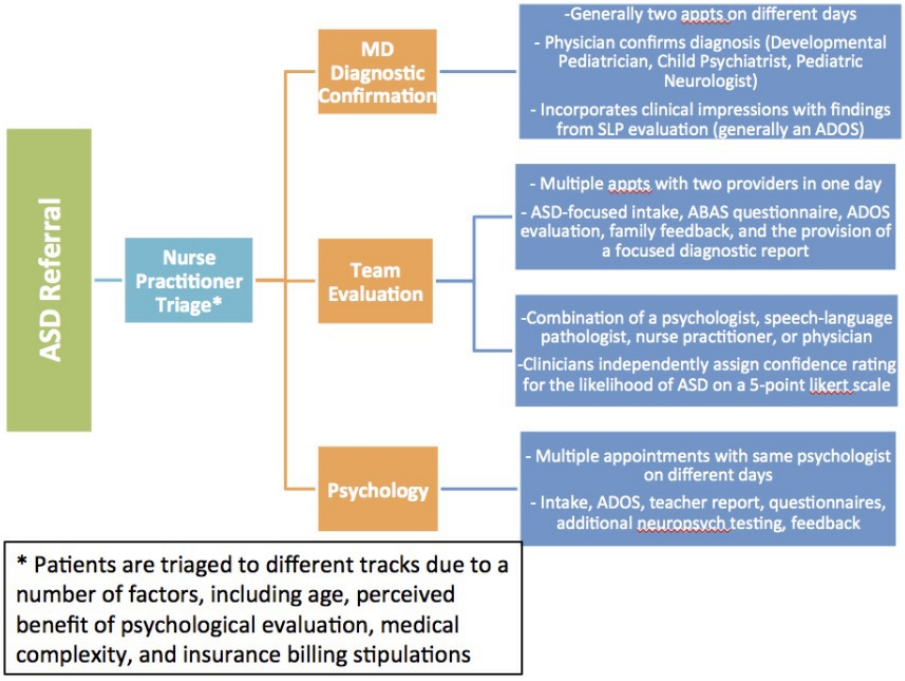


Figure 2. Team Evaluation Structure

	Clinician A	Clinician B
Hour 1	ADOS with Patient A *Hand off*	History with Patient B *Hand off*
Hour 2	ADOS with Patient B	History with Patient A
Hours 3 – 4	Rounds/write report	Rounds/write report
Hour 5*	Feedback with Patient A	Feedback with Patient B

* If diagnosis is unclear, the family is asked to return for a follow-up appointment(s) with one team clinician for further evaluation and/or to gather additional information (i.e., from teacher, other professional, etc) before making the diagnosis.

88 **123.088** Temper Tantrums in Preschool Age Children with and without Autism Spectrum Disorder

K. S. Davlantis[1], *G. Dawson*[1], *L. Franz*[1], *M. Sabatos-DeVito*[2], *E. Paisley*[1], *J. Newman*[1] *and H. Egger*[3], *(1)Duke Center for Autism and Brain Development, Duke University School of Medicine, Durham, NC, (2)Duke University School of Medicine, Duke Center for Autism and Brain Development, Durham, NC, (3)Department of Psychiatry and Behavioral Sciences, Duke University School of Medicine, Durham, NC*

Background: The presence of tantrums, aggressive behavior, and self-injury is related to significant parental stress and poorer long-term outcomes in children with autism spectrum disorder (ASD). Yet, very little is known about the frequency and nature of tantrums in young children with ASD and how they may differ from tantrums of neurotypical children.
Objectives: This project sought to characterize the frequency and nature of tantrums in preschool age children with ASD as compared to a representative community sample of neurotypical preschool age children.
Methods: This is a descriptive study of 25 children diagnosed with ASD (*M* age = 53.6 months, *SD* = 13.2 months; *M* IQ = 64.6, *SD* = 18.3) as compared to a representative community sample of 307 neurotypical children (*M* age = 40.8 months, *SD* = 14.4 months) recruited from pediatric primary care (percentages for the community sample are weighted back to the screened population sample of 1,073 children). Data collection is ongoing and additional data will be analyzed in the final study. The prevalence of non-destructive tantrums (i.e. episodes of temper, frustration, or upset manifested by shouting, crying, or stamping and non-destructive violence against property) and destructive tantrums (i.e. episodes of temper, frustration, or upset manifested by shouting, crying, or stamping and destructive violence or violence against oneself, other people, or

property), mean frequency of tantrums, and content of tantrums were measured using the Preschool Age Psychiatric Assessment (PAPA), a well-validated parent interview used to assess psychopathology in children ages 2 to 5 years. Chi-squared tests and general linear models were used to evaluate differences between groups.
Results: Thirty-three percent of neurotypical children versus 92% of children with ASD exhibited non-destructive tantrums over the three-month interview period (a significant difference at $p < .0001$). Twenty-six percent of neurotypical children versus 64% of children with ASD exhibited destructive tantrums over the same interval (a significant difference at $p < .0001$). Neurotypical children exhibited, on average, 9.3 tantrums over the three-month interview period, while those with ASD exhibited 49.8 tantrums over the same interval (a significant difference at $p < .0001$). The content of tantrums differed between groups, with children with ASD significantly more likely to engage in various behaviors (e.g., biting themselves).
Conclusions: Significant differences in the frequency and nature of tantrums were found between the ASD and neurotypical groups. While children with ASD exhibited more tantrums of both types, the primary difference was seen in the prevalence of non-destructive tantrums. The content of tantrums also differed between the groups, with children with ASD exhibiting significantly more of nearly every behavior assessed. This preliminary characterization of tantrums in children with ASD, as compared to neurotypical children, offers insight into a commonly-occurring associated symptom of ASD. Frequency and type of tantrums have been found to be associated with higher risk for mental health disorders in typical children. Future research is needed to examine the extent to which these early challenging behaviors are associated with later mental health and other behavioral outcomes in children with ASD.

89 **123.089** The Autism Mental Status Exam. Validation of a Spanish Version in Argentina

S. H. Cukier[1], *A. Rattazzi*[2], *V. M. Ensenat*[3], *M. C. Lopez*[4], *K. A. Gutson*[5], *J. I. Gomez de la Fuente*[2], *E. Zieba*[6] *and D. Grodberg*[7], *(1)PANAACEA, Buenos Aires, Capital Federal, Argentina, (2)PANAACEA, Buenos Aires, Argentina, (3)Pediatrics, British Hospital of Buenos Aires, Buenos Aires, Argentina, (4)Child and Adolescent Psychiatry, FLENI, Escobar, Argentina, (5)PANAACEA, Programa Argentino para Niños, Adolescentes y Adultos con Condiciones del Espectro Autista, Buenos Aires, Buenos Aires, Argentina, (6)Hospital Pedro De Elizalde, Buenos Aires, Argentina, (7)Yale Child Study Center, New Haven, CT*

Background: In many areas of Argentina, as in other Latin-American countries, physicians and institutions typically do not have the resources to train in or to administer comprehensive diagnostic observational assessments for patients suspected of ASD. This fact leads frequently to under and misdiagnosing leaving a very important amount of the population underserved, and preventing researchers from selecting representative samples for clinical and epidemiological research. The autism mental status exam (AMSE) is a free and brief eight-item observation tool that addresses this gap. The AMSE, designed at the Seaver Autism Center for Research and Treatment at the Icahn School of Medicine at Mount Sinai, structures the observation and documentation of signs and symptoms of ASD and yields a score. Excellent sensitivity and specificity was demonstrated in a population of high-risk adults and recently, in a population of 45 young children with social and communication concerns.
Objectives: To provide with a short and free diagnostic tool feasible to be used in middle –income countries such as Argentina by investigating the validity and inter-rater reliability of the Spanish version of the AMSE in a sample of local children and adolescents.
Methods: The AMSE was translated into Spanish, adapted to the local idiomatic expressions and back-translated into English. AMSE's test is now being performed in a population of 150 children and adolescents (age 18 months to 18 years) with social and communication concerns who are evaluated at four different autism centers in Argentina. The ADOS is to be used to estimate the most effective criterion cut-off on the AMSE for Argentine population. Each subject receives a developmental evaluation, including the AMSE followed by independent standardized assessment using the ADOS. Rapid Database Generator (RDG) toolset will be used to analyze the data, to determine cut off criteria, sensitivity and specificity of AMSE to predict the result from ADOS and DSM-5 diagnosis of ASD.
Results: A summary of the results including cut off criteria, sensitivity, specificity and inter-rater reliability will be presented, and also an analysis of regional similarities and differences. Preliminary results show good sensitivity (>95%), specificity (>95%) (using a cut-off of 5 points in AMSE), and inter-rater reliability (>80%) in this high-risk Argentine sample.
Conclusions: Preliminary findings suggest that the AMSE Spanish version provides a rapid and reliable observational assessment in high-risk Argentine population. This could have a direct impact in the care of patients with ASD by providing a free, standardized diagnostic tool for ASD. This project also addresses a research priority by reliably standardizing the phenotyping of children in under resourced international populations, since the use of the AMSE will lay the foundation for epidemiologic surveillance in populations that typically do not engage in research. Open-source and open access models also provide a way to facilitate global collaboration and training. Using tools like AMSE, the autism scientific community and clinicians worldwide should be able to deliver cost-effective services to everyone in need.

90 **123.090** The Development and Impementation of ASD Diagnostic Procedures in Nigeria

ABSTRACT WITHDRAWN

Background: The field is only beginning to understand how to identify ASD in non-Western populations. Simply translating instruments is not sufficient (Hableton, 1996); rather, they must be adapted to ensure construct equivalence, or the degree to which the measured construct has equivalent meaning across cultures. Construct, method and item biases are all important to consider in the adaptation of measures (Van de Vijver, F., & Tanzer, N. K., 1998).
Objectives: The project objective was to better understand the local norms in Lagos, Nigeria, in order to help the team at The Learning Place Centre (TLPC) develop an ASD diagnostic procedure. The acceptability and utility of the diagnostic procedure was qualitatively evaluated
Methods: TLP Centre in Lagos, Nigeria is an urban school and community-based autism center. They sought out AACTION Autism for assistance in developing a multidisciplinary diagnostic clinic. In the first phase of procedure development, we gathered qualitative information about the families who use the TLP Centre This occurred in conjunction with the Nigerian's team visiting Chicago. A culturally appropriate instrument (the Nigerian Autism Play Assessment- NAPA) was developed for use along with structured developmental interviews and medical history. The Nigerian team participated in general ASD training, as well as diagnostic evaluation overview. In the second phase, the team tested out the NAPA with 60 children ages 3-10 suspected of having ASD. The NAPA was refined based on feedback from TLP Centre staff.
The collected clinical information will be compared against DSM-5 and ICD-10 diagnostic criteria, and the team will arrive at diagnosis for each case. Reliability coders in the US, experienced ASD clinicians, will review the clinical reports (minus diagnosis) which includes data from medical and developmental histories, as well as the NAPA, and independently make the DSM-5 and ICD-10 diagnoses.
Results: We will present the results of the acceptability and fidelity of implementation from the field test. It is anticipated that an approach comparing information obtained via developmental history, the NAPA, and medical history with DSM-5 and ICD-10 diagnostic criteria will be useful and acceptable to the team. The inter-rater reliability between the TLP Centre raters and USA-based clinicians will be reported. The key aspects of the Nigerian culture that related to diagnostic process will be discussed.
Conclusions: Outcomes of the investigation will inform practices at the TLP Centre and throughout Africa, as the center actively participates in the Autism Society of West Africa meetings.
Hambleton, R. K. (1996). Guidelines for Adapting Educational and Psychological Tests. Retrieved from ERIC database.
Van de Vijver, F., & Tanzer, N. K. (1998). Bias and equivalence in cross-cultural assessment. *European review of applied psychology*, *47*(4), 263-279.

91 **123.091** The Difference of WISC-IV Profile Between ASD and TD Children in China

G. Li[1] *and Y. Du*[2], *(1)1551 Shoup Court , Room 334, Emory Autism Center, Atlanta, GA, (2)Shanghai Mental Health Center, Shanghai Jiaotong University School of Medicine, Shanghai, China*

Background: Autism spectrum disorder (ASD) is neurodevelopmental disorders characterized by severe deficits in social interaction and communication, an extremely limited range of activities and interests, and stereotypic and repetitive behavior according to DSM-5. Intelligence quotient (IQ) but not the core symptoms have been known to predict outcomes in autism. High functioning autism (HFA) has been used to describe individuals with AD whose IQ is above the intellectual disability range (70) since 1988. Many researches reported the IQ profile in High Functioning Autism (HFA). While there is no research about IQ profile reported in China. As ASD children are social deficit. We hypothesis is that HFA children scored lower on Verbal Comprehension Index and its subtests, no difference on other index and its subtests with TD children.
Objectives: This study aims to investigate the difference of IQ profile of HFA children and typically developing (TD) children in China.
Methods: The sample for the study was composed of 17 HFA children (14 males and 3 females; male: female ratio = 4.67:1) ranging in age from 6 to 16 years from Pediatric Outpatient of Shanghai Mental Health Center, Shanghai Jiaotong University School of Medicine. The children of control group were recruited in Shanghai. The control sample included 21 children (15 males and 6 females; male: female ratio = 2.5:1). The children's ages ranged from 6 to 16 years. Wechsler Intelligence Scale for Children (WISC-IV Chinese version) was used to rating the IQ profiles of children. All of the statistical analyses were performed using the Statistical Package for Social Sciences version 17.0.
Results: There was no difference of age (t = 0.593, P = 0.557) and sex (χ^2 = 0.643, P = 0.709) between the two groups. There was no significance between the two groups on block design (t = -1.808, P = 0.082) and digit span (t = -1.651, P = 0.110) . On other subtests, index scores, full scale IQ, HFA children scored significantly worse than TD children. The block design (=11.24+4.81), similarities (=11.18+4.89) was higher, while comprehension score was lowest (= 6.64 + 5.48) in ASD group.
Conclusions: The IQ profile of HFA children are different from TD children by WISC-IV in China.

92 **123.092** The PlacentASD® Test at Birth Predicts Subsequent Behavioral Outcomes

K. K. Quinlan[1], *K. O. Olive*[2], *K. M. Milano*[2] *and* ***H. J. Kliman***[2], *(1)Yale College, Yale University, New Haven, CT, (2)Dept. Ob/Gyn, Yale University, New Haven, CT*

Background: According to the Centers for Disease Control and Prevention (CDC), the average age of autism spectrum disorder (ASD) diagnosis in the US is over 4 years old, although methods are available to make the diagnosis at 2 years old. Early diagnosis and intervention have been shown to improve developmental outcomes in children

at a time when their brains are most responsive to modification. The PlacentASD® Test diagnoses ASD risk status at birth by evaluating the placenta of the newborn.
Objectives: We investigated the relationship between PlacentASD®-determined ASD risk status and the attainment of age-appropriate developmental milestones.
Methods: Fourteen newborn placentas were evaluated for the frequency of trophoblast inclusions to determine ASD risk status. Children were dichotomously divided into low-risk (having the same risk of developing ASD as the general population) or high-risk (having an increased risk of developing ASD). Two families were unable to be interviewed, both of which were determined to have children at low-risk for developing ASD. The remaining twelve families were interviewed between 2 and 24 months following delivery to assess motor (movement and physical development), language/communication, cognition (learning, thinking, and problem solving), and social/emotional behaviors of their child using published CDC milestone guidelines. The interviewer was blinded to the PlacentASD®results. Children were characterized as either neurotypical (achieving all age-appropriate behavioral categories) or delayed (delayed in any one or more behavioral categories). The Fisher exact probability test was used to compare the group outcomes.
Results: Of the twelve families who were interviewed, 5 children were at high-risk of developing ASD, while 7 children were at low-risk of developing ASD, as determined by PlacentASD® testing. All of the low-risk children were reported by their parents as having reached all appropriate behavioral milestones, while three of the five high-risk children had been diagnosed with developmental delays prior to 20 months of age. The other two high-risk children had reached all behavioral milestones at the time of the interview. Interestingly, two of the high-risk, developmentally delayed children, had undergone early intervention and progressed sufficiently to exhibit age appropriate behavioral milestones by the time they reached their second birthdays. Children designated as low-risk by the PlacentASD® Test were 4.5 times more likely to achieve normal developmental milestones compared to children designated as high-risk for ASD (LR: 4.5, 95% CI: 1.33–15.3; p = 0.045).
Conclusions: A low-risk determination by the PlacentASD® Test appears to predict neurotypical behavioral outcomes in children up to 24 months of age, while a high-risk determination poses a 4.5 times increased likelihood of children exhibiting developmental delays. Knowing that a child is at increased risk of developing ASD will allow parents and healthcare providers to initiate early intervention, which has the potential to normalize behavioral milestones.

93 **123.093** The Potential of Eye-Tracking As an Outcome Measure for Autism Intervention Studies

S. Fletcher-Watson[1] *and S. Hampton*[2]*, (1)University of Edinburgh, Edinburgh, Scotland, United Kingdom, (2)University of Edinburgh, Edinburgh, United Kingdom*

Background: Outcome measurement is a significant issue in autism intervention research. Among other concerns, it is possible that autism intervention trials may fail to detect change because of inadequate outcome measurement – either because changes occur in domains which are not measured or because the measures used are insufficiently sensitive. Short intervention periods may induce change in domains proximal to the intervention which would take longer to become apparent at the level of global symptom change. There is a need for objective measures, that can be administered by blinded researchers, to detect such proximal intervention effects.
Eye-tracking is a method which can be applied to non-verbal populations, to chart the development of cognition in early life, and to detect differences between typical and atypical populations in childhood, adolescence and adulthood. In both of these areas, eye-tracking is demonstrably pragmatic, objective and sensitive and can be administered blind. However eye-tracking is not normally used to evaluate response to intervention.
Objectives: To investigate whether eye-tracking can be used to detect subtle changes in eye-movements in response to repeated exposure to learning content.
Methods: Participants were 40 typically developing children, aged 20-25 months (mean = 23 months). We used a Tobii eye-tracker to assess free-viewing of**:** cartoon images from an iPad app called FindMe; cartoon images from other apps (close-generalisation)**;** photographs (distant-generalisation). All images were matched for level of complexity. Half the participants took home an iPad with the app for a period of 10 – 14 days. The FindMe app rewards participants for finding and touching the person within a scene. Then all participants returned to view the same stimuli again.
Results: Preliminary data (n=15) indicate that repeated exposure to visual content in an iPad app does change eye-movement patterns. For children in the app-exposure group, mean looking time on the person (FindMe images) increased by 80ms on average, while the control group had a looking time change of -3ms. In the final analysis we will report data on the relationship between level of exposure (e.g. amount of game play, highest level reached) and fixation patterns, as well as evidence of effects for close- and distant-generalisation stimuli.
Conclusions: This proof-of-concept study indicates that repeated exposure to learning content can, even in a very short period of time, lead to changes in fundamental behaviours which are indicative of underlying cognition. We will interpret results in the light of the potential future application to meaningful outcome measure in autism intervention, especially where interventions are mediated by technology.

94 **123.094** The Relationship Between Joint Attention, Play and Imitation Skills, with Cognitive Outcomes in Preschoolers with Autism Spectrum Disorder

H. C. Koh*, G. Swee, J. Ong, W. Q. Teoh and S. B. Lim, Department of Child Development, KK Women's and Children's Hospital, Singapore, Singapore*

Background:
Research evidence suggests that presence of early social behaviours such as joint attention, imitation and play skills, are associated with better cognitive and language outcomes in children with Autism Spectrum Disorder (ASD), although these findings need further replication with larger clinic samples.
Objectives:
This study aims to determine i) how joint attention, play and imitation skills are associated with cognitive abilities of children with ASD at 2-4 years old, and ii) how early social behaviours, cognitive abilities of children with ASD at 2-4 years old are associated with cognitive abilities of the children at 5-6 years old, in a clinic sample.
Methods:
A retrospective medical records review was conducted for 484 children with ASD who underwent a diagnostic assessment at 2-4 years old from 2009-2011 within a child development specialist clinic in Singapore. Measures of joint attention, play and imitation skills were taken from the Autism Diagnostic Observation Schedule (ADOS), which was the standard behaviour observation tool used for ASD diagnostic evaluations within the clinic. A variety of cognitive assessments were used to measure cognitive abilities of the children at 2-4 years old and at 5-6 years old. Standard scores that provide estimates of a child's non-verbal reasoning abilities were used where available. The children's cognitive assessment results were categorized into Adequate (IQ≥80) or Delayed (IQ<80). A proportion of the children completed a cognitive assessment at 2-4 years old (*n*=291, 246 boys), as cognitive assessments were optional for ASD diagnostic evaluations. A smaller selection of those children had their cognitive assessment results at 5-6 year old available in their medical records (*n*=187, 160 boys).
Results:
Logistic regression analyses indicate that ratings on functional and make-believe play significantly predicted cognitive assessment results at 2-4 years old, and ratings on initiation of joint attention and a child's cognitive assessment results at 2-4 years old significantly predicted cognitive assessment results at 5-6 years old.
Conclusions:
Children with ASD who demonstrated better play with toys/objects were more likely to have adequate cognitive assessment results at 2-4 years old. Children who obtained adequate cognitive assessment results at 2-4 years old, were more likely to show similar results at 5-6 years old. Children with ASD who were better at initiating joint attention with others at 2-4 years old, were more likely to have adequate cognitive assessment results at 5-6 years old. Children who direct others' attention to objects of interest to them, may respond better to cooperative learning approaches, which can better facilitate their cognitive development.
These results highlight significant relationships between joint attention and play, for cognitive abilities of children with ASD. Interventions that target joint attention and play in children with ASD can be further investigated to determine if developing joint attention and play skills in children with ASD can improve their cognitive outcomes.

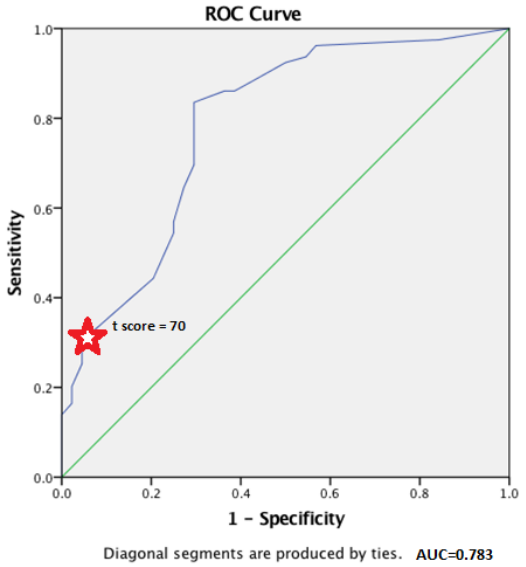
95 **123.095** The Validity of the Child Behavior Checklist in Identifying Anxiety Disorders in Children with ASD

A. Bennett[1]*, M. C. Souders*[2]*, L. R. Guy*[3]*, K. Rump*[4]*, J. Worley*[5]*, H. E. Dingfelder*[6]*, J. C. Bush*[7]*, A. McVey*[8]*, C. M. Kerns*[9]*, J. Miller*[10]*, J. Herrington*[11] *and M. Franklin*[12]*, (1)Child Development, Children's Hospital of Philadelphia, Philadelphia, PA, (2)Clinical Genetics Center, The Children's Hospital of Philadelphia, Philadelphia, PA, (3)TEACCH Autism Program, University of North Carolina at Chapel Hill, Greensboro, NC, (4)The Center for Autism Research, Philadelphia, PA, (5)CHOP, Blue Bell, PA, (6)University of Pennsylvania, Philadelphia, PA, (7)Indiana University, Bloomington, IN, (8)Marquette University, Milwaukee, WI, (9)A.J. Drexel Autism Institute, Philadelphia, PA, (10)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (11)The Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (12)Psychiatry, University of Pennsylvania, Philadelphia, PA*

Background: While there is increased awareness of the impact of elevated anxiety rates in ASD, there are few well-validated screening measures for identifying DSM-based anxiety disorders in children or adolescents with ASD. The Child Behavior Checklist (CBCL) is a parent-completed behavioral screening measure that has been used in several autism registry networks, including the Autism Speaks Autism Treatment Network (AS-ATN), the Center for Disease Control (CDC) Study to Explore Early Development (SEED), and the Simons Foundation Autism Research Initiative (SFARI). It is also often used in clinical settings as a behavioral screening measure for children. For these reasons, data on the validity of the CBCL in predicting true anxiety disorders in children with ASD could have a significant influence on clinical practice as well as ASD research initiatives.
Objectives: The objective of this study was to examine the validity of the CBCL anxiety subscale in children and adolescents with ASD versus typically developing controls (TDCs). Ratings on the CBCL were used to predict DSM-driven anxiety disorder diagnoses established via psychodiagnostic interviewing (the gold-standard Anxiety Disorder Interview Schedule [ADIS]).
Methods: 204 children were recruited through two studies following a two-by-two factorial design, including children with (ASD) and without ASD (TDC) and with (ANX) and without (NON) an anxiety disorder (ASDANX: N = 79; ASDNON: N = 44; TDCANX: N = 18; TDCNON: N = 30; mean age = 11 years). ASD diagnosis was confirmed through research-reliable ADOS and parent interview. Anxiety diagnoses were determined by the ADIS. The ASDANX and TDCANX groups presented with a range of anxiety

disorders, including social anxiety disorder, generalized anxiety disorder, separation anxiety disorder, and specific phobia. None of the groups differed in general cognitive ability or age. Subjects in the ASD groups did not differ in core symptoms of ASD (measured by the Social Responsiveness Scale [SRS]). Sensitivity and specificity of CBCL in predicting anxiety disorder status was examined via multinomial logistic regression (MLR) and receiver operating characteristic (ROC) curves, carried out separately for the ASD and TDC groups.
Results: CBCL Anxiety subscale t-score of 70 was highly predictive of anxiety disorder diagnosis among children with ASD (Chi Square = 61.97, p < .01) on MLR. CBCL successfully classified ASD participants as ANX or NON with an overall accuracy of 79%. Sensitivity (86% true positive rate) was superior to specificity (68% true negative rate). ROC curve had AUC=0.783. Although fairly robust, these predictive rates were lower than the predictive rates of anxiety disorder among TDCs for this study (94% and 93%, respectively).
Conclusions: The CBCL Anxiety subscale has good convergent validity with gold standard diagnostic tools designed to measure common anxiety disorders in children and adolescents. The relatively higher rate of sensitivity versus specificity indicates that the CBCL may prove more valuable in identifying co-occurring anxiety disorder in children with ASD rather than in ruling anxiety out. Further research is needed to determine if a different t-score or separate ASD-Anxiety subscale should be created to identify the unique features of Anxiety in children with ASD.

Fig. 1



96 **123.096** The Value of the AQ in Outpatient Mental Health Service

*M. L. Bezemer and **E. M. Blijd-Hoogewys**, Autism Team, INTER-PSY, Groningen, Netherlands*

Background:
In clinical practice, the Autism Spectrum Quotient (AQ; Baron-Cohen et al., 2001) is often used to measure the degree to which adults exhibit autistic traits and to decide whether further ASD assessment is required (case identification).
The AQ is a self-report questionnaire. Since self-insight might be diminished in individuals with ASD, the perspective of an informant is important. Therefore, an AQ Dutch spouse-version was developed (Blijd-Hoogewys, 2014).
There is debate on whether there are gender differences concerning the expression of autistic traits, and whether these differences influence case identification.
Objectives:
The aim was to study the value of the AQ as an instrument for case identification, comparing self-report and spouse-report, and gender differences.
Methods:
The sample consisted of Dutch patients with a suspected ASD and an average intelligence. They were referred to a specialized ASD outpatient mental health service.
In total, there were 194 AQ self-reports (n = 106 men, n = 88 women) and 49 AQ spouse-reports (n = 26 men, n = 23 women). AQ-scores were analyzed, using a clinical cut-off point of 26 (dichotomous scoring).
Results:
There was no significant difference in AQ-score between self-report and spouse-report (M = 28.08, SD = 9.14; M = 27.02, SD = 8.03 respectively; t = .61, df = 96, p = .54).
Concerning the classification of the AQ-score as clinical (≥ 26) or non-clinical, there was a moderate agreement between self-report and spouse-report (κ = .58, p < .001).
The AQ-scores of men and woman did not differ significantly on the self-report (M = 25.06, SD = 9.28; M = 25.51, SD = 9.11 respectively; t =-.34, df = 192, p = .73). They did differ significantly on the spouse-report (men: M = 29.60, SD = 6.57; women: M = 24.13, SD = 8.67; t = 2.50, df = 47, p =. 02).
Results of the self-reports showed a relation between AQ-score above/below cut-off and the presence/absence of an ASD-diagnosis (X^2 = 28.15, df = 1, p < .001). Overall, 76% of participants with clinically elevated AQ-scores were diagnosed with ASD (versus 38% of participants with non-clinical AQ-scores). The predictive values of the AQ differed for men and women. For men, sensitivity was 58% and specificity was 66% (PPV = 0.73, NPV = 0.50). For women, sensitivity was 73% and specificity was 82% (PPV = 0.80, NPV = 0.75). The same pattern was seen in spouse-reports.
Conclusions:
The AQ is moderately valuable for case-identification in an outpatient mental health service. The AQ self-report and AQ spouse-report give roughly similar information about autistic traits. There are gender differences though; female spouses report their men to exhibit more ASD traits than reported by the men themselves. Also, the AQ self-report of women seems to be more predictive for an ASD diagnosis than those of men.
Note that the AQ is not intended to be diagnostic. If there are clinically significant levels of autistic traits, a comprehensive diagnostic evaluation is warranted.

97 **123.097** Timing of ASD Diagnosis: Demographic Factors of Influence

***E. J. Libsack**[1], A. Kresse[1], E. E. Neuhaus[2], S. Trinh[3], R. Bernier[3] and S. J. J. Webb[3], (1)Seattle Children's Research Institute, Seattle, WA, (2)Seattle Children's Hospital, Seattle, WA, (3)University of Washington, Seattle, WA*

Background: The average age of diagnosis among children with Autism Spectrum Disorder (ASD) exceeds 4 years, often with a significant lag between parent first concern and diagnosis. While studies have investigated the impact of demographic factors on likelihood of ASD diagnosis, their impact on the timing of diagnosis is less clear. Girls and high functioning children may be more likely to experience significant diagnostic delays given current (and historic) public perception of the disorder.
Objectives: Data are from a multi-site study focusing on multimodal neurogenetic exploration of girls (and boys) with ASD. In a sample of children with ASD without intellectual impairment, we explore the effects of parental education, household income, child gender, and child birth-order on parent report of the timing of ASD diagnosis.
Methods: Preliminary data were analyzed from one site and included 43 children (26 males; 8-17 years) with ASD (mean IQ=104.4, SD=21.2). Parents completed a demographic questionnaire, medical history interview, and Autism Diagnostic Interview Revised. In order to analyze the influence of child gender, we matched a subsample of 17 ASD males and 17 ASD females on age and IQ. Additional data from other sites will be included in the final analyses.
Results: Children who had two parents with less than a bachelor's degree (non-BA), were diagnosed with ASD at a significantly later age (M=111.7, SD=52.9) than children with one parent with at least a bachelor's degree (BA-1; M=66.8, SD=31.2, p=.02), and children with two parents with at least a bachelor's degree (BA-2; M=66.8, SD=32.6,

p<.01). Children in the non-BA group also experienced a significantly longer delay (M=109.2, SD=24.5) from age of parental first concern to age of ASD diagnosis, than children in the BA-1 (M=51.8, SD=28.7, p<.01) and BA-2 (M=58.5, SD=37.4, p<.01) groups. There was no effect of household income on timing of diagnosis.
In our IQ- and age-matched subsample, time between age of first concern and ASD diagnosis was marginally longer for females (M=76.1, SD=44.5) than males (M=52.8, SD=30.3, p=.09). Later-born females (M=108.3, SD=32.6) were diagnosed with ASD at a later age than later-born males (M=58.5, SD=29.5, p=.04).
Conclusions: Children whose parents have more formal education were diagnosed with ASD at an earlier age and experienced a shorter delay between parent concern and ASD diagnosis. These findings suggest that higher parent education, separate from household income, influenced timing of diagnosis. Males also experienced a marginally shorter wait time between parents' first concern and ASD diagnosis than females, particularly for later-born children. Gender did not significantly effect age of ASD diagnosis, but data collection is on-going and additional data from 3 other sites will be available. Together, our findings suggest an influential role of both parent education and child gender in the timing of ASD diagnosis even within children with higher functioning ASD outcomes.

98 **123.098** Two Validation Studies of a Performance Validity Test for Autism Spectrum Disorder

L. M. Olde Dubbelink[1,2], *A. M. Scheeren*[1], *A. G. Lever*[1] *and H. M. Geurts*[3], *(1)Dutch Autism & ADHD research center (d'Arc) Dept of Psychology, Brain and Cognition, University of Amsterdam, Amsterdam, Netherlands, (2)Dept. of Research, Development & Innovation, Dr. Leo Kannerhuis, Doorwerth, Netherlands, (3)Dutch Autism & ADHD research center (d'Arc) Dept of Psychology, Brain and Cognition, University of Amsterdam; Dr. Leo Kannerhuis, Amsterdam, Netherlands*

Background: People seeking treatment for psychological symptoms can feign or exaggerate their functioning in order to receive external incentives such as financial aids or reduced responsibility for criminal actions. To detect malingering and increase diagnostic accuracy, performance validity tests (PVT's) are used in (neuro)psychological assessments. Currently, no PVT exists for autism spectrum disorder (ASD). Therefore, in two studies, we examined whether the Morel Emotional Numbing Test (MENT), a simple emotion recognition test, has potential as a PVT for ASD in adulthood. As intelligent adults with ASD usually do not have difficulties in recognizing simple emotions, we hypothesized that they would perform near to perfect on the MENT. Furthermore, we hypothesized that instructed malingerers would perform poorly on this test.
Objectives: To examine the validity of a simple emotion recognition task, the MENT, as a PVT for adults with ASD.
Methods: In Study 1, 19 adults with ASD and 19 typically developing (TD) controls(age: 27-54; IQ>80) completed the MENT. In Study 2, 26 TD students instructed to simulate ASD and 26 TD controls (age: 18-46) completed the MENT.
Results: In Study 1, Bayesian hypotheses testing showed that adults with and without ASD performed equally well on the MENT. In Study 2, group comparisons demonstrated that instructed malingerers made more errors on the MENT than those instructed to do their best. Moreover, instructed malingerers performed worse on the MENT than adults with ASD. ROC curve analyses demonstrated that a cut-off point of 7 errors reached a specificity of 100% and a sensitivity of 96%.
Conclusions: These study findings suggest that the MENT may be considered as a PVT for ASD, because it appears to be face-valid measure of ASD, is insensitive to ASD (i.e. has high specificity), and detects malingerers by luring them to perform beneath their true level of ability (i.e. has high sensitivity). However, one should note that these findings are preliminary as the performances of intelligent adults with ASD (Study 1) may not generalize to individuals with ASD with lower intellectual abilities or a broader age range. Moreover, performances of healthy students instructed to malinger as reported in Study 2 may not be comparable to the performances of those suspected of malingering in a real diagnostic setting. Therefore, we encourage future research on the validity of the MENT as a PVT for ASD in a clinical or a forensic context.

99 **123.099** Validation of Eye Gaze Response to Dynamic Social Stimuli As Biomarker Related to Social Communication for Clinical Trials Involving Children with ASD

B. P. Rardin[1], *M. Murias*[2], *S. T. Major*[1], *M. Sabatos-DeVito*[3], *J. Newman*[1], *K. S. Davlantis*[1] *and G. Dawson*[1], *(1)Duke Center for Autism and Brain Development, Duke University School of Medicine, Durham, NC, (2)Duke University, Durham, NC, (3)Duke University School of Medicine, Duke Center for Autism and Brain Development, Durham, NC*

Background: Eye-gaze tracking (EGT), a non-invasive and objective measure of an individual's gaze response to visual stimuli, is easy to administer and has been shown to differentiate autism spectrum disorder (ASD) from other populations across the age span. It has been demonstrated that children with ASD show differential gaze patterns and attention when presented with socially salient stimuli, an important finding given that social communication deficits are a core feature of ASD. EGT has been proposed as a potential stratification or early efficacy biomarker in clinical trials assessing treatments for social communication impairments in children with ASD. However, its correlation with well-validated measures of social communication impairments has not yet been established.
Objectives: The study examined the degree to which eye-gaze patterns towards social stimuli are correlated with well-validated parent-report measures of social communication that are commonly used in clinical trials with children with ASD.
Methods: Participants were 25 children diagnosed with ASD based on the ADOS-2 and ADI-R (M age = 4.47 (+/- 1.10) years; M NVIQ = 64.3 (+/- 24.6)). EGT data were collected using the Tobii TX300 system at a sampling rate of 120 Hz. Participants were shown a three-minute video stimulus that included an actress and distractor toys (Chawarska et al. 2012). Two subjects were excluded due to noncompliance. Data analysis was constrained to time periods when the actress on the video directed speech toward the child. Dependent variables were proportion of time viewing the video presentation and proportion of time spent viewing actress. Analyses examined the correlations between the EGT variables and measures of social communication derived from the Vineland Adaptive Behavior Scales (Vineland-II), PDD Behavior Inventory (PDDB-I), and Behavior Assessment System for Children (BASC-2).
Results: The proportion of time viewing stimuli was highly correlated with the PDDB-I – Expressive Social Communication Abilities Composite score (r=0.72, p<0.001), PDDB-I – Expressive/Receptive Social Communication Abilities Composite score (r=0.68, p<0.001), and the Vineland-II – Expressive Communication Composite score (r=0.69, p<0.001). The proportion of time spent viewing the actress was strongly correlated with the BASC-2 – Functional Communication score (r=0.69, p<0.001), PDDB-I – Expressive Social Communication Abilities Composite score (r=0.73, p<0.001), PDDB-I – Expressive/Receptive Social Communication Abilities Composite score (r=0.68, p<0.001), and the Vineland-II – Expressive Communication Composite score (r=0.76, p<0.001). Notably, neither EGT measure was correlated with the PDDB-I Autism Composite score, a measure of broad ASD symptoms, (r=0.19 and 0.25, respectively).
Conclusions: Eye-gaze responses to dynamic social stimuli were found to be strongly and consistently correlated with well-validated parent-report measures of social communication. EGT variables did not correlate with broader autism symptom measures that include repetitive/restricted behaviors, suggesting that the EGT variables were specifically related to social communication impairments. Given the relative ease of using EGT with children with ASD, these findings support the ability of eye-gaze in response to dynamic social stimuli to serve as a non-invasive and objective biomarker of social communication in clinical trials. The present study is ongoing, and a final analysis will be conducted on a larger sample of children with ASD.

Poster Session
124 - Medical and Psychiatric Comorbidity
5:30 PM - 7:00 PM - Hall A

100 **124.100** A Case Study of the Gut Microbiome in ASD: Correlation of Microbial Profiles with GI and Behavioral Symptoms

R. A. Luna[1,2], *A. Magee*[1,2], *J. K. Runge*[1,2], *A. Venkatachalam*[1,2], *M. Rubio-Gonzales*[1,2] *and J. Versalovic*[1,2], *(1)Texas Children's Microbiome Center, Texas Children's Hospital, Houston, TX, (2)Department of Pathology & Immunology, Baylor College of Medicine, Houston, TX*

Background: Gastrointestinal (GI) disorders are now widely recognized as a clinical symptom of autism spectrum disorder, and research into the microbiome-gut-brain axis is beginning to reveal the interconnectivity between GI pain and potential behavioral challenges. Large studies in well-controlled cohorts are needed to provide the baseline dataset for this population, but there can be much learned from individual case studies, especially those with a longitudinal component. As a prelude to a much larger study underway, a single child with autism was followed over a 2-week period, including daily stool collection, alongside a neurotypical sibling for comparison.
Objectives: The objectives of this case study were to 1) evaluate current sequencing and analysis strategies to assess the microbial profile in a child with autism compared to an unaffected sibling, 2) correlate GI symptoms, stooling pattern, and diet diaries as well as available behavioral data over a 2-week period, and 3) identify organisms of interest for exploration in a larger dataset in the future.
Methods: Over a 2 week period, daily stool samples (plus one additional sample) were collected from the child with ASD with a single stool sample collected from an unaffected sibling. Next-generation sequencing (454 and Illumina) of the V1V3 and V4 variable regions of the 16S rRNA gene was performed, and resulting sequences were quality filtered, assigned to operational taxonomic units (OTUs), and classified based on comparison to the Greengenes database. Individual species of interest in ASD as well as OTUs of significance related to the child with ASD and absent in the unaffected sibling were identified.
Results: Principal component analysis revealed clear separation between the 15 samples obtained from the child with ASD compared to the unaffected sibling. Three organisms (individual OTUs) previously reported in autism were identified in the microbial profile of each of the 15 ASD samples but absent in the microbial profile of the unaffected sibling: *Sarcina ventriculi*, *Barnesiella intestihominis*, and *Clostridium bartlettii*. In addition, distinct differences were seen in the microbiome of the ASD child during days 6-8, a period where GI symptoms were reported (pain and diarrhea). Of note, the detection of *Haemophilus parainfluenzae*appeared to coincide with the onset of the GI episode. Beyond the correlation of GI symptoms with changes in the microbiome, that period also coincided with a trend toward behavior challenges, specifically an increase in self-injurious behavior. A separate 2-day period exhibiting the same microbial profile did not coincide with a change in GI symptoms but was accompanied by the same increase in self-injurious behavior, suggesting the possibility of GI pain that was not reflected in a change in stooling pattern.

Conclusions: While in-depth studies of the gut microbiome in autism that are underway will generate the critical mass of data needed as a comparison dataset, this case study illustrates the benefit of longitudinal sampling of a single patient in parallel with collection of clinical metadata (behavioral, gastrointestinal, and dietary). Microbiome characterization shows great potential as a companion diagnostic in the evaluation of individuals with autism spectrum disorder.

101 **124.101** A Profile on Healthcare Utilization during the First Year of Life in Children with Autism Spectrum Disorder

G. Liu[1], *L. Kong*[1], *D. Leslie*[1] *and M. Murray*[2], *(1)Public Health Sciences, Penn State College of Medicine, Hershey, PA, (2)Psychiatry, Penn State Hershey, Hershey, PA*

Background: The prevalence of autism spectrum disorder (ASD) has been increasing at an alarming rate. Despite the fact that there has been mounting evidence suggesting that ASD can be traced back to as early as the second trimester of pregnancy, most children with ASD are not diagnosed until age 4 or older. While studies from recent decades have presented substantial evidence on the effectiveness and importance of early detection and intervention, there has been little progress in identifying early markers to identify children at high risk of developing ASD.
Objectives: In this study, we use a large, national claims database to comprehensively examine the healthcare utilization history of children during their first year of life. The goal of this study is to develop an understanding on the medical profile of ASD-affected children during infancy and identify early indicators that are associated with the ASD risk.
Methods: Using claims data from the MarketScan® Commercial Claims and Encounters database (2005-2013), we identified children who were born in this period and were followed up for at least one year. We constructed a cohort of children with at least two separate diagnoses of ASD (ICD 9 codes 299.0x and 299.8x), as well as a control cohort of children with no ASD diagnosis before the age of 6. We linked their medical and demographical information to establish a complete medical profile of their first year since birth. We constructed the following healthcare utilization measures for the first year since birth: (1) healthcare expenditures (adjusted to year 2013 dollars), (2) in-/out-patient encounters, (3) hospital length of stay (in days), and (4) emergency department (ED) visits. Furthermore, we calculated the number of ED visits during the first 6 months and used multivariable logistic regression to determine the association between the number of ED visits and age at initial ASD diagnosis.
Results: We identified a total of 274,141 children, of whom 7,959 (2.9%) had ASD. Healthcare utilization measures during the first year of life showed significant differences (p-value <.0001) between children with ASD and those without. On average, ASD children had higher healthcare costs, more in-/out-patient encounters, longer stay in hospitals and more ED visits. In particular, the multivariable logistic regression confirmed that the frequency of ED visits in the first 6 months is significantly associated with the risk of being diagnosed with ASD later on, after controlling for gender, geographic region and residence (urban vs. rural). Compared with children without any ED visit in the first 6 months, the adjusted odd ratios (confidence intervals) of ASD risk for 1, 2, 3, and >3 ED visits were 1.24 (1.16-1.33), 1.39 (1.22-1.58), 1.93 (1.58-2.37) and 3.27 (2.63-4.06), respectively.
Conclusions: Children who were later on diagnosed with ASD had distinct patterns of healthcare utilization even during their infancy. They used more healthcare services than non-ASD children; even as early as within 6 months after birth, well before any clinically identifiable ASD symptoms were able to manifest.

Table 1. Healthcare utilization during the first year of life in children with and without ASD.

	ASD (n=7,959)	Non-ASD (n=xx)
Medical cost		
Mean (sd)	20,556 (100,018)	8,481 (46,094)
Median(25th-75th)	4,042 (1,986-8,257)	3,018 (1,539-5,202)
Number of encounters		
Mean (std)	15.5 (14.2)	12.4 (8.7)
Median(25th-75th)	12 (8-18)	11 (7-16)
Length of hospital stay		
Mean (std)	7.2 (18.4)	4.1 (10.0)
Median(25th-75th)	3 (2-4)	2 (2-3)
ED visits		
Mean (std)	0.51 (1.17)	0.36 (1.00)
Median(25th-75th)	0 (0-1)	0 (0-1)

102 **124.102** ADHD Diagnosis and Treatment Among ADHD Children with and without ASD

B. Zablotsky*, M. D. Bramlett and S. J. Blumberg, National Center for Health Statistics, Hyattsville, MD*

Background: Children diagnosed with autism spectrum disorder (ASD) are commonly diagnosed with other co-occurring developmental, psychiatric, neurological and medical conditions (Levy et al., 2010). The most prevalent psychiatric co-occurring condition is attention-deficit/hyperactivity disorder (ADHD), with approximately one in two children with ASD also having ADHD (Zablotsky et al., 2015). Parents of children diagnosed with ASD frequently report obstacles in accessing and receiving care for their child's ASD (Kogan et al., 2008). However, little is known about how a child's ASD may affect the ability to receive care for other mental health conditions, more specifically whether a diagnosis of ASD may make receipt of services for ADHD easier or more difficult among children with both conditions.
Objectives: 1) Compare the age of ADHD diagnosis and the age of first ADHD medication between children currently diagnosed with ADHD and ASD to children currently diagnosed with ADHD without ASD, 2) Explore whether ADHD treatment barriers and parental satisfaction of their child's ADHD management and treatment vary by whether a child is currently diagnosed with ASD.
Methods: Data are drawn from the 2014 National Survey of the Diagnosis and Treatment of Attention-Deficit/Hyperactivity Disorder and Tourette Syndrome (NS-DATA), a follow-up to the 2011-2012 National Survey of Children's Health. Households with a child between the ages of 4-17 and currently diagnosed with ADHD were eligible for the current study (n=2,464). Children currently diagnosed with ASD and ADHD (n=352) were compared to those who were diagnosed with ADHD without ASD (n=2,112). Prevalence estimates were calculated using Stata 13.1 SE, which accounted for the complex survey design of the NS-DATA. Differences between children with and without current ASD were compared using multivariate logistic regression, controlling for differences between the groups in demographics, ADHD severity, and the impact of the child's ADHD on the family. Interaction terms were used to test whether the effects of covariates differed by whether the child had ASD or not.
Results: Among children with ADHD, those with ASD were diagnosed with ADHD at an earlier age and started treatment with medication for ADHD at an earlier age. Approximately 11% of children with ADHD had trouble obtaining treatment for their ADHD regardless of whether the child was currently diagnosed with ASD. Additionally, children in the two groups had parents who were equally satisfied with the ADHD treatment and management their child receives.
The effects of most covariates did not differ by whether the child has a current ASD diagnosis, with two exceptions: girls had a later age of first ADHD medication than boys, unless they had ASD, in which case they had a younger age than boys; and non-Hispanic black children had a higher unmet treatment need than all other children if they had been diagnosed with ASD.
Conclusions: The presence of ASD may prompt diagnostic services for a developmental disorder at an earlier age. However, after receiving an ADHD diagnosis, children with ASD do not appear much different than children without ASD.

103 **124.103** Adaptive Behavior Impairments Vary with Depression Status in Adolescents and Young Adults with ASD

R. N. Crist[1] *and K. Gotham*[2], *(1)Psychiatry, Vanderbilt University School of Medicine, Nashville, TN, (2)Vanderbilt University, Nashville, TN*

Background:
Adaptive behavior is an important index of functioning in autism spectrum disorder (ASD), and has been shown to predict adult outcomes within this population (Howlin, 2000). ASD is associated with high rates of impairment in adaptive behavior (Rydén & Bejerot, 2008). Despite highly variable symptom expression and intellectual functioning within ASD, existing literature supports a general pattern in the adaptive behavior profiles of adults with ASD, with relative strengths in daily living skills and to a lesser extent communication, and relative weaknesses in socialization (Farley et al., 2009; Kanne et al., 2010).
Other clinical populations, such as adults with depression, tend to experience impaired adaptive functioning as well (Lowe et al., 2008). Empirical evidence suggests high rates of psychiatric comorbidity in ASD across the lifespan, with depression a particularly common co-occurring condition for adults with ASD (Lugnegard et al., 2011). Despite the known negative effects of ASD and depression singularly on adaptive behavior skills, the combined impact is unclear.
Objectives:
This study aims to assess the relation between depression and adaptive behavior in adolescents and adults with ASD. By comparing adaptive behavior profiles of those with and without co-occurring depression, we hope to comment on the effects of depression on adaptive behavior within the ASD population.
Methods:
Participants included 50 adolescents and adults with ASD (16-35 years) and verbal IQ ≥ 70. ASD diagnosis was confirmed via parent completion of the Autism Diagnostic Interview-Revised (ADI-R; Rutter et al., 2003), as well as administration of the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000). Parents also completed the second edition of the Vineland Adaptive Behavior Scales (Sparrow et al., 2005) to assess participants' adaptive functioning in the domains of Daily Living Skills, Communication, and Socialization. Participants completed the Beck Depression Inventory, 2nd edition (BDI-II; Beck et al., 1996) to assess depressive symptoms.

Results:
Verbal IQ was not significantly different between depressed (DEP) and non-depressed (ND) participants. The depressed subsample tended to be slightly older (M=22.5 years, SD=4.3, compared to M=20.2 years, SD=3.8 in the ND group), however group differences were not significant (t(48)=1.67, p=.099). Vineland composite adaptive behavior scores were found to be significantly lower among the depressed sample (M=62.4, SD=12.8 vs. M=74.5, SD=13.1 in ND) when controlling for the effects of age (F(2,46)=3.43, p=.041). Within specific domains, Vineland Daily Living standard scores were significantly lower in the depressed subsample (F(2,47)=5.94, p=.005), as were Communication domain scores (F(2,46)=14.23, p=.000). Vineland Socialization domain scores were not significantly different between groups when controlling for age. BDI-II scores showed a significant negative correlation with both Daily Living (r=-.361, p=.010) and Communication (r=-.410, p=.003) domain scores, but were not significantly correlated with Socialization scores.
Conclusions:
This study provides evidence that comorbid depression exacerbates adaptive functioning impairments in adults with ASD. Furthermore, these data suggest that co-occurring depression is associated with diminished adaptive behavior skills in areas that otherwise tend to be relative strengths within ASD (Daily Living Skills and Communication), providing evidence for unique functional impairments related to this psychiatric comorbidity.

104 **124.104** Addressing Intolerance of Uncertainty in Anxious Young People with Autism Spectrum Disorder

J. Rodgers[1], *E. Honey*[2], *M. H. Freeston*[3] *and A. Hodgson*[4], *(1)Newcastle University, Newcastle University, Newcastle, United Kingdom, (2)CNDS, Northumbria Tyne and Wear NHS Foundation Trust, Newcastle Upon Tyne, United Kingdom, (3)Psychology, Newcastle University, Newcastle, United Kingdom, (4)Newcastle University, Newcastle, United Kingdom*

Background: Anxiety is a significant problem for many children with a diagnosis of autism spectrum disorder (ASD). Children with ASD frequently present with multiple anxiety disorders concurrently therefore treatments targeting underlying anxiety mechanisms may be most efficacious. Over the last five years our group has worked towards providing a theoretically informed formulation of anxiety in ASD. This work has focused on a consideration of a well-established model of anxiety: the Intolerance of Uncertainty Model. *Intolerance of uncertainty* (IU) is a construct associated with a range of anxiety disorders. It is a 'broad dispositional risk factor for the development and maintenance of clinically significant anxiety' in neurotypical populations. The concept of IU has utility not only to theoretically inform understanding of the factors underlying the development and maintenance of anxiety, but has also been shown to be a beneficial target for treatment. Intervention studies with neurotypical individuals with high IU provide evidence that reduction of IU is associated with reduction in anxiety. Cognitive behavioural treatments for clinically anxious patients have been developed which emphasise treating the cognitive *process* rather than the cognitive *content* of anxiety, specifically by aiming to increase patients' tolerance for uncertainty and thereby achieving more sustainable change. Over the past five years research has investigated the relevance of IU to anxiety in ASD. This work indicates that IU is a key construct in anxiety in children and adolescents with ASD, which may account for the increased vulnerability to a range of anxiety disorders in this population.
Objectives: Our objective was to develop and evaluate the feasibility and acceptability of a parent group intervention targeting IU for young people with ASD.
Methods: **Phase One**: Focus group were undertaken to inform the development of the intervention materials and trainers' manual. An eight week manualised intervention programme was developed; *CUES, Coping with Uncertainty in Everyday Situations*. The treatment aimed at providing parents of children with ASD, with effective strategies to reduce their child's IU in everyday situations. **Phase Two**: The intervention was delivered in two staggered parent intervention groups to eight parents of children with ASD, aged between 8 and 12 years. The intervention included in-session activities and homework tasks. Baseline and outcome measures assessing child and parent anxiety and IU were completed. Individual follow-up interviews were undertaken with parents to ascertain acceptability and feasibility.
Results: Attendance at and retention to the intervention programme was good. Findings demonstrated the intervention to be acceptable and feasible to families. Parents reported a reduction in their own and their child's intolerance of uncertainty and anxiety subsequent to participation on the programme.
Conclusions: The findings indicate that parents of young people with ASD view an intervention which focuses on intolerance of uncertainty to be valid and meaningful. The data available indicate that CUES may have promise as a targeted package to assist young people with ASD and their families to manage their responses to uncertainty.

105 **124.105** An Investigation of Eye Color and Autism: The Distribution of Iris Coloration Among Children with ASD in the United States

K. Callahan*, University of North Texas Kristin Farmer Autism Center, Denton, TX*

Background: The etiology of autism still lacks definitive genetic, neurochemical, or neuroanatomical markers to enable reliable diagnosis and improved early intervention. However, investigations of eye color have received increased interest among epidemiologists. Iris coloration has been associated with the phenotype of multiple genetic disorders, including albinism, schizophrenia, and Waardenburg, Angelman, and Prader-Willi Syndromes. It is also related to risk of macular degeneration, glaucoma, and melanoma. Melanin-based coloration is implicated in physiological, morphological, and behavioral traits. Researchers have identified significant correlations between eye color and behavior in animals and humans, including significant differences in physiological reactivity between light-eyed and dark eyed persons, suggesting a possible role of neuromelanin. Although eye color genes are located on chromosomes of interest in autism, and researchers have determined that melanin may play a role in Ascending Reticular Activation System functions related to arousal among individuals with ASD, little research has investigated possible relationships between eye color and autism.
Objectives: The purpose of this study was to investigate the distribution of iris coloration within a national sample of children with ASD in the United States, and determine relationships between eye color in ASD and the general population. The relationship between eye color and severity levels in the core deficits of autism (communication, socialization, and restricted/repetitive behaviors) was also examined.
Methods: Direct observations of the eyes of 162 children with ASD were conducted at autism centers in Hawaii, California, Colorado, and Texas using a systematic observation protocol. Eye colors were categorized into seven categories ranging from blue to black. Data collectors were required to complete training and demonstrate mastery of eye color ratings before conducting observations. Intervention fidelity checklists were completed for all observations, and interobserver reliability observations were conducted for approximately 80% of participants (overall agreement level of 87%). Clinical supervisors rated the severity levels of autism symptoms for each participant, and parents were asked if they have observed unusual characteristics related to their child's eyes (e.g., eyes change color during periods of extreme behaviors).
Results: Chi-square tests for goodness of fit were conducted to determine if there were statistically significant differences between the eye color distribution of the sample of children with ASD, and the general distribution of eye color in the United States as reported by Soni and Neuhoff (1985) and to check if autism symptom severity levels were related to eye color categories. There was statistical significance for iris coloration ($p<.05$). Dark eyes (black, brown, hazel) were over-represented in the ASD sample, and there were significantly fewer blue and green eyed persons with autism compared to the national population. There was no trend in symptom severity by eye color category, with non-significant results in communication, socialization, and behavior.
Conclusions: The possible significant over-representation of dark eyed individuals with ASD in a national U.S. sample warrants further investigation. Additional analyses of eye color data, including expected levels by ethnicity, are underway. Additional studies of the role of melanin could result in increased understanding about iris coloration as a possible genetic marker or correlate in ASD.

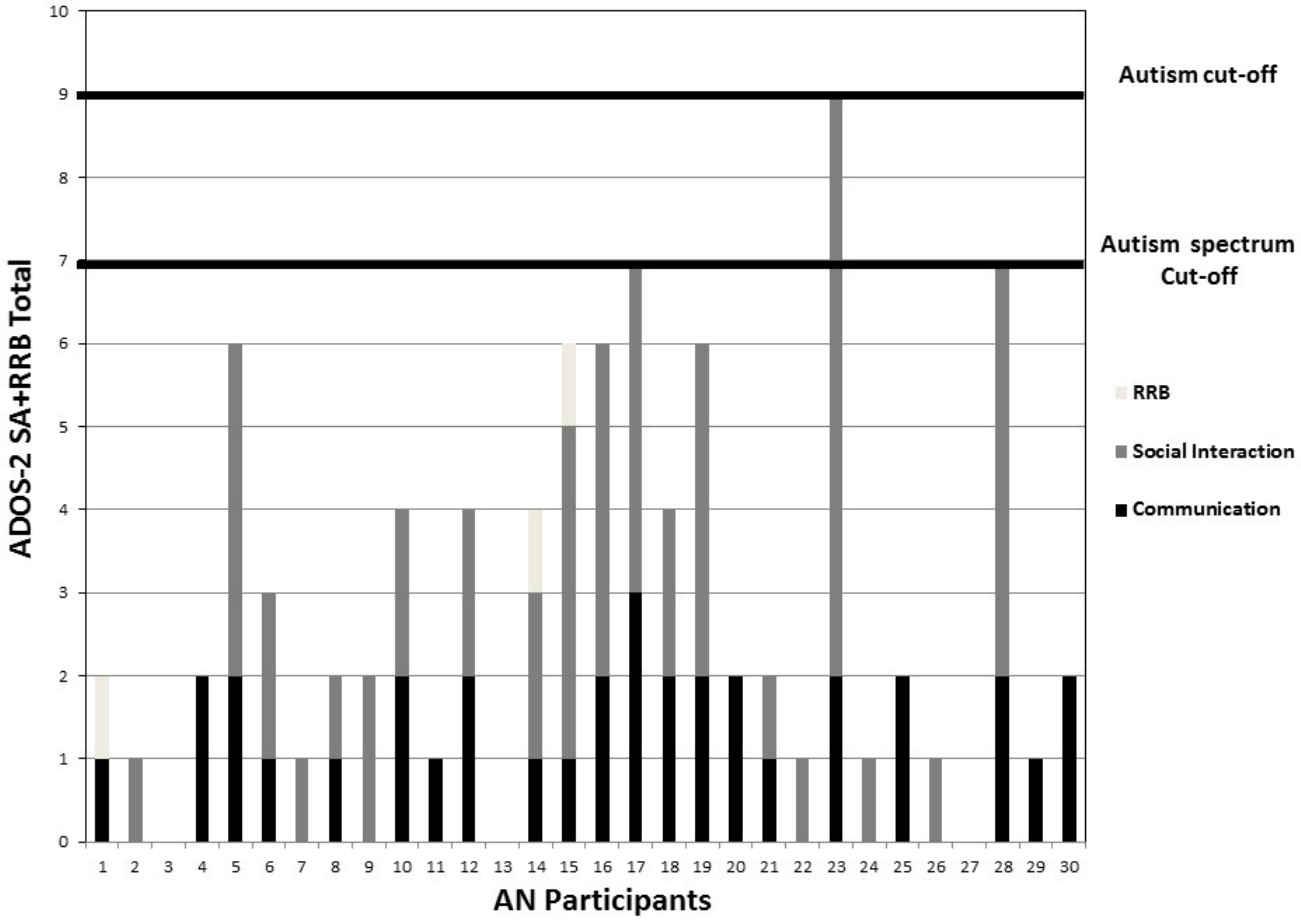
106 **124.106** Anorexia Nervosa and Autism Spectrum Disorder: Is There an Association?

V. Postorino[1], *L. Scahill*[2], *V. Zanna*[3], *M. Castiglioni*[3], *L. De Peppo*[4], *L. M. Fatta*[3], *S. Vicari*[5] *and L. Mazzone*[6], *(1)Marcus Autism Center, Emory University, Atlanta, GA, (2)Pediatrics, Marcus Autism Center, Atlanta 30329, GA, (3)Department of Neuroscience, I.R.C.C.S. Children's Hospital Bambino Gesù, Rome, Italy, (4)Department of Neuroscience, L.U.M.S.A., Libera Università Maria SS. Assunta, Rome, Italy, (5)Children Hospital Bambino Gesù, Rome, Italy, (6)Department of Neuroscience, I.R.C.S.S. Children's Hospital Bambino Gesu', Rome, Italy*

Background: Recent studies have reported a high level of autistic traits in population with anorexia nervosa (AN). Moreover, a number of cognitive features associated with Autism Spectrum Disorder (ASD) has been described in AN samples. However, it is unclear to what extent these are manifestations of ASD or whether they are the manifestations of the starvation phase of the illness. To date, few studies have used contemporary methods to confirm the diagnosis of ASD.
Objectives: The aim of the present study was to examine the presence of ASD in a group of AN during the starvation phase using the gold-standard diagnostic measure for autism (i.e., ADOS-2). We also compared the level of autistic traits and the performance on a common social perception task across four groups: AN, ASD, and two gender- and age-matched control groups (C-AN, C-ASD).
Methods: 30 female AN participants in the acute phase of illness, 27 male ASD participants and two healthy, age and gender-matched controls groups (n=35 females; n=30 males) were enrolled in this study. Controls were screened for AN with the Eating Attitude Test-26 and the Eating Disorder Invenory-3. The ADOS-2 Module 3 was administered by a psychologist trained to research reliability to the AN and the ASD groups. Parents of all individuals completed the Autism Spectrum Quotient (AQ). Subjects completed the NEPSY-II social perception domain (i.e., Theory of mind-TOM and Affect Recognition-AR).
Results: Of the 30 AN participants evaluated using the ADOS-2, 1 was classified on the ADOS algorithm as having autism (Social Affect-SA=9, Restricted/Repetitive Behaviors or Interests-RRB=0, Overall Total-OT= 9); two scored in the ASD range (SA=7, RRB=0, OT=7 both participants)(Figure 1). The remaining participants scored below the ADOS threshold for ASD. Moreover, no similarity between the AN and the ASD groups were detected on the AQ (total and sub-scores) (AN: AQ Total: 18.17 ± 5.92, ASD:AQ Total: 29.6± 6.45, t=5,272, p<0.001) and the NEPSY-II domain. On the other hand, the ASD group had higher scores only on the AQ social skill subscale compared to the C-ASD group (t=3,927, p<0.001). Whereas the C-AN scored higher on the AQ attention to detail (t=-2,082, p=.043), communication (t=-1,138, p=.022) and imagination (t=-1,155, p=.020) subscales and on the NEPSY TOM domain (t=-,813, p=.012) compared to the AN group.
Conclusions: To our knowledge, this is the first study evaluating an AN sample during the starvation phase using the ADOS. Only 10% of subjects in the AN group scored above the conventional ADOS threshold. In these three AN subjects, none was rated above threshold for RRB. On the AQ, none of the AN subjects exceeded the threshold, suggesting low level of autistic traits. On the social perception domain tasks, the ASD group showed significantly greater impairment than the AN group. Our findings do not

support the presence of autistic traits in individuals with AN. Further longitudinal studies are needed in order to determine the association between these conditions.

Figure 1. Scores on the ADOS-2 of the AN participants



107 **124.107** Anxiety and Satisfaction with Life in Young Adults with Autism Spectrum Disorder

I. C. Smith[1], *R. Elias*[2] *and S. W. White*[1], *(1)Virginia Polytechnic Institute and State University, Blacksburg, VA, (2)Virginia Tech, Blacksburg, VA*

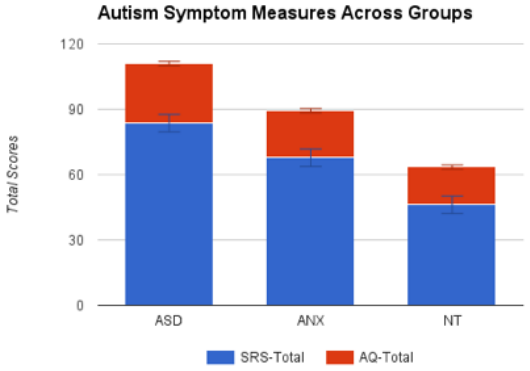
Background:
The comorbidity of anxiety and ASD in children and adolescents is well established (van Steensel, Bogels, & Perrin, 2011). Extant literature on comorbid anxiety symptoms as they manifest in adults with ASD is limited, but preliminary evidence suggests rates of comorbidity comparable to those found in children and adolescents (Lugnegard et al., 2011; Maddox & White, 2015). Anxiety disorders and ASD have each been demonstrated to have substantial impact on quality of life in adults independently (Jennes-Coussens, Magill-Evans, & Koning, 2006; Mendlowicz, 2000), but the relationship between anxiety and satisfaction with life in samples with ASD has not yet been established.
Objectives:
The purpose of this study was to investigate the relationship between anxiety symptoms and satisfaction with life in a sample of emerging adults entering a college transition support program. We hypothesized that satisfaction with life would significantly and negatively correlate with anxiety symptoms.
Methods:
Data from the current study were collected prior to enrollment in a randomized controlled trial of a college transition support program for adolescents and young adults with ASD. The sample currently consists of 11 individuals (17-24 years old; 8 males) with ASD, though we anticipate a large sample (n = 25) by May 2016. All participants had a confirmed diagnosis of ASD based on the ADOS-2 (Lord et al., 2012) and were cognitively high-functioning (IQ>80). The Anxiety Disorders Interview-Client Version (ADIS-5; Brown & Barlow, 2014) was used to assess for presence of comorbid anxiety. Participants completed the Satisfaction with Life Scale (SWLS; Diener et al., 1985) and parents completed the Adult Behavior Checklist (ABCL; Achenbach & Rescorla, 2003).
Results:
Anxiety disorders were highly prevalent in the sample, with all participants meeting criteria for diagnosis of at least one anxiety disorder. Social Phobia was the most prevalent diagnosis, with 8 of 11 (73%) individuals meeting diagnostic criteria. Other diagnoses included specific phobias (5 of 11, 46%), GAD (4 of 11, 36%), and OCD (3 of 11, 27%). A Pearson correlation between the SWLS and the anxiety problems subscale of the ABCL was not significant, $r(9) = .10$, $p = .78$. However, the correlation between the SWLS and the anxiety/depression subscale of the ABCL was large and significant, $r(9) = -.65$, $p = .03$. The correlation between the SWLS and the withdrawn subscale of the ABCL was also large and significant, $r(9) = -.65$, $p = .03$.
Conclusions:
The current findings partially support a relationship between anxiety symptoms and satisfaction with life in young adults with ASD. Given that no significant relationship was found between the anxiety problems subscale, but significant correlations were found for the anxious/depressed and withdrawn subscales, it is possible that depressive symptoms contribute more to poor satisfaction with life than anxiety symptoms. Such results are surprising given the relatively low comorbidity of depression as compared to anxiety in ASD. While these results should be interpreted with caution due to the small sample size, further research is warranted on the effect of anxious and depressive symptoms on satisfaction with life in ASD.

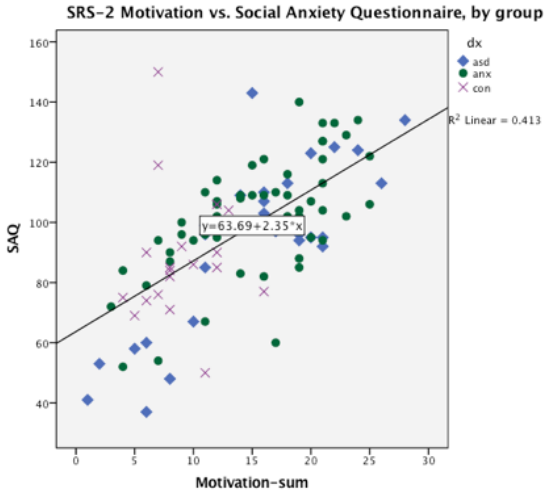
108 **124.108** Anxiety in Autism and Autism in Anxiety: Symptom Overlap on the SRS-2 Adult Self-Report

A. Ward[1], *C. Nielson*[1], *K. G. Stephenson*[1], *M. Maisel*[1], *T. P. Gabrielsen*[1], *M. H. Freeston*[2], *J. Rodgers*[3], *M. South*[1] *and S. B. Gaigg*[4], *(1)Brigham Young University, Provo, UT, (2)Psychology, Newcastle University, Newcastle, United Kingdom, (3)Newcastle University, Newcastle Upon Tyne, United Kingdom, (4)City University London, London, United Kingdom of Great Britain and Northern Ireland*

Background: There is growing awareness that common autism symptom measures including the ADI-R (van Steensel et al. 2013), ADOS-G (Pine et al., 2008) and SRS (Cholemkery et al., 2014; Puelo & Kendall, 2011) may overlap with other non-diagnostic constructs including anxiety and mood symptoms. On the one hand, knowing about co-occurring social difficulties may be useful for treatment in mood and anxiety disorders. On the other hand, these findings raise questions about the discriminant validity of hallmark symptoms of autism from other associated features. Previous studies in this area have been with children. To our knowledge, there is little or no work in this area for adults, where anxiety and autism symptoms may converge more strongly.
Objectives: We aimed to characterize the overlap of autism and anxiety symptoms using two separate autism symptom measures in ASD, anxious, and non-anxious adults.
Methods: Participants included adults diagnosed with ASD (*n*=39; ASD group); first-time visitors to a university counseling center who scored high on intake surveys of

anxiety (*n*=56; ANX group); and a sample of university students with no psychiatric history (*n*=37; NT group). Participants all completed the self-report Social Responsiveness Scale-Second Edition (SRS-2) and the Autism Spectrum Quotient (AQ) in addition to IQ testing and a battery of emotion symptom questionnaires.
Results: Strong, significant correlations were found between ASD and anxiety measures in all three groups. One-way ANOVA indicated significant main effects for diagnosis on both the AQ and SRS total scores. Post-hoc analyses showed that the ANX group scored significantly higher than the NT group but significantly lower than the ASD group on both measures. The ANX raw scores mean and standard deviation (68 ± 24) indicates that many in this group are scoring in a range thought to indicate autism diagnosis. The SRS-2 *Motivation*subscale, which includes items related to social approach and social discomfort ("I avoid starting social interactions with other adults;" "I enjoy making small talk (casual conversation) with others") did not differentiate between ASD and ANX groups. In both the ASD and ANX groups, the Motivation scale was most strongly correlated with social anxiety measures but these were not significantly correlated in the NT group.
Conclusions: The SRS-2 and AQ have been shown to discriminate between ASD and typically developing (TD) individuals. Our data also indicates higher autism symptom scores in an ASD vis-á-vis anxious sample of adults, but likewise shows that the ANX group had markedly elevated scores on both measures. This seems to be at least partially driven by high scores on the Motivation subscale, which includes a number of items related to social anxiety. Further work to separate autism versus anxiety-related social behaviors can inform clinical intervention—including the need to explicitly treat social anxiety in adults with ASD—as well as research into the overlap of anxiety in autism.





109 **124.109** Assessing Anxiety Symptomatology in Children with ASD Using Existing Measures: Is the Spence Children's Anxiety Scale- Parent Version a Useful Tool?

I. Magiati[1], *J. W. Lerh*[2], *M. J. Hollocks*[3], *M. Uljarevic*[4], *J. Rodgers*[5], *H. McConachie*[6], *A. Ozsivadjian*[7], *M. South*[8,9], *A. V. Van Hecke*[10], *A. Y. Hardan*[11], *R. A. Libove*[11], *S. R. Leekam*[12] *and E. Simonoff*[13], *(1)Department of Psychology, National University of Singapore, Singapore, Singapore, (2)Psychology, NATIONAL UNIVERSITY OF SINGAPORE, Singapore, Singapore, (3)King's College London, London, England, United Kingdom of Great Britain and Northern Ireland, (4)Olga Tennison Autism Research Centre, La Trobe University, Bundoora, Australia, (5)Newcastle University, Newcastle Upon Tyne, United Kingdom, (6)Institute of Health and Society, Newcastle University, Newcastle upon Tyne, United Kingdom, (7)Guy's Hospital, London, United Kingdom, (8)Brigham Young University, Provo, UT, (9)Psychology and Neuroscience, Brigham Young University, Provo, UT, (10)Marquette University, Milwaukee, WI, (11)Stanford University, Stanford, CA, (12)School of Psychology, Cardiff University, Cardiff, United Kingdom, (13)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom*

Background: Assessing anxiety in ASD is challenging, because of core ASD features and anxiety symptom overlap and both traditional as well as varied manifestations of anxiety in ASD (Ozsivadjian et al., 2012; Kerns et al., 2014). Kerns and Kendall (2012) called for the validation of anxiety measures in ASD, but it is currently unclear whether ASD-specific measures are needed or existing ones are reliable and valid. There is to date no informant- or self-report anxiety checklist developed or validated specifically to assess anxiety in this population, but a growing number of studies in the last few years have begun to examine the use of existing measures.
Objectives: To examine the internal consistency and convergent, divergent and discriminant validity and to explore the factor structure and clinical usefulness of the Spence Children Anxiety Scale-Parent Version (SCAS-P). This paper presents final analyses of a larger sample than previously reported in an earlier preliminary presentation (Magiati et al., 2015).
Methods: Data from 12 studies from the UK, Singapore and the USA were pooled together. Participants were caregivers of 870 youth with a professional diagnosis of ASD, Autism, Asperger's syndrome or PDD-NOS (87.7% males; 95% had a diagnosis of ASD; mean age=11.6 years, SD = 2.77) most of whom had at least one measure of autism symptomatology available. IQ data were available for 278 participants and another 238 had adaptive functioning scores. All but 21 clinically anxious help-seeking youth were recruited from special schools, other community or ASD diagnostic settings.
Results: Items from the total SCAS-P scale and from all but the Physical Injury subscales (α=.55) were internally reliable (all α>.75). The SCAS-P total and subscale scores had convergent validity with the Developmental Behavior Checklist (DBC) anxiety subscale (r=.32-.64; n=238). The clinically anxious subsample (n=21) had significantly higher total, generalized and social anxiety scores compared to the remaining participants. The existing SCAS-P six-factor structure was not a good fit for data obtained from 435 randomly selected participants in this sample and thus a principal components analysis (PCA) was carried out. Thirty of the 38 items loaded on five factors (social/ generalized anxiety, separation, obsessive compulsive, somatic symptoms and specific phobias) explaining 57.9% of the variance. A confirmatory factor analysis of the revised structure was re-run for the other half of the sample, but it was not a good fit.
Conclusions: The original SCAS-P full scale and subscales had excellent internal consistency and showed good evidence of convergent, divergent and discriminant validity, with the exception of the Physical injury subscale. Despite its promising psychometric properties, the lack of an adequate factor structure fit is concerning and suggests that future research should look into modifying and re-evaluating the SCAS-P for use in children with ASD.

110 **124.110** Association Between Autistic Traits and Suicidality in a Sample of University Students

S. Yilmaz[1], *S. Herguner*[2] *and S. Kılınç*[1], *(1)Meram Faculty of Medicine, KONYA, Turkey, (2)Meram Faculty of Medicine, NE University, Konya, Turkey*

Background: The high prevalence of anxiety disorders and depression within the autism spectrum disorder (ASD) population is widely recognized. However, few data have been published on suicidal thoughts and behaviors (i.e., suicidal ideation, plan, or intent or a past suicide attempt) in youth with ASD. **Objectives:** This study examined the role of three potential mediating variables in the relationship between autistic traits and suicidality in the general population. The purpose of this study was to examine autistic trait direct and indirect effect on depression and suicidality. **Methods:** Participants included 320 university students (155 males, 165 females) ranging in age from 18 to 42 (M = 21.2, SD = 2.40). Depression symptoms and suicidality of the participants were assessed using the Beck Depression Inventory. The Autism spectrum quotient (AQ) was used to assess autistic traits. Multiple Logistic regression analyses were conducted to assess suicidality predictors. Structural Equation Modeling was conducted to asses AQ direct and indirect effect on Suicidality. **Results:** The first model of Logistic regression AQ Attention to Detail and Communication subscale are related to suicidality , attention switching is a negatively related to suicidality. The second model, depression related to suicidality, AQ Attention Switching negatively related to suicidality. Other subscales have not significant predictor effect on suicidality. In the Structural Equation Modeling AQ Attention to detail and communication effect suicide indirectly (via depression), Attention switching's effect is negatively but directly on suicidality. **Conclusions:** This study provides preliminary evidence that effect of Autistic trait on suicidality may be related to autistic trait depression relationship.

111 **124.111** Associations Between Cytokines, Endocrine Stress Response, and Gastrointestinal Symptoms in Autism Spectrum Disorder

B. J. Ferguson[1], *S. Marler*[2], *L. L. Altstein*[3], *E. B. Lee*[2], *M. O. Mazurek*[4], *A. McLaughlin*[5], *K. Hartnett*[6], *E. A. Macklin*[7], *E. McDonnell*[3], *D. J. Davis*[6], *A. Belenchia*[6], *C. H. Gillespie*[6], *C. A. Peterson*[8], *M. L. Bauman*[9], *K. G. Margolis*[10], *J. Veenstra-Vander Weele*[11] *and D. Q. Beversdorf*[12], *(1)Radiology, University of Missouri, Columbia, MO, (2)Vanderbilt University, Nashville, TN, (3)Massachusetts General Hospital Biostatistics Center, Boston, MA, (4)University of Missouri - Columbia, Columbia, MO, (5)Pediatrics, St. Louis University, St. Louis, MO, (6)University of Missouri, Columbia, MO, (7)Biostatistics Center, Massachusetts General Hospital, Boston, MA, (8)Nutrition & Exercise Physiology, University of Missouri, Columbia, MO, (9)Boston University School of Medicine, Boston, MA, (10)Columbia University, New York, NY, (11)New York State Psychiatric Institute / Columbia University, New York, NY, (12)University of Missouri, Columbia, Columbia, MO*

Background: Many children and adolescents with Autism Spectrum Disorder (ASD) have significant gastrointestinal (GI) symptoms, but the etiology is currently unknown. Some individuals with ASD, show altered reactivity to stress, as well as altered immune markers, particularly stress-responsive cytokines including TNF-α and IL-6.
Objectives: To assess potential relationships between GI symptoms and stress response, we examined whether GI symptoms are associated with increases in stress-associated endocrine and cytokine biomarkers in ASD. We hypothesized that positive relationships would exist between GI symptomatology and cortisol, TNF-α, IL-6. Furthermore, we conducted exploratory analyses to examine the effects of the presence or absence of key co-occurring medical and psychological conditions on these relationships in ASD.
Methods: A sample of 120 individuals aged 6-18 with ASD that are enrolled in the Autism Treatment Network at the University of Missouri Thompson Center for Autism and Neurodevelopmental Disorders and the Vanderbilt Kennedy Center participated in the study. Participants provided pre- and post-stress salivary cortisol samples to measure the endocrine stress response, and a pre-stress blood sample to measure levels of interleukin 6 (IL-6) and tumor necrosis factor alpha (TNF-α). To assess the response to stress, cold pressor and vibrotactile stimulation were applied to the hands in independent trials. Upper and lower GI tract symptomatology were assessed using the Questionnaire on Pediatric Gastrointestinal Symptoms, Rome III. Exploratory analyses were conducted between measures of intelligence, key co-occurring conditions in ASD, and IL-6, TNF- α, and pre- and post-stress cortisol to examine potential relationships.
Results: Lower GI tract symptoms were significantly associated with post-stress cortisol concentration. This relationship between cortisol response to stress and GI functioning was greater for children who had a history of regression or loss of skills that were previously acquired. Exploratory analyses also revealed significant correlations between cortisol change score, IQ, and inappropriate speech. In contrast, lower GI tract symptoms were not associated with levels of TNF-α or IL-6. Significant correlations were found, however, between TNF-α and IL-6 and irritability, socialization, and IQ.
Conclusions: These findings suggest that individuals with ASD and lower GI tract symptoms may have an increased response to stress, but this effect is not associated with concomitant changes in stress-associated cytokines. This relationship with stress may be relevant for future individualization of treatment of lower GI tract symptoms in ASD. The relationship between endocrine stress reactivity and lower GI tract symptoms in children with loss of skills, as well as the relationships between cortisol, IL-6, and intelligence in ASD, warrant further investigation.

112 **124.112** Associations Between Sleep and Behavioral Problems in Children with ASD

M. O. Mazurek[1] *and K. Sohl*[2], *(1)University of Missouri - Columbia, Columbia, MO, (2)University of Missouri - Thompson Center, Columbia, MO*

Background:
Children with autism spectrum disorder (ASD) are at high risk for sleep disturbance. These problems have a significant impact on daytime functioning; however, the relationships between sleep and behavioral dysregulation in children with ASD are not fully understood. This is an important consideration, given that children with ASD experience high rates of behavioral problems, including aggression, irritability, hyperactivity, and inattention. A large body of literature has demonstrated that sleep disturbance is associated with these types of behavior problems in typically developing children. Surprisingly, however, the relationship between specific types of sleep and behavioral problems in children with ASD has received relatively little empirical attention, as noted in a recent review.
Objectives:
The purpose of the current study was to examine the relationships between distinct types of sleep and behavioral problems in children with ASD. The specific behavior problems selected for examination were aggression, irritability/hostility, inattention, and hyperactivity, given their particular clinical relevance in the ASD population. The primary hypothesis was that sleep problems would be associated with daytime behavioral disturbance among children with ASD. The secondary research aim was to identify the specific types of sleep symptoms that were most closely related to each behavioral problem.
Methods:
Participants included 81 children and adolescents with ASD recruited through an interdisciplinary academic medical center. Participants ranged in age from 3 to 19 years (*M* = 10.3, *SD* = 3.8), and the majority of children in the study were male (86.4%). All participants had been previously evaluated and diagnosed by an interdisciplinary team, comprised of a physician and psychologist, using standardized diagnostic tools (i.e., ADOS or ADOS-2), cognitive and adaptive skill assessment, and clinical interview. Measures for the current study included selected subscales of the Children's Sleep Habits Questionnaire, the Children's Scale for Hostility and Aggression: Reactive/Proactive, and the Vanderbilt Attention Deficit/Hyperactivity Disorder Parent Rating Scale.
Results: In bivariate correlations, sleep problems were associated with all four types of behavior problems of interest, including physical aggression, irritability, inattention, and hyperactivity ($p < .05$ to $p < .001$; small to medium effect sizes). Backward stepwise linear regression models revealed that distinct sets of sleep problems predicted each behavior problem, with different combinations of variables accounting for between 22 and 32% of the variance in behavior problems across statistical models. Importantly, the night awakenings score was a significant predictor in three of four models (i.e., physical aggression, inattention, and hyperactivity).
Conclusions:
Sleep disturbance is associated with behavioral dysregulation among children with ASD. Of particular note, night awakenings appear to have the most consistently strong association with daytime behavior problems, even after controlling for the effects of age and sex. Future research is needed to develop more targeted treatments for these conditions and to identify patterns of change over time.

113 **124.113** Attention-Deficit/Hyperactivity Disorder Is Common in Autism Spectrum Disorder and Negatively Affects the Clinical Presentation

D. A. Zachor[1] *and E. Ben Itzchak*[2], *(1)Tel Aviv University / Assaf Harofeh Medical Center, Zerifin, Israel, (2)Ariel University, Givat Shmuel, Israel*

Background:
The co-existence of autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) has recently been supported by the DSM 5. The prevalence rate of ADHD symptoms within ASD populations has been reported to be between 16-50%, significantly more than in the general population (7-10%). The impact of having ASD and ADHD on the severity of the clinical presentation has been investigated in only a few studies. More severe ASD symptoms, emotional instability, poorer adaptive skills and poor academic achievements positively correlated with the existence of ADHD symptoms.
Objectives:
1. To assess the rate of ADHD symptoms in a population diagnosed with ASD
2. To compare the clinical presentation in a subgroup with only ASD diagnosis to a subgroup with ASD and ADHD symptoms.
Methods:
The study included 155 participants, diagnosed with ASD, age range 4:0-10:8y (M=6:7; SD=20.8m) and with male:female ratio of 6.4:1. All the participants underwent comprehensive medical, cognitive and behavioral assessments using standardized tests. Autism symptom severity was measured using the Autism Diagnostic Observation Schedule calibrated severity scales (ADOS CSS). ADHD symptom severity was measured using the Conners Teacher ADHD rating scale-the long form (CRS-R). Standard scores > 60 on any of the different DSM-IV ADHD subscales are considered significant for ADHD symptoms.
Results:
Using the Teacher CRS-R, of the ASD population, a score > 60 was noted for 66% on the DSM ADHD total score subscale, for 66.5% on the DSM Inattention subscale and

for 46.5% on the DSM Hyperactive–Impulsive subscale.
We then divided the entire ASD group into two subgroups, one without ADHD symptoms (ASD-ADHD) (n=75; mean age=6:3y)) and the second with ADHD symptoms (ASD+ADHD) (n=80; mean age=6:5y). The two subgroups were compared for age, sex, autism severity, cognitive level and anxiety symptoms. The two subgroups were not significantly different in age. A trend for lower male:female ratio (relatively more girls) was observed for the subgroup ASD+ADHD (4.7:1) compared to the subgroup ASD-ADHD (9.7:1) (p=.7).
Looking at cognitive measures, the ASD+ADHD subgroup had significantly lower IQ scores (M=86.3, SD=19.1) than the subgroup ASD-ADHD (M=93.0, SD=19.4) (p<.05). Examining the verbal and non-verbal IQ scores revealed that only for the non-verbal IQ scores, the ASD+ADHD subgroup (M=95.7, SD=18.9) had significantly lower scores than the ASD-ADHD subgroup (M=105.0, SD=18.9) (p<.05).
A high prevalence of anxiety symptoms, measured by the Anxiety subscale scores of the CRS-R, was noted for the two subgroups. The prevalence was significantly higher for the subgroup ASD+ADHD (65.9%) than for the subgroup ASD-ADHD (35.6%) (p<.001). Comparison of autism severity using the ADOS-CSS measure revealed no significant difference between the two studied subgroups.
Conclusions:
A high rate of ADHD symptoms was noted in ASD in comparison with the general population. In ASD with ADHD, inattention was the most commonly reported symptom. The clinical presentation in ASD with ADHD is characterized by lower cognitive ability and more anxiety symptoms; however autism severity is not affected. In light of the negative effects of ADHD on the clinical presentation, it is highly important to diagnose and treat ADHD in ASD.

114 **124.114** Autistic Traits in Women with Primary Dysmenorrhea

*H. Toy[1], A. Hergüner[2], S. Simsek[1] and **S. Herguner**[1], (1)Meram Faculty of Medicine, NE University, Konya, Turkey, (2)Konya Research and Training Hospital, Konya, Turkey*

Background: Recent studies showed that women with ASD had higher rates of androgen related conditions, including delayed menarche age, irregular menstrual cycle, delayed menarche age, unusually painful periods, and excessive menstrual bleeding. Previously, we found elevated levels of autistic traits in females with polycystic ovary syndrome. Objectives: In this study, we investigated the autistic traits in female university students with primary dysmenorrhea (PD). Methods: The Autism Spectrum Quotient (AQ) was used to measure autistic traits and Brief Symptom Inventory (BSI) for evaluating anxiety and depression levels. The dysmenorrheal pain was measured in each individual by a Visual Analogue Scale (VAS), coded from 0-10. Seventy women with PD (VAS >6) and 70 with no PD (VAS <3) enrolled into the study. Results: There were no differences between groups in terms of age, duration of education and marital status. Women with PD had higher AQ Total and AQ Attention Switching scores than subjects without PD. Pearson analysis revealed that AQ Total and AQ Attention Switching scores were correlated with VAS, after controlling for anxiety and depression. According to the linear regression, VAS was predicted by AQ Attention Switching subscale. Conclusions: Our findings showed that women with PD had more autistic traits than age-matched women who reported no PD. These findings suggest that there may be a common mechanism between dysmenorrhea and autistic traits.

115 **124.115** Biophysiology and Standardized Measures of Anxiety in Adolescents with ASD

***R. B. Grossman**, J. Mertens, E. Zane and K. Neumeyer, Emerson College, Boston, MA*

Background:
Current estimates place the comorbidity of anxiety and autism spectrum disorder (ASD) between 11% and as high as 84% (White et al. 2009). Comorbid anxiety may compound difficulties in social relatedness inherent in ASD and lead to further isolation and social awkwardness (Myles et al. 2001). But the relationship between biophysiologic markers of anxiety, children's self-reported anxiety levels, and parental perceptions of their child's anxiety levels is poorly understood. Current data indicate both a difference in parent- and self-reported anxiety levels of children with ASD (Steensel, et al. 2012), and an unclear relationship between social stressors and biophysiologic signs of arousal (Levine et al., 2012).
Objectives:
To analyze biophysiologic markers of arousal in response to the Trier Social Stress Test (TSST, Kirschbaum et al. 1993), as well as the relationship between parent- and child-reported anxiety levels in children with and without ASD.
Methods:
Participants were 12 children with ASD and 28 TD children, matched for age (mean 13:6, range 10:8-17:9), sex, IQ, and language ability. All participants completed the Brief Fear of Negative Evaluation Straightforward Items questionnaire (BFNE, Carleton et al. 2006) and parents and children completed the Screen for Child Anxiety Related Emotional Disorders (SCARED, Birmaher et al. 1999).
The TSST involves two tasks: A story telling activity, where participants must prepare and then present an imaginative narrative based on a short story fragment, and a math task, requiring sequential subtraction of 13 from 1,022. Participants must complete both tasks in front of a panel of non-responsive judges and are told that their performance will be assessed and compared to the performance of all other children who have participated in this task. We used a Biopac system to record electrodermal activity and extracted the number of skin conductivity responses during each of the TSST tasks as well as a low-anxiety baseline.
Results:
Preliminary analysis of 6 participant in each diagnostic cohort shows significantly higher rates of skin conductivity responses indicating heightened anxiety levels in both groups during the story and math sections of the TSST as compared to baseline ($p < 0.05$ for all comparisons) and no significant between-group differences for any of the measured activities.
Analysis of the standardized measures revealed no significant between-group differences in reported anxiety for the BFNE or the SCARED. However, within-group correlations revealed significantly greater agreement between scores on the parent and child forms of the SCARED in the ASD compared to the TD group ($p = 0.015$)
Conclusions:
The lack of between-group differences on standardized tests of anxiety and biophysiologic measures suggests that children with high-functioning autism respond comparably to their TD peers when asked to perform in a socially stressful environment. Interestingly, parents of children with ASD appear to be more aware of their children's anxiety levels, as indicated by high correlations between parent and child SCARED scores, while parents of TD children – who presumably spend less time worrying about their children's ability to function in a social context – tend to over- or under-estimate their children's anxiety levels.

116 **124.116** Bone Accrual in Boys with Autism Spectrum Disorder

***A. Neumeyer**[1], N. Cano Sokoloff[2], E. McDonnell[3], E. A. Macklin[4], C. McDougle[2] and M. Misra[5], (1)Lurie Center for Autism Massachusetts General Hospital, Lexington, MA, (2)Pediatrics, Massachusetts General Hospital, Lexington, MA, (3)Massachusetts General Hospital Biostatistics Center, Boston, MA, (4)Biostatistics Center, Massachusetts General Hospital, Boston, MA, (5)Pediatric Endocrinology, Massachusetts General Hospital/ Harvard Medical School/ Harvard Medical School, Boston, MA*

Background: In children with Autism Spectrum Disorder (ASD), bone mineral density (BMD) and cortical thickness are reported to be lower than in typically developing controls (TDC) in cross-sectional studies.
Objectives: Our objective was to prospectively assess bone accrual over a four-year period in adolescent males with ASD compared to TDC during the critical adolescent years when bone accrual rates are at their highest.
Methods: 36 males (19 ASD, 17 TDC) were enrolled at study initiation. Over four years, eleven participants (5 ASD, 6 TDC) were lost to follow-up. Thirteen participants (6 ASD, 7 TDC) were subsequently added for the follow-up visit to total 25 ASD, 24 TDC, (10.8± 1.7y and 11.7± 1.9y respectively). BMD was measured at the hip and lumbar spine using dual-energy X-ray absorptiometry (DXA) in 2011 and 2015. In 2015, whole body BMD was also measured for returning and new participants. BMD Z-scores were calculated using Hologic pediatric databases. We collected the medical history, activity questionnaires, food records, and fasting calcium, phosphorus, and 25(OH) vitamin D levels. Bone accrual rates were calculated for 14 ASD (10.8± 1.7y at baseline and 14.71± 1.7y at follow up) and 11 TDC (11.2± 1.5y at baseline and 15.2± 1.6y at follow up) who participated at both time points. Data are represented as mean (SE).
Results: Tanner stage, BMI z-scores, height z-scores and, serum vitamin D and calcium did not differ between groups at baseline and follow up. Boys with ASD had lower BMD Z scores than controls at (i) the lumbar spine at baseline [-1.01(0.23) vs. -0.14(0.24), $P < 0.009$] and follow-up [-1.16(0.31) vs. -0.17(0.35), $P < 0.04$], (ii) the total hip at baseline [-0.69(0.28) vs. 0.04(0.23), $P < 0.025$] and follow-up [-1.27(0.32) vs. -0.18(0.36), $P <0.027$] and (iii) femoral neck at baseline [-1.57(0.18) vs -0.51(0.18), $P <0.001$] and follow-up [-1.52(0.29) vs. -0.32(0.33), $P < 0.009$], and for the whole body less head at the follow-up visit [-1.25(95% CI -1.68, -0.82) vs. -0.48(95% CI -0.91, -006)]. Bone accrual rates did not differ between ASD and TDC at any site. Vitamin D intake from food was lower in ASD vs. TDC at baseline [5.09(0.99) vs. 9.27(1.01) mcg/day, $P < 0.006$], but not at follow-up. Calcium intake at baseline and follow-up did not differ between groups. In addition, a lower proportion of ASD vs. TDC were categorized as being "very physically active" at both baseline (16% vs. 75%, $P < 0.001$) and follow-up (14.7% vs. 74.8%, $P < 0.01$).
Conclusions: This is the first study to prospectively examine BMD in adolescent boys with ASD compared with controls. Participants with ASD continued to have lower BMD during adolescence compared to controls, but bone accrual (change in BMD over time) did not differ between groups. Further studies are needed to (i) evaluate the long-term consequences of decreased BMD in ASD, (ii) evaluate BMD in females and adults with ASD, and (iii) assess the effect of interventions to improve BMD in individuals with ASD.

117 **124.117** Cardiac Autonomic Measures during Baseline Resting Conditions in Autism Spectrum Disorders: Two Meta-Analyses

***L. Verhoeven**[1], H. M. Geurts[2,3] and I. Smeekens[1,4,5], (1)Dr. Leo Kannerhuis, Doorwerth, Netherlands, (2)Dutch Autism & ADHD research center (d'Arc) Dept of Psychology,*

Brain and Cognition, University of Amsterdam; Dr. Leo Kannerhuis, Amsterdam, Netherlands, (3)Dept. of Research, Development & Innovation, Dr. Leo Kannerhuis, Doorwerth, Netherlands, (4)Donders Institute for Brain, Cognition and Behaviour, Radboud University Medical Centre, Nijmegen, Netherlands, (5)Karakter, Child and Adolescent Psychiatry University Centre, Nijmegen, Netherlands

Background: Cardiac autonomic markers such as heart rate (HR) and heart rate variability (HRV) are increasingly being related to behavioral characteristics of autism spectrum disorder (ASD). Theories such as the neurovisceral integration model (Thayer & Lane, 2000) and the polyvagel theory (Porges, 2001, 2007) also relate cardiac autonomic functioning to appropriate social and environmentally adjusted behavior. Two recent reviews (Benevides & Lane, 2015; Klusek, Roberts & Losh, 2015) have provided qualitative descriptions of research findings so far regarding baseline levels of cardiac autonomic functioning as well as cardiac autonomic reactivity to different kinds of tasks in individuals with ASD. In general, they report mixed results regarding baseline functioning and some evidence for altered cardiac autonomic reactivity to tasks. Unfortunately quantitative analyses, such as meta-analyses, are lacking.
Objectives: The aim of the present review was to improve current knowledge on cardiac autonomic functioning in baseline conditions among individuals (all ages) with ASD by means of meta-analyses.
Methods: Two meta-analyses were conducted to investigate whether individuals with ASD differ from typically developing individuals regarding their baseline levels of heart rate (meta-analysis 1) and heart rate variability (meta-analysis 2). For this purpose, systematic searches were conducted among the databases of PsychINFO, Web of Science and PubMed for the period 1990 - august 2015.
Results: Regarding HR, ten studies could be included with a total sample size of 339 ASD participants and 291 control participants. For HRV, 15 studies were included with a total sample size of 537 ASD participants and 410 control participants. Results of the meta-analyses revealed that individuals with ASD have higher heart rate (g = 0.68) and lower HRV (g = -0.46) in baseline conditions than typically developing individuals without ASD, irrespective of age and intellectual functioning. While the heart rate findings seem very robust, the heterogeneity with respect to the studies focusing on HRV was large. This implies that the HRV findings need to be interpreted cautiously.
Conclusions: The present results of heightened HR and lowered HRV in baseline conditions among individuals with ASD provide a theoretical basis for the lack of adaptation and unresponsiveness to environmental challenges frequently encountered in individuals with ASD, for example in social situations. This theoretical basis relies on the described assumptions of the neurovisceral integration model and polyvagel theory that cardiac autonomic functioning is related to appropriate social and environmentally adjusted behavior.

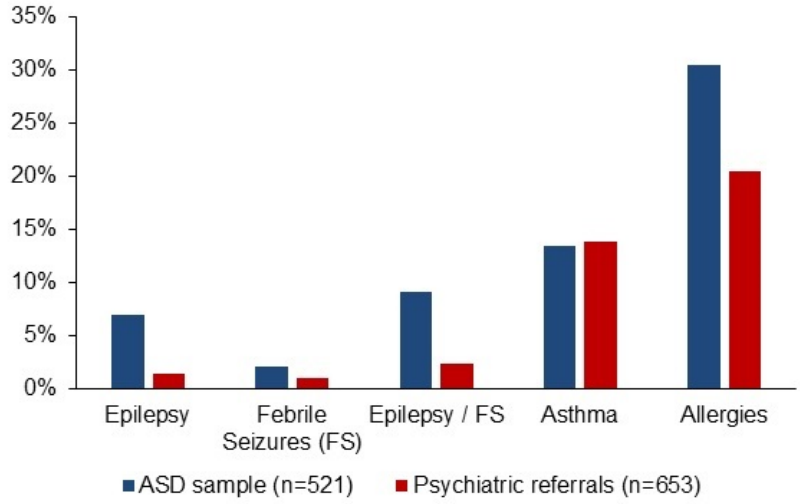
118 **124.118** Clinical Correlates for Seizure Disorder, Asthma, and Allergies in Youth with ASD Versus Psychiatric Referrals

K. D. Gadow *and R. J. Weber, Stony Brook University, Stony Brook, NY*

Background: In this study we sought to compare rates of three relatively common co-occurring medical conditions known to add to caregiver burden in a large group of children with autism spectrum disorder (ASD) and a comparison sample of non-ASD neuro-atypical psychiatric outpatient referrals. Such a comparison would address at least in part the question of whether the seemingly higher rates of these conditions was peculiar to ASD or more generally associated with CNS dysfunction. Equally important was the desire to determine if the clinical correlates of these medical conditions differed in these two groups of youth, which would suggest that the biologic substrates of neurobehavioral syndromes and co-occurring medical conditions interact to result in unique clinical presentations.
Objectives: To examine comparative rates of seizure disorder, asthma, and allergy in youth with ASD versus typically developing peers and their association with clinical correlates and other types of psychopathology.
Methods: This study examined the rates of these conditions in a large sample of consecutively referred youth with ASD (n=521) and an equally large sample of youth referred for psychiatric outpatient evaluation (n=653). Caregivers completed a developmental history questionnaire (parents) and a well-validated psychiatric symptom severity and impairment rating scale (parents, teachers).
Results: Rates of seizure disorder and allergies, but not asthma, were significantly higher in the ASD group than psychiatric referrals (Figure 1, Panel A), and this was also case when the groups were limited to children (6-12 years) with IQs ≥70 (Figure 1, Panel B). In the total sample, approximately one fourth (23%) of youth with ASD with either allergies or asthma had both disorders, and the rate of co-occurrence was higher for the comparison group (33%) (Figure 2). Within each diagnostic group, there were no differences in ASD severity between children with or without epilepsy, asthma, or allergy; however, there were significant interactions for epilepsy (repetitive behaviors) and asthma (communication). In the ASD sample, children with epilepsy had more severe schizophrenia symptoms, and psychiatric referrals with allergy had more anxiety and depression symptoms (parent's ratings) but *less*severe aggression (teachers' ratings). Epilepsy and asthma associations with treatment (i.e., psychotropic medication, special education) were unique to ASD; youth with ASD and epilepsy were more likely be receiving these treatments than ASD youth without epilepsy, though for non-ASD youth treatment did not differ for those with and without epilepsy. In the ASD sample, youth with asthma less often received special education, but no such association was present in non-ASD psychiatric referrals.
Conclusions: Compared with a heterogeneous group of non-ASD neuro-atypicals, youth with ASD are at differentially greater risk for seizure disorder and allergy. Furthermore, youth with ASD with and without seizure disorder, asthma, or epilepsy evidence a different pattern of associations with clinically relevant (e.g., psychiatric symptoms) and ecologically valid variables (e.g., treatment), and these relations vary depending on the type of co-occurring illness, all of which underscores the value of considering the notion of unique clinical presentations within neurodevelopmental disorders for furthering our understanding of nosology.

Figure 1: Distribution of epilepsy, febrile seizures, asthma, and allergies in youth with ASD and non-ASD outpatient psychiatric referrals.

Panel A: Full sample.



Panel B: Sub-sample, all 6-12 years old with IQ ≥ 70.

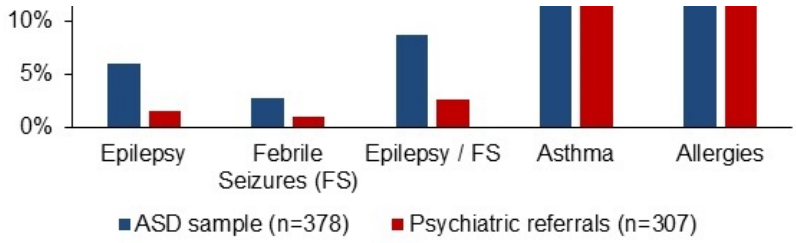
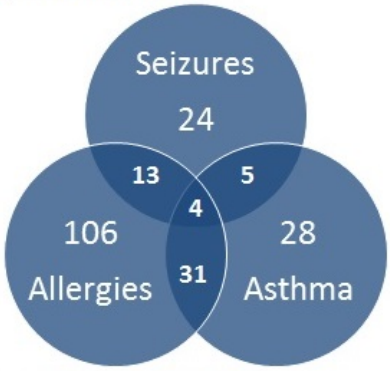
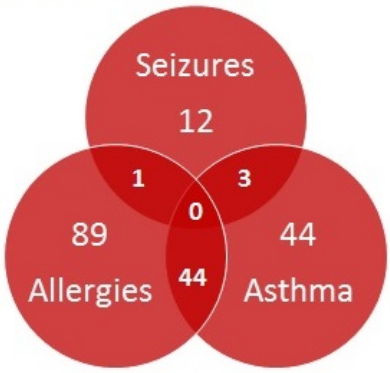


Figure 2: Co-occurrence of seizure disorder, allergies, and asthma in youth with ASD and outpatient psychiatric referrals.

Panel A: ASD sample. Affected n=211.



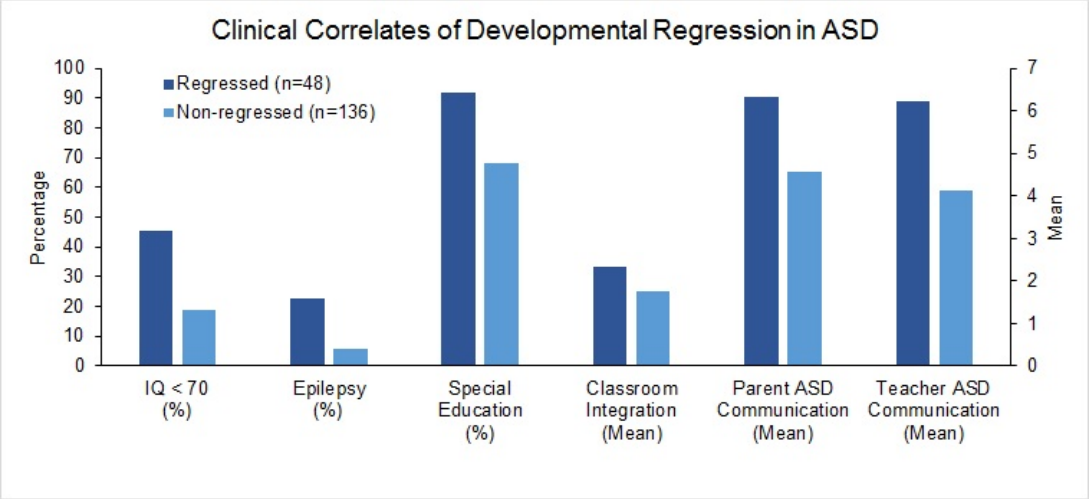
Panel B: Psychiatric referrals. Affected n=193.



119 **124.119** Parent-Reported Developmental Regression in Autism Spectrum Disorder: Epilepsy, Intellectual Disability, Schizophrenia Symptoms, and Special Education

R. J. Weber, *E. Kang, T. Rosen, G. Perlman and K. D. Gadow, Stony Brook University, Stony Brook, NY*

Background: A minority of youth with autism spectrum disorder (ASD) are reported to experience loss of pre-acquired skills during the preschool years. A recent meta-analysis puts the rate of developmental regression at 32% with a mean onset of 1.78 years (Barger, Campbell, & McDonough, 2013). Among the most consistent findings characterizing this ASD subgroup are greater severity of intellectual and ASD symptoms relative to non-regressed peers. However, little research has addressed the association of non-ASD DSM-defined psychiatric comorbidity with developmental regression, plausible particularly as it pertains to schizophrenia spectrum disorder symptoms (SSD) given preliminary evidence supporting a clinically relevant sub-group within the broader ASD phenotype (Gadow & DeVincent, 2012).
Objectives: 1. To determine whether a brief parent report of developmental regression provides clinically helpful information about youth who are referred for evaluation in a developmental disabilities outpatient clinic. 2. To examine the association of SSD with developmental regression and explore associations with specific symptoms.
Methods: Case records for consecutive referrals to a university hospital developmental disabilities clinic were screened for children between 6 and 18 years old at time of evaluation diagnosed with ASD. Caregivers completed ratings of psychiatric symptoms (parents, teachers) and a background history questionnaire (parents). Separate chi-square tests (categorical variables), *t* tests (continuous variables), and Mann-Whitney *U*tests (ordinal variables) data were conducted to examine group differences.
Results: Parents of 48 youth indicated that their child had experienced developmental regression in communication and/or social skills by the age of 36 months; parents of 136 youth reported that their child had not experienced regression. The developmentally regressed group were more likely to have intellectual disability; more severe ASD communication deficits; diagnosis of epilepsy; and to be receiving special education services and in more socially restrictive settings than non-regressed youth (see Figure). Youth in the regressed group were rated by parents as having significantly greater SSD symptom severity (t=2.41, p=.017); however, teachers' symptom severity ratings did not significantly differ between groups. The regressed group was also more likely to be impaired by SSD symptoms according to both parents' (χ^2=7.66, p=.006) and teachers' ratings (χ^2=6.35, p=.012). Analyses of individual symptoms showed that parents' ratings for youth in the regressed group were significantly greater than the non-regressed group for disorganized behavior (U=2420.0, p=.018) and avolition (U=2368.0, p=.012).
Conclusions: The findings support the clinical utility of asking parents about their child's early developmental history during initial diagnostic evaluations, specifically perception of developmental regression, as a history of regression indicates increased risk for a more impacted clinical course (e.g., intellectual disability, epilepsy, ASD communication deficits, special education, and social exclusion in special services), and owing to its typical age of onset, may be of value in procurement of early intervention. Youth with regression were more likely to experience greater severity of and impairment from SSD symptoms than youth without regression, specifically disorganized behavior and negative symptoms. It is noteworthy that these symptoms, as is the case with developmental regression, correlate with ASD symptom severity whereas positive symptoms and disorganized thinking do not (Gadow, 2013).



120 **124.120** Continuity, Change and Predictors of Anxiety Symptoms in a Community Sample of Children and Youth with ASD: A Prospective Follow-up Study

*E. J. Teh, G. Tan and **I. Magiati**, Department of Psychology, National University of Singapore, Singapore, Singapore*

Background: Many individuals with ASD experience high rates of anxiety, but mixed findings have so far been reported in the literature regarding anxiety's relationship with other individual characteristics (i.e. age, gender, cognitive and adaptive functioning, ASD symptomatology). Few studies have examined whether the relationship between ASD and anxiety symptoms may be "fractionable", that is whether ASD social/communication or stereotyped behavioural symptoms may be differentially associated with anxiety. Furthermore, most existing studies have been cross-sectional and continuity and change in anxiety symptoms in prospective study designs has not yet been sufficiently explored.
Objectives: (i) to examine continuity and change in caregiver reported anxiety symptoms of young people with ASD; (ii) to examine the predictive value of earlier child characteristics in explaining and predicting anxiety 12-18 months later, considering the two domains of ASD symptomatology independently; and (iii) to explore whether the relationship between anxiety and ASD symptomatology is uni- or bi-directional.
Methods: Participants were caregivers of 54 children and youth aged 6 to 17 years (88.9% males) with a clinical diagnosis of ASD, Asperger's syndrome or PDD-NOS recruited from special schools in Singapore. Data was collected on adaptive functioning, anxiety symptoms (using the Spence Children's Anxiety Scale- Parent Version; SCAS-P) and other emotional or behavioural problems at Time 1 and then 12-18 months later. 241 children participated in the study at Time 1 (Magiati et al., 2015), of whom 164 agreed to be contacted at follow-up and fifty-four (33% response rate) completed the measures at Time 2. Hierarchical regression analyses examined the incremental predictive value of earlier child variables (age, gender, adaptive functioning, autism symptoms and Time 1 anxiety) on Time 2 anxiety symptoms.
Results: Mean total and subscale anxiety rates were generally stable from Time 1 to Time 2, except for social anxiety symptoms, which significantly increased over time. Age, adaptive functioning and earlier repetitive/stereotyped behaviors, but not earlier social/communication ASD symptoms, were significant predictors of later total anxiety scores. However, when Time 1 anxiety was included as a covariate, the variance in Time 2 anxiety scores was fully explained by earlier total anxiety scores. The same pattern of findings was found for generalized anxiety, panic/agoraphobia and obsessive-compulsive SCAS-P subscale scores. Only for separation anxiety symptoms did earlier stereotyped behavioral ASD symptoms significantly predict later separation anxiety over and above baseline separation anxiety scores and all other child factors examined. Time 1 anxiety scores, however, did not predict Time 2 stereotyped ASD symptoms, suggesting the relationship may be unidirectional.
Conclusions: Anxiety symptoms in young people with ASD remain generally stable over time without intervention, while social anxiety increases. Only Time 1 ASD repetitive behavior, but not social/communication, symptoms predicted anxiety one year later, after age and adaptive functioning were controlled for. However, this relationship was fully explained by earlier anxiety scores predicting later anxiety scores, with the exception of separation anxiety. Given our small sample size and exclusive use of caregiver-report measures, we recommend replication with larger samples and use of multiple-informant measures to validate and extend our preliminary findings.

121 **124.121** Decreased Immune Regulation in Children with ASD Who Experience GI Symptoms

***D. Rose**[1], M. Careaga[2], H. Yang[3], H. Hughes[3], J. Van de Water[4], A. Fasano[5] and P. Ashwood[6], (1)UC Davis M.I.N.D. Institute, Sacramento, CA, (2)UC Davis/MIND Institute, Sacramento, CA, (3)UCD MIND Institute, Sacramento, CA, (4)University of California at Davis MIND Institute, Davis, CA, (5)Pediatrics, MassGeneral Hospital for Children, Charlestown, MA, (6)UC Davis, Sacramento, CA*

Background: Multiple studies have reported increased prevalence of gastrointestinal (GI) symptoms in children with autism spectrum disorders (ASD) and one recent study estimated that children with ASD are 6 to 8 times more likely to have persistent GI symptoms including: diarrhea, constipation, alternating bowel habits, gassiness or bloating, vomiting and abdominal pain have been reported in numerous studies. In addition, intestinal and peripheral inflammation, altered microbiome profiles, and impaired intestinal permeability have been observed in children with ASD who experience GI symptoms.
Objectives: To assess immune dysfunction and relationship to behavior in children with ASD with and without GI co-morbidities.
Methods: Over a hundred children participated in our study and were placed into one of four study groups based on responses from two questionnaires: children with ASD who experience GI symptoms of irregular bowel habits (ASD^{GI}) and children with ASD who do not have a history of GI symptoms (ASD^{NOGI}) compared to typically developing children with GI symptoms (TD^{GI}) and typically developing children without a history of GI symptoms (TD^{NOGI}). Peripheral blood mononuclear cells (PBMC) were isolated from participant's blood, stimulated *in-vitro* for 24 hrs and supernatants were assessed for cytokine production via Luminex multiplex assays. Behavioral assessments and diagnosis were performed by trained clinicians.
Results: Our data show children in the ASD^{NOGI} group demonstrated elevated innate immune responses, including increased levels of IL-1α, IL-1β and TNFα after stimulation with Toll-Like receptor (TLR)-4 ligands compared to TD^{NOGI} controls. The ASD^{GI} group produced increased levels of the mucosal relevant cytokines IL-5, IL-15 and IL-17 compared to ASD^{NOGI} following TLR-4 stimulation. The production of the regulatory cytokine TGFb1 was decreased in all stimulatory conditions in children with ASD^{GI} compared with children in either ASD^{NOGI} or TD^{NOGI} groups. While diagnostic scores from the ADOS were not different between ASD groups we did find that children in the ASD^{GI} group have worse scores on the Aberrant Behaviors Checklist (ABC) subscales in: Irritability, Hyperactivity and Social Withdrawal. We also report finding positive correlations between TLR-4 stimulated innate cytokines IL-1 α, IL-1β and TNFα and worsening behavioral scores on the ABC.
Conclusions: While immune responses in children with ASD and GI symptoms were generally similar to children with ASD without GI symptoms, we did find evidence of reduced regulatory cytokines and increased mucosal related cytokines in the ASD^{GI} group that may suggest that children with ASD and GI symptoms have a unique imbalance between regulatory and inflammatory pathways.

122 **124.122** Descriptive Study of Individuals with Pitt-Hopkins Syndrome (PTHS)

***K. C. Guest**[1], S. E. O'Kelley[1], E. Rahn[2], K. D. Krubinski[1], B. A. Modi[1], A. Kennedy[2] and D. Sweatt[2], (1)Psychology, University of Alabama at Birmingham, Birmingham, AL, (2)Neurobiology, University of Alabama at Birmingham, Birmingham, AL*

Background: Limited clinical studies of individuals with PTHS have shown developmental delay and severe intellectual disability, motor difficulties (delayed or not walking), and autistic symptoms (Sweatt, 2013; Van Balkom et al., 2012). PTHS is caused by disruption (mutation or deletion) of transcription factor 4 (TFC4, located on chromosome 18). Haploinsufficiency, or inheriting only one working copy of TCF4 causes PTHS. Approximately, 200-300 documented cases of PTHS exist worldwide. Though characterized as an 'atypical' ASD, individuals with PTHS demonstrate a number of symptoms similar to those diagnosed with autism including: difficulties in pretend play, social interactions, verbal and nonverbal communication; sensitivity to sensory information; and behavioral problems like aggression and tantrums. The current study focuses on presenting preliminary descriptive information of individuals with PTHS within a well-defined genetic sample.
Objectives: The purpose of the research is to describe 10 individuals with PTHS living in the US participating in the current study. Specifically, information on the child's age, diagnosis/diagnoses, gender, race and ethnicity, loss of skills, intervention and education history, displays of aggression and tantrums, as well as family history of ASD and maternal/paternal education levels will be explored.
Methods: Parents of individuals with PTHS interested in participating completed a comprehensive demographic interview by telephone. Currently, 26 families have enrolled in the study and preliminary data are presented on the 10 families that have completed the study to date.

Results: The study contains 6 males and 4 females who had been diagnosed with PTHS. The average age of the individuals at the time of their initial demographic interview was 5.85 years with a range of 2.0-17.33 years. The majority of the participants were Caucasian (90%) and Non-Hispanic/Latino (80%). In addition to a PTHS diagnosis, many children were also diagnosed with Developmental Delay (80%), Speech Language Disorder (80%), Intellectual Disability (50%), Learning Disability (50%), and Epilepsy (40%). Only one child was co-diagnosed with ASD. Only three individuals had a reported loss of language skills at some point during development. All of the individuals with PTHS were currently receiving speech therapy, occupational therapy, and were either receiving, or had received, Early Intervention services in the past. Almost all (90%) were receiving physical therapy services. A low frequency of aggression to adults (20%), aggression to peers (30%), and no aggression to strangers were reported. However, a majority (60%) of individuals were reported to display temper tantrums ranging in frequency from 1 time per day to 2-3 times per week. Mothers and fathers in the sample were well-educated. None of the fathers of individuals with PTHS and only one of the mothers reported a family history of ASD.
Conclusions: Since PTHS is so rare, it is vitally important that researchers and clinicians understand the descriptive information of individuals with this syndrome in more detail in order to differentiate the clinical presentation from that of other developmental disabilities and to guide more informed recommendations for intervention.

123 **124.123** Determinants of the SLEEP and Eating Problems in NEWLY-Diagnosed Preschool Children with Autism Spectrum Disorder

A. Bilgic *and S. Herguner, NE University, Konya, Turkey*

Background: Children with autism spectrum disorder (ASD) are known to suffer from significantly more sleep and eating problems than typically developing children, but less is known about the determinants of these problems especially in early ages.
Objectives: This study evaluated the relationships of severity of ASD, behavioral problems, sensory hypersensitivity, and parental psychiatric symptoms to severity of sleep and eating problems in preschool children with ASD.
Methods: The sample consisted of 46 newly-diagnosed children with ASD aged 21–63 months. The ADI-R was used to measure the severity of ASD and parents reports on a range
of scales were collected.
Results: According to regression analyses, there were regression relationships between lower ADI-R communication scores and more sensory processing impairment in movement area to
higher emotional overeating scores, higher maternal somatization scores to higher food responsiveness scores, more sensory processing impairment in taste/smell area to lower
enjoyment of food and higher satiety responsiveness scores, more sensory processing impairment in visual area to higher slowness in eating scores, and higher paternal hostility and child irritability scores to higher emotional undereating scores. Regarding to eating problems, a positive association between streotypic behavior and sleep problems in these children was observed.
Conclusions: Findings of this study suggest that a variety of variables such as severity of ASD, coexisting behavioral problems, sensory hypersensitivity, and parental pscyhiatric status may have an impact on child eating behaviors in preschool children with ASD. However, only streotypic behaviors showed a relationship with sleep problems in these children.

124 **124.124** Development of the Anxiety Scale for Children – ASD (ASC-ASD)

J. Rodgers[1]*, S. Wigham*[2]*, H. McConachie*[3]*, M. H. Freeston*[4]*, E. Honey*[5] *and J. R. Parr*[6]*, (1)Newcastle University, Newcastle Upon Tyne, United Kingdom, (2)Newcastle University, Newcastle upon Tyne, NE1 4LP, United Kingdom of Great Britain and Northern Ireland, (3)Institute of Health and Society, Newcastle University, Newcastle upon Tyne, United Kingdom, (4)Psychology, Newcastle University, Newcastle, United Kingdom, (5)CNDS, Northumbria Tyne and Wear NHS Foundation Trust, Newcastle Upon Tyne, United Kingdom, (6)Institute of Health and Society, Newcastle University, Newcastle Upon Tyne, United Kingdom*

Background: Many children with ASD experience high levels of anxiety. There is a lack of suitable anxiety measures for people with ASD. Most measures have not been developed for this population. It is now generally accepted that existing anxiety measures may require adaptation to more accurately capture the varied manifestations of anxiety often associated with ASD, including anxiety related to sensory hypersensitivity, intolerance of uncertainty and ASD-specific phobias. A widely used, well validated measure of anxiety for typically developing children is the Revised Child Anxiety and Depression Scale (RCADS).
Objectives: (i) to modify the RCADS to include items related to uncertainty, sensory anxiety and phobias; (ii) to investigate the factor structure, reliability and validity of the adapted measure with a representative sample of children and parents.
Methods: Participants were 177 children with ASD and no intellectual disability, aged 8-16 years (mean 11.1, SD=2.1) years, and their parents, recruited from a representative national research database (ASD-UK).The RCADS is a 47-item measure of anxiety and depression with six subscales: panic, separation anxiety, Obsessive Compulsive Disorder (OCD), generalised anxiety disorder (GAD), social phobia and depression. An adapted version of the RCADS was created with the addition of items relating to sensory anxiety, intolerance of uncertainty and phobias. Content validity was refined during focus groups with parents. Children completed the child version of the adapted measure and the Screen for Anxiety and Related Emotional Disorders (SCARED). Parents completed parental-report versions of the adapted measure, the SCARED and the Repetitive Behaviour Questionnaire (RBQ), Short Sensory Profile (SSP), the Strengths and Difficulties Questionnaire (SDQ), and the Child Depression Inventory (CDI-2). Parents and children completed the new measure again one month after initial administration.
Results: The original RCADS anxiety items were analysed to determine whether the original factor structure was replicated. OCD items did not load on a distinct factor and were excluded from further analyses. The remaining 41 RCADS anxiety items were combined with the new items and further factor analyses undertaken. Items with factor loadings <.5 were excluded. Twenty four items loaded on four factors in both child- and parent- report versions: Performance Anxiety, Anxious Arousal, Separation Anxiety, and Uncertainty, forming the new measure the Anxiety Scale for Children- ASD (ASC-ASD). Internal consistency of the ASC-ASD subscales and total scores was excellent (Cronbach's alphas ranging from .85 to .94). One month test-retest reliability was excellent for both versions (r = .84 and r =.82). Convergent validity was demonstrated with significant correlations between the ASC-ASD and SCARED, SSP, RBQ and the emotion subscale of the SDQ. Correlations with the CDI were significant, but weaker, demonstrating divergent validity.
Conclusions: Results provide evidence for the need to adapt anxiety measures for young people with ASD and support emerging evidence for the importance of uncertainty in the presentation of anxiety in ASD. The ASC-ASD is one of the first reliable and valid ASD specific anxiety measures which captures aspects of anxiety relevant to ASD that are absent in other measures; replication and extension is required in novel samples.

125 **124.125** Does the Collaborative and Proactive Solutions Model Explain Aggressive Behavior in Children with Autism Spectrum Disorder without Intellectual Disability?

P. Cleary[1]*, B. B. Maddox*[2]*, E. S. Kuschner*[1]*, L. R. Guy*[3]*, R. T. Schultz*[4]*, J. Miller*[2] *and B. E. Yerys*[5]*, (1)Children's Hospital of Philadelphia, Philadelphia, PA, (2)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (3)TEACCH Autism Program, University of North Carolina at Chapel Hill, Greensboro, NC, (4)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (5)The Center for Autism Research, Philadelphia, PA*

Background:
Aggression in children with autism spectrum disorder (ASD) is common, with 68% showing aggression toward family members and 49% toward non-family members at some point during their lifetime. Importantly, IQ is not correlated with aggression, highlighting that children with ASD without an intellectual disability (ID) exhibit high levels of aggression. This is a significant problem as aggressive behavior requires higher levels of psychiatric care and places both the aggressor and their target at risk for physical injury. In school-age children without ASD or ID, there is an evidence-based cognitive behavioral treatment for aggression – Collaborative & Proactive Solution (CPS) – that posits a model of five lagging skills that contribute to aggressive and challenging behaviors. This model specifies impairments in executive function (EF), language, emotion regulation (ER), cognitive flexibility, and social skills as contributors to aggression. No studies have looked at whether the CPS model explains aggression in school-age children with ASD without ID.
Objectives:
To evaluate the CPS model in school-age children with ASD without ID.
Methods:
A sample of 147 children with ASD participated in this study (Mean age=9 years, 2 months; Full-Scale IQ=101.37). ASD was diagnosed using DSM-IV criteria and confirmed with ADI-R/ADOS. All measures are parent-report. Aggression was quantified using the Behavioral Assessment System for Children, Second Edition (BASC-2) Aggression subscale. The EF domain included the Behavior Rating Inventory of Executive Function (BRIEF) Inhibition, Shifting, Working Memory, and Planning scales. The Language domain included the Vineland Adaptive Behavior Scales, 2nd Edition Receptive and Expressive Language scales. The ER domain included the BRIEF Emotional Control scale and the BASC-2 Anxiety and Depression scales . The Cognitive Flexibility domain included the Repetitive Behaviors Scale-Revised Compulsive, Ritual, and Sameness scales. The Social Skills domain included the BRIEF Monitor scale, BASC-2 Social Skills scale, and the Social Responsiveness Scale's Total score. We examined whether each domain successfully predicted aggression above and beyond age and IQ. We also examined the independent contribution of each domain, relative to the other four domains.
Results:
Children with ASD had a mean Aggression T-score of 52.22 (Range 35-97; SD=10.91), with 23.8% having scores in the borderline range (T>60) and 6.8% in the clinical range (T>70). Linear regressions showed that all CPS domains explained significant variance in aggression above age and IQ ($R^2\Delta$s=.09 to .39). The total CPS model explained almost half of the variance related to aggression (R^2=.473, *Adjusted* R^2=.402), and showed significance for unique variance in EF ($R^2\Delta$=.041) and ER ($R^2\Delta$=.147).

Within these two domains, the BRIEF Inhibit Scale and BASC-2 Depression Scale explained a significant amount of variance.
Conclusions:
This study shows that impairments in EF and ER domains relate to aggression in school-age children with ASD without ID. Our results validate the CPS model of aggression. Future studies should test whether the CPS treatment is effective for reducing aggression and challenging behaviors in children with ASD without ID.

126 **124.126** Early Life Influences and Child Weight Outcomes in the Study to Explore Early Development (SEED)

T. V. Kral[1], *J. L. Chittams*[2], *C. B. Bradley*[3], *J. L. Daniels*[4], *C. G. DiGuiseppi*[5], *S. L. Johnson*[6], *J. Pandey*[7], *J. A. Pinto-Martin*[8], *N. Rahai*[9], *A. Ramirez*[10], *L. A. Schieve*[11], *A. M. Thompson*[12], *W. Thompson*[11], *G. C. Windham*[13], *W. E. York*[14], *L. Young*[15] *and S. E. Levy*[7], *(1)University of Pennsylvania School of Nursing, Philadelphia, PA, (2)Biostatistics Consulting Unit, University of Pennsylvania School of Nursing, Philadelphia, PA, (3)Epidemiology, University of North Carolina at Chapel Hill, Chapel Hill, NC, (4)University of North Carolina, Chapel Hill, NC, (5)Epidemiology, University of Colorado - Denver, Aurora, CO, (6)University of Colorado Denver, Aurora, CO, (7)Children's Hospital of Philadelphia, Philadelphia, PA, (8)Biobehavioral Health Sciences, University of Pennsylvania School of Nursing, Philadelphia, PA, (9)Center for Public Health Initiatives, University of Pennsylvania, Philadelphia, PA, (10)Study to Explore Early Development, University of Pennsylvania School of Nursing, Philadelphia, PA, (11)National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention, Atlanta, GA, (12)Office of Nursing Research, University of Pennsylvania School of Nursing, Philadelphia, PA, (13)California Department of Public Health, Richmond, CA, (14)Nursing Research, University of Pennsylvania School of Nursing, Philadelphia, PA, (15)School of Nursing, PA-SEED, CADDRE, Philadelphia, PA*

Background: Maternal pre-pregnancy obesity, excess gestational weight gain, and rapid weight gain during early infancy have all been associated with an increased risk of childhood obesity in typically developing children. Given the high prevalence of overweight/obesity among children with Autism Spectrum Disorder (ASD), there is a pressing need to examine early life influences on child weight outcomes in this population.
Objectives: To examine the associations between 1) maternal pre-pregnancy weight status, 2) gestational weight gain, and 3) rapid weight gain during infancy and weight outcomes in children classified as ASD, developmental delay (DD), and general population controls (POP).
Methods: SEED is a multi-site case-control study of children, aged 3-5 years, who were classified as ASD (n=668), DD (n=914), or POP (n=884). Maternal weight outcomes were derived from a maternal interview; child weight outcomes were ascertained from medical records (birth to 6 months) and a dysmorphology exam (age 3-5 years). Maternal pre-pregnancy body mass index (BMI) was calculated as weight (kg) divided by height (m) squared. Maternal gestational weight gain was compared to the Institute of Medicine (IOM) guidelines for weight gain during pregnancy, and categorized as meeting or not meeting (above or below) the recommendations. Child age- and sex-specific weight and BMI percentiles and z-scores were calculated using the WHO Growth Charts (birth to 24 months) and the CDC Growth Charts 2000 (>24 months). Rapid weight gain was defined as a change in infant weight-for-age z-scores from birth to 6 months greater than 0.67 SDs.
Results: After adjusting for case status, mothers who were overweight/obese prior to pregnancy were 2.40 (95% CI: 1.98, 2.91) times more likely to have an overweight/obese child at ages 3-5 years as compared to mothers who were underweight/normal-weight prior to pregnancy (P<0.0001). Adherence to the gestational weight gain recommendations was a significant predictor of child weight status at ages 3-5 years (P=0.043). Mothers who exceeded the weight gain recommendations during pregnancy were 1.30 (95%CI: 1.06, 1.61) times more likely to have an overweight/obese child at ages 3-5 years as compared to mothers who met the weight gain recommendations (P=0.014). There also was a significant relationship between rapid weight gain during infancy and case status. Children in the ASD group showed the highest frequency of rapid weight gain (35.9%) when compared with children in the DD (31.0%) and POP (28.3%) groups (P=0.02). Among children with ASD, those with rapid weight gain during infancy showed a higher frequency of overweight/obesity at ages 3-5 years than those without (35.6% vs. 18.3%; P=0.0007).
Conclusions: The findings from this study suggest that maternal pre-pregnancy overweight/obesity and excess weight gain during pregnancy were significant risk factors for overweight/obesity in their children. Children with ASD experienced rapid weight gain during infancy with a greater frequency compared to children in the DD and POP groups, which may contribute to their higher weight status later in life. Subsequent analyses will parse out the independent and combined contributions of these maternal and child risk factors to childhood obesity while also controlling for possible confounders.

127 **124.127** Effect of Comorbid ADHD on IQ and Adaptive Behavior in Children with ASD: Implications for Outcomes and Treatment

C. Montiel-Nava[1,2], *Z. Gonzalez*[1], *J. A. Chacin*[3] *and L. Palacios-Cruz*[4], *(1)Psychology, La Universidad del Zulia, Maracaibo, Venezuela, (2)Center for Graduate Studies, Universidad Latina, Panama, Panama, (3)La Universidad del Zulia, Maracaibo, Venezuela, (4)National Institute of Psychiatry, Mexico DF, Mexico*

Background: The conceptualization of ASD as a comorbid disorder with ADHD has been surrounded by controversy. The paucity of studies that compare comorbid patterns in children with ASD has added to such debate, specifically in connection to ADHD. Several reports show moderate to high ADHD prevalence among children with ASD, identifying ADHD as the most common comorbidity for this group of children. A better understanding of the comorbidity between both entities should, therefore, give rise to an appropriate sequence of intervention goals.
Objectives: The aim of this study was to establish comorbidity rates of ADHD in Venezuelan children with ASD and to describe clinical phenomenology in both groups (ASD and ASD+ADHD) and the implications of the comorbidity for treatment decisions.
Methods: Diagnostic and demographic data for children between two and seven years of age were collected as part of an epidemiological study of autism in Venezuelan children. The assessment protocol included the Raven's Progressive Matrices Test and ADOS. Parents completed the VABS and ADI-R. Clinical manifestations of ADHD were evaluated using the Spanish version of the Conners' Parent Rating Scale – Revised (CPRS-R).
Results: The assessment was completed by 103 children, of whom 65% (n=67) were diagnosed with ASD, while 35% (n=36) met criteria for an additional diagnosis of ADHD. Among the comorbid cases, 23 (64 %) were of the combined subtype, 3 (8 %) predominantly inattentive, and 10 (28 %) predominantly hyperactive-impulsive. Diagnosis was found to have no main effect on the ASD symptoms' measures of communication (p=0.55), reciprocal social interaction (p=0.277), and play and stereotyped behaviors (p=0.112). Diagnosis had a main effect on IQ (p=0.04); children from the comorbid group scored lower (86.71) than those from the pure group (90.62). By contrast, diagnosis had no effect on the adaptive functioning measures: daily living skills (p=0.255), communication (p=0.109), and socialization (p=0.135).
Conclusions: The clinical presentation of ADHD in children with ASD has been found to be similar to the typical presentation of ADHD. This is of paramount relevance due to the availability of treatment. To date, there are few treatments for the core symptoms of ASD, while there is a wide scope of options for the treatment of ADHD. Thus, when a child presents with both diagnoses, the identification of ADHD offers more comprehensive treatment options, which impact adaptive functioning and quality of life. The results of this study reveal once again the heterogeneity of the clinical expression of ASD as a frequent phenomenon and not just the exception. Our results suggest that, in pediatric mental health settings, the condition of comorbidity is expected between ASD and ADHD. The data obtained do not support the idea of different clinical syndromes for ASD depending on the presence of an ADHD comorbid condition.

128 **124.128** Examining the Factor Structure of the Spence Children's Anxiety Scale – Parent Version in Children with Autism Spectrum Disorder

K. Jitlina[1], *B. Zumbo*[1], *P. Mirenda*[1], *P. Szatmari*[2], *S. E. Bryson*[3], *E. Fombonne*[4], *I. M. Smith*[5], *T. Vaillancourt*[6], *J. Volden*[7], *L. Zwaigenbaum*[8], *S. Georgiades*[9], *E. Duku*[9], *M. Elsabbagh*[10], *T. Bennett*[9] *and A. Thompson*[9], *(1)University of British Columbia, Vancouver, BC, Canada, (2)Centre for Addiction and Mental Health, Toronto, ON, Canada, (3)Dalhousie University, Halifax, NS, Canada, (4)Oregon Health & Science University, Portland, OR, (5)Dalhousie University / IWK Health Centre, Halifax, NS, Canada, (6)University of Ottawa, Ottawa, ON, Canada, (7)University of Alberta, University of Alberta, AB, Canada, (8)University of Alberta, Edmonton, AB, Canada, (9)McMaster University, Hamilton, ON, Canada, (10)McGill University, Montreal, PQ, Canada*

Background: Anxiety disorders are estimated to occur in approximately 40% of youth with ASD, and represent one of ASD's most highly comorbid psychopathologies (van Steensel et al. 2011). The assessment of anxiety in ASD is problematic because ASD-specific characteristics, such as social skill impairments and alexithymia, may alter the experience of anxiety in this population (Kerns & Kendall, 2012). Consequently, the appropriateness of anxiety assessment tools originally developed for typically developing children cannot be assumed in ASD. Research examining the psychometric properties of existing anxiety measures in ASD samples is emerging. Initial evidence for the reliability of the Spence Children's Anxiety Scale – Parent Report (SCAS-P; Spence, 1999) - a widely used anxiety rating scale - has been demonstrated in two samples of children with ASD (Magiati et al., 2015; Zainal et al., 2014). Support for a six correlated factor structure in the SCAS-P (separation anxiety, social phobia, generalized anxiety, panic attacks and agoraphobia, obsessive-compulsive disorder, physical injury fears) has been found in community and clinical samples (Arendt et al., 2014; Nauta et al., 2004). However, the SCAS-P's factor structure when used with children with ASD has not yet been examined.
Objectives: The purpose of this study was to examine the factor structure of the Spence Children's Anxiety Scale – Parent Report (SCAS-P) in children with ASD.
Methods: Data were drawn from the Canadian Pathways in ASD study (N=421) and included children whose parents who had completed all 38 items of the SCAS-P (n=167; 83.1% boys; mean age 7.74 years old [SD=.22]). All children had a diagnosis of ASD based on DSM-IV criteria and confirmed with ADI-R/ADOS. Confirmatory factor analysis (CFA) using robust weighted least squares estimation was used to examine the fit of the previously supported six-correlated factor model, and four other theoretically guided models (Arendt et al., 2014; Nauta et al., 2004). If the CFA did not result in model fit, principal axis factoring (PAF) using direct oblimin rotation was used to explore an alternative plausible structure. Parallel analysis guided factor selection.
Results: CFA suggested the model only partially met criteria (CFI=.888, TLI=.878, RMSEA=.040, [CI 90% .031-.048; Test of close fit p=.983], SRMR =.117). PAF suggested a six-factor solution best described the data, explaining a 48.3% of the variance. Four factors emerged: physical symptoms of autonomic arousal; panic, agoraphobia, and compulsive behaviors; social phobia; and separation anxiety. Two factors had mixed item groupings: the first was comprised of items relating to separation anxiety and physical symptoms; and the second contained items related to obsessions, compulsions, and generalized worries. Four items (13, 21, 23, 30) had small loadings <|.3| on all factors.
Conclusions: CFA on five SCAS-P factor structures previously suggested in community and clinical samples did not show a good fit in a small sample of children with ASD.

As a follow up, exploratory analyses resulted in an alternative six-factor solution, with four items not showing strong loadings onto any factors. The findings are discussed with regards to the nature and assessment of anxiety in ASD.

129 **124.129** Exploring Anxiety and Executive Function Among School-Aged Children with ASD

G. Greco[1] *and S. Faja*[2]*, (1)Boston Children's Hospital, Harvard Medical School, Boston, MA, (2)Boston Children's Hospital/Harvard Medical School, Boston, MA*

Background: The prevalence of anxiety in children with autism spectrum disorder (ASD) is higher than that of the general population. Previous research has found that between 22-84% of children with ASD are affected by at least one anxiety disorder (Vasa & Mazurek, 2015). Many individuals with ASD also exhibit significant difficulties with executive function (EF). To our knowledge, only two studies have investigated the connection between anxiety symptoms and EF in children with ASD, one of which included adolescents aged 14-16 years (Hollocks, et al. 2014) and the other used only parent report measures (Lawson, et al., 2015).
Objectives: The first objective was to determine whether diagnostic groups of school-aged children differed on a parent reported measure of children's anxiety. A second goal was to explore the relation between EF performance and anxiety symptoms in children ages 7-11 with ASD.
Methods: Participants included 28 children with ASD and 33 children with typical development (TD) all between 7-11 years of age. The groups were age, sex, and IQ-matched. Executive function was measured using parent report from the Behavioral Rating Inventory of Executive Function (BRIEF) and two computer-based tasks, the Change Task and Stroop Task. The Change Task included "Go" trials, which were a two-choice reaction time task, and "Change" trials, which added an additional stop signal that designated when children should stop and press a third button. During the Stroop Task, words were presented in pseudo-random order in red, green, yellow, and blue and children responded to the color the word was written in, even when the word introduced conflicting information (e.g., *blue* written in *red*). Anxiety was measured via parent report on the Child Behavior Checklist (CBCL).
Results: Groups differed significantly on scales of anxiety, $t(58) = 4.02$, $p < .001$, anxious depression, $t(58) = 3.29$, $p = .002$, and internalizing problems, $t(58) = 4.00$, $p < .001$, with parents of children with ASD reporting higher scores on all three measures. Within the ASD group, children with worse BRIEF shifting scores were rated as being more anxious, $r = .44$, $p = .02$. Stop signal reaction time, which indicates latency of inhibition, was correlated with CBCL subscales of anxiety, $r = .41$, $p = .05$, anxious depression, $r = .57$, $p = .004$, and internalizing problems, $r = .50$, $p = .01$. Lower inhibition on the Stroop Task was also correlated with higher reported anxiety symptoms, $r = -.48$, $p = .02$.
Conclusions: We found that children with ASD had significantly higher ratings of anxiety when compared to TD children, which supports previous research that individuals with autism are affected by comorbid anxiety. Additionally, within the group with ASD, measures of EF, specifically inhibition and shifting, were correlated with parent reported levels of child anxiety. This relationship may indicate that inhibition and shifting play a role in the behavioral functionality of individuals with ASD, which is exhibited as anxiety. We expect to have data for approximately 20 more children with ASD by May.

130 **124.130** Exploring Relationships Between Negative Cognitions and Anxiety Symptoms in Youth with Autism Spectrum Disorder

A. Keefer[1,2]*, N. L. Kreiser*[1,2]*, V. Singh*[1]*, A. Blakeley-Smith*[3]*, A. Duncan*[4]*, S. Hepburn*[5]*, C. Johnson*[6]*, L. G. Klinger*[7]*, A. T. Meyer*[8]*, J. Reaven*[9] *and R. A. Vasa*[1,2]*, (1)Kennedy Krieger Institute, Baltimore, MD, (2)School of Medicine, Johns Hopkins University, Baltimore, MD, (3)Univ. of Colo. Denver-JFK Partners, Aurora, CO, (4)Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (5)University of Colorado / JFK Partners, Aurora, CO, (6)Center for Autism and Related Disorders, Kennedy Krieger Institute, Baltimore, MD, (7)Psychiatry, University of North Carolina TEACCH Autism Program, Chapel Hill, NC, (8)University of North Carolina, Carrboro, NC, (9)Univ. of Colorado Denver-JFK Partners, Aurora, CO*

Background: Negative cognitions (NC) are central to the conceptualization and treatment of anxiety disorders in youth without ASD (Beck & Rush, 1985; Davis et al., 2011) and demonstrate relationships with anxiety symptoms, intolerance of uncertainty (IU), and worry (McEvoy et al., 2014). In ASD, meta- and socio-cognitive impairments raise questions about the role of NC in the phenotype of anxiety, and modified cognitive-behavioral interventions (MCBT) often place less emphasis on addressing NC. Yet, two recent studies found that youth with ASD reported more NC than anxious and non-anxious youth without ASD, and NC predicted severity of anxiety, depression, and disruptive behaviors (Farrugia et al., 2006; Ozsivadjian et al., 2013). These findings, coupled with data showing that about one third of youth with ASD do not respond to MCBT (Vasa et al., 2014), suggest that further research on the relationship between NC and anxiety is needed to guide interventions.
Objectives: The objectives of this study are: 1) To examine relationships between negative cognitions (NC) and anxiety symptoms, worry, and intolerance of uncertainty (IU) (Aim 1), and 2) To assess predictors of negative cognitions (NC) in youth with anxiety and ASD (Aim 2).
Methods: Forty-one children and adolescents with ASD, ages 8 to 14 years participated in the Face Your Fears MCBT group therapy program as part of a multi-site treatment study (Reaven et al., 2011). The diagnoses of ASD and anxiety were established using standardized instruments. NC were assessed using the Children's Automatic Thoughts Scale (CATS; Schniering & Rapee, 2002), a self-report measure comprised of four sub-categories: physical threat, social threat, personal failure, and hostile intent. Children also completed measures of IU (IUS-C), anxiety (SCARED), and worry (PSWQ-C) preceding the intervention. Spearman Rho correlations were conducted to examine Aim 1. Multiple linear regressions were run to examine Aim 2.
Results: Preliminary analyses indicated moderate to strong relationships between NC and anxiety symptoms (Total NC: $r = 0.56$, $p < 0.001$; NC sub-categories: $r = 0.33$ - 0.64, $p < 0.05$) and IU (Total NC, $r = 0.52$, $p < 0.001$; NC sub-categories $r = 0.34$ - 0.54, $p < 0.05$). All NC sub-categories ($r = 0.44$ - 0.51, $p < 0.05$) except hostile intent were associated with worry (Table 1) (Aim 1). Results of the regression analyses showed that anxiety and IU were each independently associated with NC (Table 2) (Aim 2). Age, gender, and IQ were not significant predictors of NC and were excluded from the model.
Conclusions: Results support previous literature indicating a relationship between NC and anxiety symptoms in ASD youth. New findings from this study show that IU and worry are associated with NC, implicating NC as a significant component of anxiety in youth with ASD. IU may be key in the development of NC and may be a treatment target. Further analysis of interaction effects to differentiate relationships between NC and anxiety associated variables will be pursued. Relationships between specific NC (i.e., item-level analysis) and anxiety disorders, IU, and worry will be investigated.

Table 1

Spearman Correlations between Negative Cognitions (Sub-category and Total), Anxiety, Worry, and IU

CATS categories	SCARED	PSWQ-C	IUS-C
Physical Threat	0.64**	0.51**	0.41*
Personal Failure	0.37*	0.47*	0.54**
Social Threat	0.48**	0.44*	0.45*
Hostile Intent	0.33*	0.07	0.34*
Total Score	0.56**	0.45*	0.52*

*p<0.05
**p<.001

Table 2

Multiple Regressions with Anxiety and IU Predicting Negative Cognitions Total Score

	Univariate Model		Multivariate Model	
	B	SE B	B	SE B
SCARED	0.99**	0.26	0.91*	0.27
IUS-C	0.76*	0.23	0.50*	0.22
R^2				0.42
F for change in R^2				<0.001

*p<.05
**p<.001

131 **124.131** Extreme/ 'Pathological' Demand Avoidance: An Examination of the Behavioural Features Using a Semi-Structured Interview

E. O'Nions[1], *E. Quinlan*[2], *A. San José Cáceres*[2], *E. Viding*[3] *and F. Happé*[4], *(1)Division of Psychology and Language Sciences, University College London, London, United Kingdom, (2)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (3)University College London, London, United Kingdom, (4)Social Genetic and Developmental Psychiatry, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom*

Background:
Extreme/'pathological' demand avoidance is a term coined by Elizabeth Newson to describe children within the autism spectrum who exhibit an unusual pattern of behaviour. The key characteristics of this group include (1) an obsessive resistance to complying with everyday demands; (2) an apparent ability to use behaviour strategically to subvert requests (e.g. distraction, socially shocking behaviour); (3) an obsessive need for control, including domineering behaviour towards peers and adults; (5) a tendency to perceive themselves as having adult status; (6) a tendency to adopt others' roles when interacting; and (7) obsessive behaviour, often targetted at particular people. Intriguingly, reports suggest that those with PDA respond to different educational and management approaches than most individuals with autism – in particular spontaneity, humour and flexibility (Newson, Le Marechal & David, 2003). As such, there is a pressing need to better characterise the phenotypic profiles of these individuals to inform intervention studies targeting specific management approaches.
Objectives:
Whilst interest in extreme/'pathological' demand avoidance is increasing apace in the UK, to date, relatively little systematic examination of the phenotypic profile has taken place. The objective of this study was to identify descriptive behavioural features from semi-structured interviews conducted with parents of 24 children aged 8-16 years who exhibit substantial features of extreme/'pathological' demand avoidance, identified on the basis of indicators from the Diagnostic Interview for Social and Communication Disorders (DISCO) (Wing & Gould, 2002; O'Nions et al., 2015).
Methods:
Qualitative analysis using a general inductive approach (Thomas, 2006) was used to analyse the data. Four manuscripts were coded by two researchers, using open coding to highlight salient features. Preliminary codes formed the coding structure for further interviews, and additional themes or sub-themes added over the course of a full review of all interviews. Codes were then grouped into categories based on relatedness, and groups reorganized until they formed coherent themes, resulting in 11 major themes and 60 sub-themes. Subsequently, all interviews were reviewed, and the presence of each identified sub-theme coded for each individual case.
Results:
The results of the analysis highlight key behavioural traits, illustrative examples, and emergent themes. Common themes that resonate with clinical descriptions of extreme/'pathological' demand avoidance include use of 'strategic' behaviour to avoid everyday demands, a lack of awareness of social hierarchy (e.g., of own/others' age or status), and a lack of concern for one's own reputation evident in socially shocking behaviour. Obsessive controlling behaviour towards others, often parents, was frequently reported, in addition to extreme changes in mood. Descriptions from parents also highlight the range of manifestations of avoidance behaviour, perceived triggers, and patterns of early development seen in individuals with these traits.
Conclusions:
This study provides an important step towards deepening our understanding of the behavioural profile in individuals with substantial features of extreme/'pathological' demand avoidance, and highlights the very significant behavioural challenge that these individuals present.

132 **124.132** Facing Puberty: Menses in Females with Autism Spectrum Disorder

W. T. Eriksen[1], *M. C. Souders*[2], *R. Frasso*[3] *and J. A. Pinto-Martin*[4], *(1)University of Pennsylvania School of Nursing, West Chester, PA, (2)Clinical Genetics Center, The Children's Hospital of Philadelphia, Philadelphia, PA, (3)Center for Public Health Initiatives, University of Pennsylvania, Philadelphia, PA, (4)Biobehavioral Health Sciences, University of Pennsylvania School of Nursing, Philadelphia, PA*

Background: As children with Autism Spectrum Disorder (ASD) age, challenges posed by their diagnosis are supplemented with the common challenges of growing up (Fong, Wilgosh, & Sobsey, 1993; Seltzer et al., 2003). Puberty may pose unique challenges for females with ASD, who face the additional challenges with the onset of

menses. Age at menarche and menstrual symptom presentation are known risk factors for significant mental and physical health concerns across the lifespan, including breast cancer, coronary heart disease, adolescent depression and social anxiety (Stoll, Vatten, & Kvinnsland, 1994; Lakshman et al., 2009; Blumenthal et al., 2009; Kaltiala-Heino et al., 2003). Recent findings suggest that females with ASD may experience menarche incongruent to and have more severe menstrual symptoms than their peers (Burke et al., 2010; Hamilton, Marshal, & Murray, 2011; Hamilton et al., 2012; Ingudomnukul et al., 2007; Knickmeyer et al., 2006; Pohl et al., 2014; Whitehouse et al., 2011). These findings strongly recommend a more in-depth and detailed exploration into puberty and its manifestation in females with ASD.
Objectives: (1) Characterize the onset and presentation of menses for females with ASD, (2) illustrate potential differences in onset and presentation of menses between females with ASD and their typically developing (TD) peers, and (3) compare reporting of menstrual symptoms between daughters and their parents.
Methods: Web-based surveys on age at menarche and menstrual symptoms using both self- and parent-report on the daughter. Autism networks, including research communities, electronic newsletters and community events, are used to identify parents of and females with and without ASD under the age of 18, who have experienced menarche, and have had at least one cycle in the previous six months.
Results: Preliminary Analyses (n = 9, anticipated n = 200): Participants were predominately non-Hispanic White (77.8%); daughters were aged 14-16 years and all parents participating were mothers. Females with ASD reported earlier age at menarche (M = 12.63 ± 1.24 years) compared to their TD peers (M = 14.25 ± 1.06 years); ASD Parents reported slightly later age at menarche (M = 12.96 ± 1.71 years), whereas TD Parents reported slightly earlier age at menarche than their daughters (M = 13.81 ± 1.16 years). Notably, females with ASD reported greater levels of pain related to their cycle (M = 7.5 ± 0.71: 1-10 Scale) than their peers (M = 6.50 ± 2.12) and both ASD and TD parents reported much lower levels of menstrual-related pain for their daughters (ASD: M = 2.5 ± 0.71; TD: M = 4.67 ± 4.62). Further, females with ASD endorsed more words to describe menstrual pain, such as stabbing, cramping and aching, and reported more emotional symptoms related to their cycle, such as feeling teary, withdrawn, and overwhelmed.
Conclusions: Females with ASD may experience menarche earlier and may have more physical, behavioral and emotional symptoms related to their cycle than their typically developing peers. Both ASD and TD parents tended to under-estimate key menstrual variables, suggesting that parent-report of menses and menstrual symptoms in these populations should be carefully interpreted.

133 **124.133** Gender Differences in Medical and Behavioral Co-Morbidities in Children Ages 6-17 Years with ASD

I. Zamora[1], *A. Shui*[2] *and L. Yin*[3], *(1)USC/CHLA, Los Angeles, CA, (2)Massachusetts General Hospital, Boston, MA, (3)Pediatrics, Children's Hospital Los Angeles/Keck School of Medicine of USC, los angeles, CA*

Background: ASD occurs 5 times more among boys (1 in 42) than girls (1 in 189). The evidence for gender differences in regards to the behavioral presentation and co-morbid diagnoses between boys and girls with ASD is mixed. However, some previous research findings have yielded some gender differences, which has implications in the diagnosis and management of girls with ASD (Kirkovski, Enticott, & Fitzgerald, 2013; Frazier & Georgiades, 2014, May, Cornish & Rinehart, 2013; Van Wijngaarden-Cremers et al, 2014) .
Objectives: This project is an observational study to determine if differences in the prevalence of medical and behavioral co-morbidities by gender in children ages 6-17 years with ASD exist.
Methods: Autism Speaks Autism Treatment Network Registry data contributed by 17 sites in North America was used for analysis. The sample included 416 (15.29%) females and 2305 (84.71%) males with a diagnosis of ASD (Pervasive Developmental Disorder, Autistic Disorder and Asperger's Disorder). Over 80% of the sample was Caucasian/White, 3.85% Asian, 6.88% African-American and 6.45% other/multiracial. Average age of the sample at the time of enrollment was 9.62 years (SD=2.81). The outcome variables included severity of symptoms, adaptive functioning, behavioral presentation, and medical co-morbid diagnoses. Descriptive statistics or tabulations of outcome variables and covariates potentially associated with sex were run overall and by sex. Any potential outcomes and covariates with significant sex associations at the 0.05 level were analyzed using adjusted linear or logistic regression models. Race and IQ were included as covariates in subsequent adjusted models.

Results: Girls had a higher prevalence of obsessive-compulsive disorder and were less likely to be underweight. Girls were also reported to have a higher rate of behavioral challenges related to aggressive behavior, anxiety, and taste/smell sensitivities. In unadjusted analyses, ADHD medication use was lower among girls although the prevalence of ADHD was similar between boys and girls. Girls also had lower calibrated ADOS severity scores. There were no differences between girls and boys regarding age of first concern and age of diagnosis.

Conclusions: Girls ages 6-17 years with ASD may present more often with OCD or behavioral challenges compared to boys. These differences in findings highlight the unique needs of girls with ASD and have important implications in their medical and behavioral care.
Acknowledgment: This Network activity was supported by Autism Speaks and cooperative agreement UA3 MC11054 through the U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Research Program to the Massachusetts General Hospital. This work was conducted through the Autism Speaks Autism Treatment Network.

134 **124.134** Genomic and Electrophysiologic Factors Contributes to Clinical Endophenotypes in Autism and Epilepsy Populations

G. Barnes, *University of Louisville School of Medicine, Louisville, KY*

Background: Autism spectrum disorders (ASD) are known to have complex inheritance patterns such as copy number variants (CNVs), single gene disorders, and rare mutations of common synaptic genes. Alteration in interneuron enriched genes may explain why perturbations of GABAergic circuitry have been implicated in common neurodevelopmental disorders such as autism (ASD), intellectual disability, and epilepsy. Defects in GABAergic migration, cell numbers, and circuit formation are found in animal models of autism and epilepsy.
Objectives: Our central hypothesis is that temporal and spatial specific expression of GABAergic signaling pathways contributes to the influence of sleep disruption on epileptiform discharges, seizure expression, and expression of clinical endophenotypes in autism populations.
Methods: A unique database of autism epilepsy subjects (223), autism alone subjects (221), and epilepsy alone (242) was compiled by recording data from the medical records of 686 pediatric patients from Vanderbilt University and the University of Louisville. Comparisons were made between ASD alone, epilepsy alone, and ASD + epilepsy groups.
Results: Epilepsy alone (11.8 yrs), and autism-epilepsy subjects (11.5 yrs) were significantly older than ASD alone subjects (9.9 yrs, $p<0.0001$ ANOVA) with a male predominance in ASD groups (4-5: 1 M:F ratio in ASD groups vs 1:1 ratio in epilepsy alone group), $p<0.0001$). Even though there was a slightly significant difference in age of seizure onset (Epilepsy only 57 months vs ASD-Epilepsy, 62 months, $p<0.05$) and less % REM sleep (11% vs 16 to 18% for ASD groups, $p<0.04$), there were no difference in resistance to anti-seizure medications. Cognitive impairment plays a more significant role in autism epilepsy subjects (IQ=64) more so than the ASD alone (74), or epilepsy alone subjects (78, $p<0.006$). We did note that those with ASD + Epilepsy had a higher rate of detectable CNVs on clinical microarray testing (41%) than ASD alone (30%, $p<0.08$). In general, time at autism diagnosis was similar among the two ASD groups. Epilepsy subjects were significantly older when regression occurred (50 months, $p<0.007$) than those with ASD. Parent of children with ASD-Epilepsy reported more self injury and worse language use ($P<0.008$) on the Parental Concern Questionnaire than parents with ASD alone. Finally, consistent with parental reports of age at walking or talking, Vineland Adaptive Behavioral Adaptive Scales measures of Adaptive Composite as well as subscores (ADLs, Social, Communication, Motor) were significantly higher in ASD alone subjects ($p=0.04$ to 0.001) than ASD+ epilepsy subjects. However there were no differences among the two ASD groups on the Childhood Behavioral Checklist.
Conclusions: Taken together, these data suggest that distinct subgroups within the autism and epilepsy populations have associated genomic variants which may impinge strongly on function of unique neural circuits and expression of clinical endophenotypes.

135 **124.135** Ideas Improving Diagnosis of Anxiety in Autism Spectrum Disorders

C. Sudrijan, *James's St, Trinity College Dublin, Dublin, Ireland*

Background: Children with high-functioning autism spectrum disorders (ASDs) are at high risk for developing psychiatric symptoms, with anxiety disorders among the most commonly co occurring. Cognitive behaviour therapies (CBTs) are considered the best practice for treating anxiety in the general population. Modified CBT approaches for children with high-functioning ASD and anxiety have resulted in significant reduction of anxiety following intervention. Facing your Fears (FYF) is a standardized cognitive behavioural group treatment with parental involvement with the purpose of decreasing anxiety symptoms in children with high functioning ASD. The intervention is designed to target more specific social, separation and generalized anxiety symptoms in ASD population. The program comprises core components of CBT psychoeducation, awareness of negative thoughts, somatic management of physical symptoms of anxiety, graded exposure. Physiological data collected during exposure can inform whether the treatment enact changes in the patients' responses to anxious situations.
Objectives: To detect if there is physiological change in response/or during exposure to anxiety provoking stimuli that correlate with behavioural measures in children with ASD and Anxiety. (b) To detect if the change in the physiological response that correlate with behavioural measures of anxiety are still maintained after completion of FYF intervention.
Methods: Four children with a confirmed diagnosis of ASD and Anxiety and an IQ above 80 and their parents were enrolled in the 14 weeks FYF program. Independent clinical evaluators completed behavioural (Screen for Child Anxiety Related Disorders, Anxiety Disorders Interview Schedule for DSM IV) and neurocognitive (Emotion Recognition Task, Visual Dot Probe) pre- and post intervention condition. Biological parameters, such as salivary cortisol is collected pre- and post graded exposure, whereas physiological ones such as: Heart Rate, Galvanic Skin Response, Respiration and Voice is collected during the graded exposure using BioSignalPluX equipment. Baseline values for salivary cortisol are established by collection of saliva samples 3 times per day in two consecutive days. Collection of the physiological parameters 10

minutes prior graded exposure provides the baseline values for Heart Rate, Galvanic Skin Response, Respiration Rate and Voice. Behavioral measures of anxiety prior, during and post exposure are stated using Subjective Units of Distress (SUD).
Results: The estimated findings of this pilot study regard the variation of the physiological parameters in response to anxiety provoking stimuli that correlate with behavioural mesures in the presence of anxiety disorders in individuals with ASD. Results will also inform whether the changes in physiological and neurocognitive measures are still maintained after 3 months of completion FYF intervention.
Conclusions: The output of the study will consist on a comprehensive evaluation of manifestations of anxiety in children with autism and anxiety identifying specific targets and strategies for interventions. As a second output of this pilot study is to attain a greater specification in assessment of anxiety in ASD population augmenting behavioural measures with physiological measures.

136 **124.136** Identifying Task Specific Subgroups in Autism Spectrum Disorder (ASD)

S. Sarabadani[1,2], *A. Kushki*[1] *and A. A. Samadani*[1,2], *(1)Bloorview Research Institute, Toronto, ON, Canada, (2)Biomedical Engineering (IBBME), University of Toronto, Toronto, ON, Canada*

Background: Atypical autonomic nervous system (ANS) activations are commonly observed in individuals with autism spectrum disorder (ASD). These atypical activations are often manifested in irregularities in cardiac activities and the function of sweat glands.
Objectives: The goal of this study is to identify subgroups of individuals with ASD by analyzing their physiological signals in order to discriminate between specific tasks. The tasks address one of the affected domains of ASD which is anxiety.
Methods: 40 children with ASD participated in this study. We measured electrocardiogram (ECG) and electrodermal (EDA) activities from participants while they performed a sequence of different tasks including: baseline, stroop task, baseline, public speaking task, and baseline. The task in baseline was watching video. Public speaking and stroop tasks were performed in order to elicit anxiety.
Results: ECG and EDA observations were represented in terms of various time and frequency meta-features. Feature clustering with different parameters and number of clusters was then performed to examine the pair-wise separability of the tasks for the ASD group. A weak statistical correspondence between the cluster membership of the resulting clustering and the pairs of tasks under investigation was found in all pair-wise cases.
Conclusions: The lack of separability between pairs of tasks, evaluated in this work, might indicate that ASD population demonstrates non-discriminative electrocardiogram and electrodermal activations while engaged in these tasks. Other physiological observations (e.g. respiratory) might be needed to separate the tasks.

137 **124.137** Improving Certainty about Uncertainty in ASD? Confirmatory Factor Analysis of the Intolerance of Uncertainty Scale (12) in ASD Adults

C. J. Kipp[1], *E. Anderberg*[1], *D. N. Top*[2], *K. G. Stephenson*[1], *M. Maisel*[1], *J. Rodgers*[3], *M. H. Freeston*[4], *M. South*[1,5] *and S. B. Gaigg*[6], *(1)Brigham Young University, Provo, UT, (2)1190 North 900 East, Brigham Young University, Provo, UT, (3)Newcastle University, Newcastle Upon Tyne, United Kingdom, (4)Psychology, Newcastle University, Newcastle, United Kingdom, (5)Psychology and Neuroscience, Brigham Young University, Provo, UT, (6)City University London, London, United Kingdom of Great Britain and Northern Ireland*

Background: Intolerance of Uncertainty (IU) impairs the capacity to function in ambiguous contexts including situations of unpredictable change. IU is commonly observed in people who have high levels of anxiety, including many people diagnosed with autism spectrum disorder (ASD). The 12-item Intolerance of Uncertainty Scale has been validated with good psychometric properties on normative undergraduate samples. However, people with autism seem to experience anxiety differently than non-ASD samples and new autism-specific measures of anxiety are appearing. We investigated whether IU might similarly differ in ASD samples by examining the factor structure of the IUS-12 in adults diagnosed with ASD.
Objectives: This study examined the established two-factor IUS-12 using confirmatory factor analysis. These two subscales include: the Prospective IU scale, which reflects a desire for predictability, anxiety about future uncertainties, and active engagement in seeking to increase certainty; and the Inhibitory IU scale, a measure of avoidance and paralysis in response to present uncertainties. We examined evidence for this structure as well as the overall total IUS total score.
Methods: Participants for this study consisted of 74 adults diagnosed with Autism Spectrum Disorder (ASD) recruited from two separate sites in the USA and UK. Multiple CFA analyses were performed using STATA 14 to assess the construct validity of the IUS. We performed hierarchical (second-order) CFA and a bi-factor CFA using the maximum-likelihood estimator to examine the relationship between the total IUS scores and its proposed subdomains. In the event that these models did not converge or fit properly, we then performed first-order CFAs for the total score, covaried sub-scale scores, and individual CFA for each sub-scale.
Results: CFA analyses of the hierarchal and bi-factor models did not converge after 10,000 iterations, indicting that neither model was appropriate given the available data. Though the total score CFA and the covaried sub-scales CFA did converge properly, both models showed inadequate fit. Individual sub-scales CFA showed that the Inhibitory sub-scale fit properly with no modifications. The Prospective sub-scale fit properly after dropping one item (#4; “One should always look ahead so as to avoid surprises”) and covarying one set of error terms. Many participants commented that it was difficult to respond to the questions because a) they included abstract rather than concrete scenarios and b) the respondents’ degree of uncertainty varies across situations.
Conclusions: Several recent studies have shown that IU is a useful construct for mediating anxiety and repetitive behaviors in ASD samples. However, the current structure of the IUS-12 does not provide a good overall fit for this pooled sample, though the brief Inhibitory subscale works better. As with ongoing work to create autism-specific measures of anxiety, more refinement of the IU construct and measures may be helpful to understand what aspects of uncertainty are most relevant in ASD.

138 **124.138** Incidence and Effects of Feeding Problems in Children with Symptoms of Autism Spectrum Disorder

A. B. Barber[1], ***M. M. Gosa***[2] *and E. Henderson*[2], *(1)University of Alabama, Tuscaloosa, AL, (2)Communicative Disorders, University of Alabama, Tuscaloosa, AL*

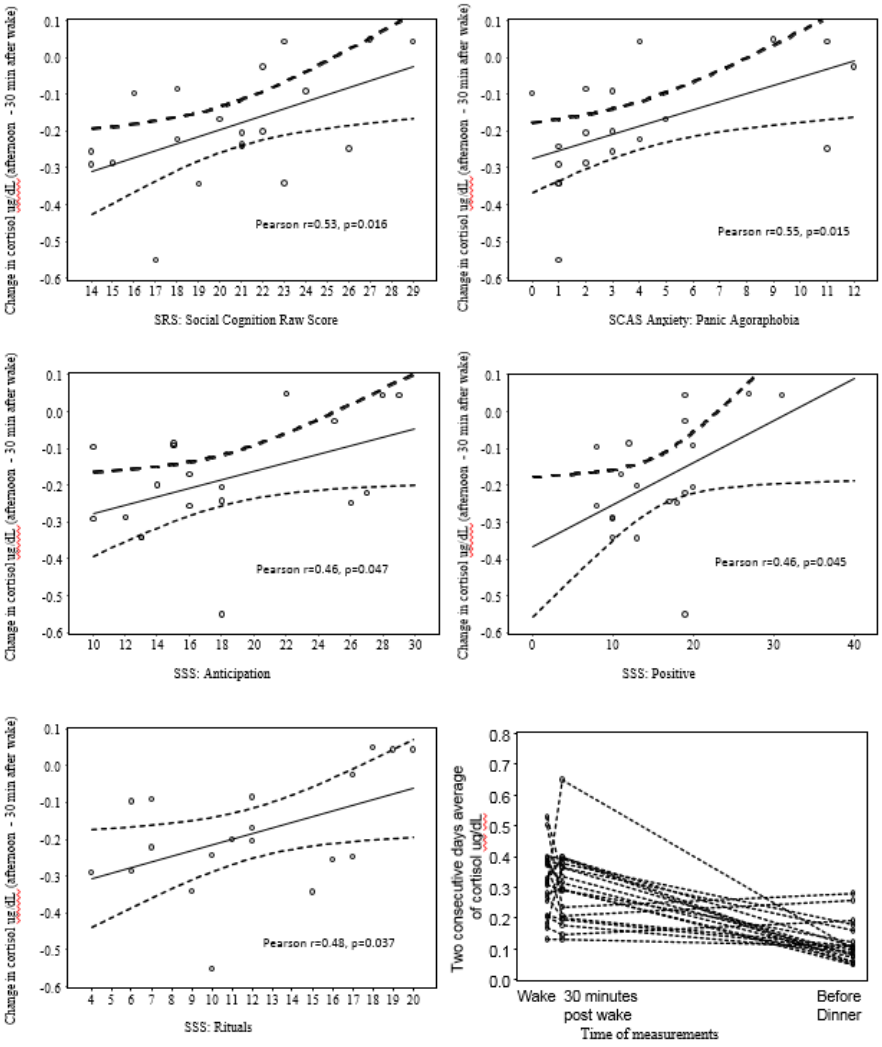
Background: Sensory processing dysfunction (SPD) is a known feature of Autism Spectrum Disorder (ASD). In children with ASD, SPD often manifests itself in extremely limited variety of dietary intake and increased dependence upon processed carbohydrate sources as their main energy source.
Objectives: This research project sought to describe the incidence and characteristics of feeding problems in a cohort of children being evaluated for possible ASD at an on-campus diagnostic clinic at a large public university.
Methods: Subjects, aged two to six years of age, were recruited from a university-based ASD Clinic. As part of the evaluation, parents completed the following measures to provide general information about their child’s symptoms, feeding and dietary habits, parent’s total stress level, and their child’s sensory responses: history form, 24 hour diet recall, *Sensory Profile* (Dunn, 1999), *Behavioral Pediatric Feeding Assessment Scale* (BPFAS) (Crist & Napier-Phillip, 2001), *Parenting Stress Index- Short Form (3rd Edition)* (PSI-SF) (Abidin, 1995), and the *Childhood Autism Rating Scale (2nd Edition)* (CARS™-2) (Schopler & Van Bourgondien, 2010). Additionally, if subjects could be conditioned height and weight measures were collected from standardized methods.
Results: In a sample of 29 children aged two to six years of age referred for evaluation of ASD, 48% (n=14/29) received a diagnosis of ASD and 35% (n=10/29) had significantly higher total frequency scores of problematic feeding behavior on the BPFAS. Forty percent of subjects with anthropometric data were classified as obese (n= 8/20) and of those subjects classified as obese, there was a significant positive correlation with higher scores on the BPFAS and increased consumption of processed foods. Analysis of 24-hour dietary recall information revealed a mean of 9.3 different foods consumed per day. Average intake of fresh fruit, vegetables, and minimally processed protein sources was just 2.25 foods in a 24-hour period, or just 24% of average number of foods consumed per day. Thirty-eight percent of subjects consumed no whole food sources in a 24-hour period. Average intake of processed and packaged foods, including foods consumed from fast food establishments, was found to be 7.39 foods per day, or more than 75% of the number of foods consumed per day. Thirty five percent of subjects received the majority of their daily intake of processed foods from carbohydrate sources, such as bread, potato chips, and French fries.
Conclusions: Data from this project reveal alarming trends with regard to incidence of obesity, reliance on processed food sources for majority of daily food intake, and minimal consumption of whole foods. These results suggest an immediate need for increased parent support and possible therapeutic intervention to reduce the number of problematic mealtime behaviors, reduce the percentage of obesity in this cohort, and increase the variety of food sources consumed.

139 **124.139** Individual Differences in HPA Axis Activity in Youth with Autism Spectrum Disorder: Relations to Stress, Anxiety, Social Responsiveness and Adaptive Skills

Z. Pan[1], *R. Gabriels*[2], *B. Dechant*[3] *and D. A. Granger*[4], *(1)Pediatrics, University of Colorado Denver school of medicine, Aurora, CO, (2)Children's Hospital Colorado, Aurora, CO, (3)University of Colorado - Denver, Aurora, CO, (4)Institute for Interdisciplinary Salivary Bioscience Research, Arizona State University, (3) Johns Hopkins University School of Nursing, Bloomberg School of Public Health, and School of Medicine, Phoenix, AZ*

Background:
Theorists speculate that individual differences in the reactivity and regulation of the hypothalamic-pituitary-adrenal (HPA) axis may provide clues as to the determinants of risk and resilience. Developmental science champions salivary cortisol to operationalize individual differences in the activity of the HPA axis (Granger et al., 2012). More than three decades of research reveals links between salivary cortisol and atypical behavior in youth (e.g., Granger et al., 1994; 1996; Gordis et al., 2006; Chen et al., 2014). Taken together, studies link salivary cortisol to distress, negative affect, and social anxiety, and show that variation in the expression of cortisol-behavior relationships is highly dependent on social contextual forces. Children with Autism Spectrum Disorder (ASD) may show variable dysregulation of diurnal patterns (e.g. Corbett 2008; Gabriels et al., 2013). Surprisingly, the depth of our knowledge about the association between environmentally sensitive physiological systems, such as the HPA axis, and adjustment in youth with ASD is very shallow. Advancing our understanding of the correlates and concomitants of HPA axis activity in ASD may have implications for individual

differences in developmental trajectory or treatment effectiveness, or both.
Objectives:
This study evaluated the association between activity of the HPA axis and stress, anxiety, and social responsiveness in youth with ASD**.**
Methods:
Saliva (later assayed for cortisol) was sampled three times a day (waking, 30 minutes post wake, and before dinner) for two consecutive days in 20 participants (19 males; 7-17 years; Parent report of the children's social responsiveness, anxiety and stress were obtained respectively using the *Social Responsiveness Scale* **(SRS),** Spence Children's Anxiety Scale (SCAS), and Stress Survey Schedule for Persons with Autism and Other Developmental Disabilities **(SSS)** (Essau 2002, Constantino 2012, Goodwin 2013)**.**
Results:
The cortisol diurnal decline was associated with SRS social cognition raw score (r = 0.53, p=0.016), SCAS panic agoraphobia (r = 0.55, p=0.015) and three SSS subscales: anticipation (r=0.46, p=0.047, positive (r=0.46, p=0.045), and rituals (r =0.48, p=0.037). Figure 1 presents the scatter plot and linear regression line.
Conclusions:
This preliminary study suggests that individual difference in the diurnal decline of cortisol in ASD patients may be associated with anxiety, stress and social responsiveness.



140 **124.140** Internalizing Psychopathology: Relations to Executive Functions in Young Children with Autism Spectrum Disorder

J. Berg[1,2]*, B. Wilson*[1] *and J. Kim*[1]*, (1)Clinical Psychology, Seattle Pacific University, Seattle, WA, (2)Psychiatry, UCLA Semel Institute, Los Angeles, CA*

Background: Children with ASD exhibit significantly higher rates of internalizing psychopathology including anxiety and depression than typically developing (TD) peers (Solomon et al., 2012). Psychiatric comorbidity in ASD increases with age and is associated with more negative outcomes overall. There is a paucity of research examining neurocognitive factors that may impact psychological outcomes for this population (Hollocks et al., 2014). Deficits in executive functioning (EF) are present in children with ASD (Hill, 2004) and associated with internalizing problems in TD populations (Koenigs & Grafman, 2009; Price & Drevets, 2012) and children with other neurodevelopmental disorders (Kelly et al., 2012). Neuropsychological deficits may partially explain the higher incidence of internalizing psychopathology in children with ASD and undermine children's adaptive responses to stress imparting greater vulnerability to poor mental health outcomes.
Objectives: The current study examines whether EF mediates the relation between developmental status and internalizing problems in young children.
Methods: Participants included 66 children ages 36 to 85 months with 40 children in the TD group (57.5% male) and 26 children in the ASD group (84.6% male). EF measures included an ecologically valid rating scale and performance-based neuropsychological task. Children completed the Tower of Hanoi-Revised (TOH-R; Welsh, Pennington, & Groisser, 1991) and parents completed the BRIEF (Goia, Isquith, Guy, & Kenworthy, 2000) or BRIEF-P (Gioia, Espy, & Isquith, 2003) Plan and Shift subscales measuring planning skills and cognitive flexibility. Parents reported on children's internalizing problems on the BASC-2-PRS (Reynolds & Kamphaus, 2004).
Results: Analyses utilized Hayes and Preacher's macro (2013), PROCESS, to test a multiple mediation model in which developmental status is associated with internalizing problems through EF with Shift, Plan, and ToH-R variables as parallel mediators. Bootstrapping results (5,000 resamples and 95% bias-corrected and accelerated CIs) supported our model (R^2= .470, F(5,55) = 9.741, p< 0.001) and indicated the predictor variables jointly accounted for 47% of the variance in internalizing problems. Significant indirect effects were found for Shift (point estimate= 1.215, SE = .301, 95% CIs[.652, 1.837]) and Plan (point estimate= .526, SE = .171, 95% CIs[.194, .869]). No significant indirect effect was found for ToH-R (point estimate= -.101, SE=.094, 95% CIs[-.340, .035]). Results indicate BRIEF Plan and Shift are significant mediators of the association between developmental status and internalizing problems whereas ToH-R did not play a mediational role.
Conclusions: The current study found a substantial indirect effect of parent reported child planning skills and cognitive flexibility on the association between ASD and internalizing problems. Performance on a neuropsychological task did not play a significant mediational role suggesting ecologically valid measures of EF may have more significance in the mechanisms underlying the association between internalizing symptoms and ASD. Research exploring the impact of neurocognitive factors on internalizing problems in individuals with ASD is limited and this is the first study to explore these relations in young children. These findings may inform interventions and potentially improve psychiatric outcomes for these children.

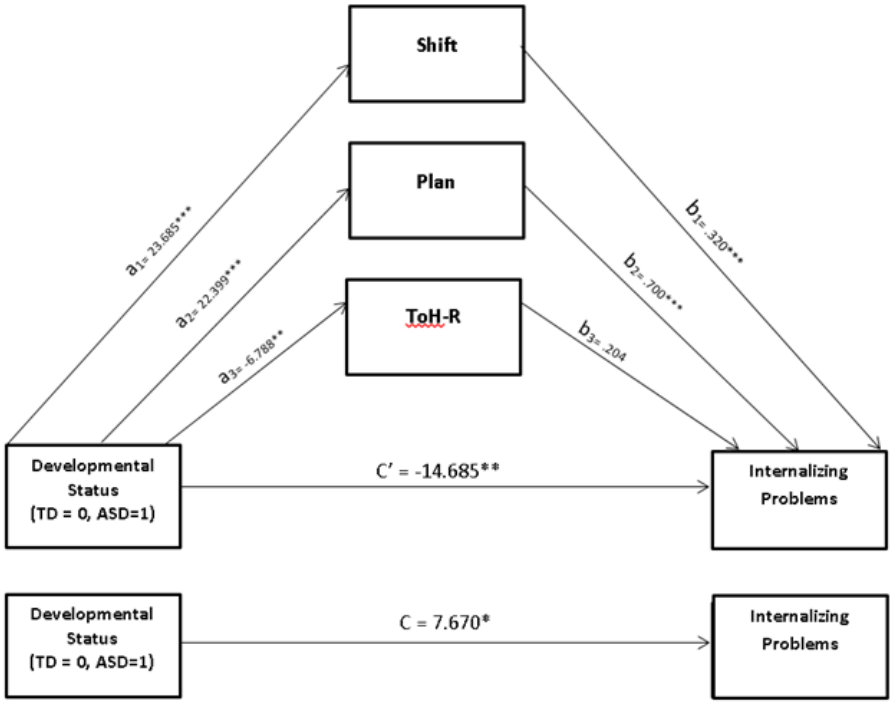


Figure 1. Multiple mediation model of developmental status, executive functioning, and internalizing problems displaying unstandardized coefficients. ToH-R = Tower of Hanoi performance scores, Plan = BRIEF Plan Subscale, Shift = BRIEF Shift Subscale. $P^* < .05$, $P^{**} < .01$, $P^{***} < .001$

141 **124.141** Longitudinal Predictors of Co-Occurring Anxiety in Children at Increased Familial Risk for ASD

B. Milosavljevic[1], *E. Shephard*[2], *T. Gliga*[3], *G. Pasco*[4], *E. J. Jones*[5], *F. Happé*[6], *M. H. Johnson*[7], *T. Charman*[1] *and T. B. Team*[8], *(1)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (2)King's College London, London, England, United Kingdom, (3)Birkbeck College, London, United Kingdom of Great Britain and Northern Ireland, (4)Institute of Psychiatry, London, United Kingdom of Great Britain and Northern Ireland, (5)CBCD, Birkbeck College, University of London, London, United Kingdom, (6)Social Genetic and Developmental Psychiatry, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (7)Birkbeck, University of London, London, United Kingdom of Great Britain and Northern Ireland, (8)Birkbeck, University of London, London, United Kingdom*

Background:
Co-occurring anxiety is highly prevalent in individuals with ASD and their family members. Yet the shared neurocognitive correlates and early childhood predictors of these two conditions remain unclear. Research on the predictors of anxiety in children without ASD suggests that early difficulties with attentional flexibility and regulation of temperament may be markers of later development of anxiety. However, there is presently a scarcity in longitudinal research exploring the pathways leading to the development of anxiety in individuals with ASD.
Objectives:
This prospective longitudinal study aimed to explore the symptoms and longitudinal predictors of anxiety in children at increased familial risk for ASD. The aims of the study are to examine if 1) increased anxiety is observed among children at high-risk for ASD; 2) there are differences in anxiety symptoms among high-risk children who meet diagnostic criteria for ASD and those who do not; 3) difficulties with attentional disengagement and temperament in early life are associated with the development of anxiety within high-risk children.
Methods:
Symptoms of anxiety were measured at age 6-8 in a cohort of children at high-risk (HR) for ASD, who have been studied prospectively since infancy. Anxiety symptoms were measured using the Spence Children's Anxiety Scale parent-report (SCAS-P). Anxiety symptoms were compared between high-risk children who met DSM-5 criteria for ASD (HR-ASD; n=15), high-risk children without ASD (HR-no ASD; n=27) and low-risk controls (LR; n=37). Disengagement time on the Gap/Overlap task measured at 7m, 14m and 36m was used to explore the relationship between early attention and later anxiety. Finally, early temperament was measured using parent report at 7m, 14m, 24m and 36m with the Infant Behaviour Questionnaire (IBQ), Early Childhood Behaviour Questionnaire (ECBQ) and Child Behaviour Questionnaire (CBQ).
Results:
The HR participants exhibited higher anxiety than LR across SCAS-P subscales. Furthermore, the HR-ASD group had significantly higher anxiety compared to LR, and there was a trend for higher anxious symptoms in HR-no ASD than LR (Figure 1). Within the high-risk group, disengagement times on the Gap/Overlap task at 14m and higher levels of Negative Affect (NA) in toddlerhood were associated with increased anxiety at 6-8 years (Table 1).

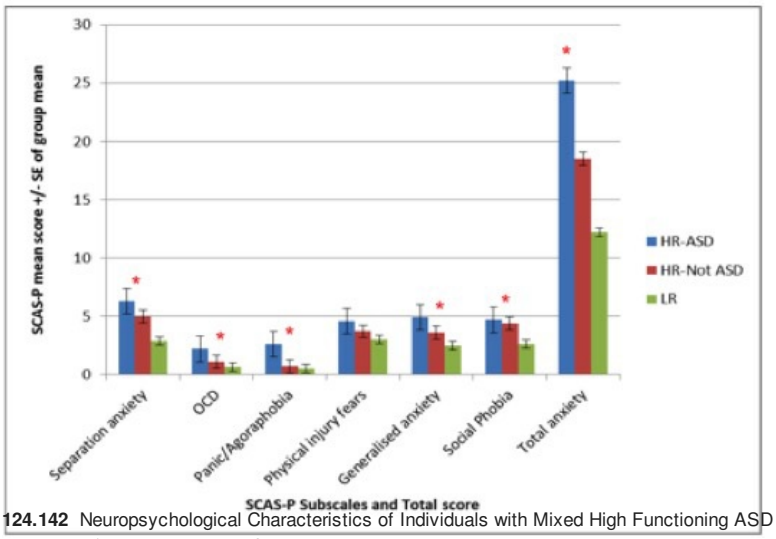
Table 1 Associations between anxiety, attentional disengagement and temperament

SCAS-P subscale	*Negative Affect 7m*	*Negative Affect 14m*	*Negative Affect 24m*	*Negative Affect 36m*	*Disengagement 14m*
Separation Anxiety	.13	.14	.19	.20	.22
OCD	-.05	.24	.40*	.38*	.22
Panic/Agoraphobia	.04	.22	.54**	.41*	.06
Physical Injury Fears	.10	.13	.29	.18	.36*
Generalised anxiety	.14	.32*	.46*	.42*	.24
Social phobia	.13	.39*	.54**	.37*	.22
Total anxiety	.11	.31*	.51**	.41*	.28

*p<.05 **p<.01

Conclusions:
Children at risk for ASD, particularly those who develop the condition themselves, exhibit increased anxiety. Among HR children, difficulty regulating attention and negative emotionality in infancy and toddlerhood are associated with the development of anxiety. This suggests that the pathways to developing anxiety are similar within children with ASD and their siblings as they are in non-ASD populations.

Figure 1 Anxiety symptoms in HR-ASD, HR-no ASD and LR at age 6-8 years



142 **124.142** Neuropsychological Characteristics of Individuals with Mixed High Functioning ASD and ADHD

C. Colombi[1] *and M. Ghaziuddin*[2]*, (1)Psychiatry, University of Michigan, Ann Arbor, MI, (2)Psychiatry, University of Michigahn, Ann Arbor, MI*

Background: Clinical heterogeneity is a well-established characteristic of ASD. It is estimated that 75% of individuals with ASD present associated medical conditions, genetic syndromes, mental health or developmental disorders (Ghaziuddin, 2008). In addition to the social communication impairment and the presence of restricted and repetitive behavior, a large portion of individuals with ASD presents symptoms of ADHD. While the comorbidity of ASD and ADHD is well known in the clinical realm, relatively little research has examined the neuropsychological profiles of children with mixed ASD and ADHD.
Objectives: To examine the neuropsychological characteristics of individuals with ASD + ADHD and those with ASD only.
Methods: 57 individuals with high functioning ASD (FSIQ > 70) were enrolled in the study. The sample consisted of 22 children with ASD and 25 children with ASD + ADHD (age 7 to 13). The battery administered to all participants comprised the Wechsler Scales of Intelligence, the Child Behavior Checklist (CBCL), the "Reading the Mind in the Eyes" (Baron-Cohen, 2001) used to evaluate empathy, the Purdue Pegboard Test used to evaluate manual dexterity, and the Tower of London Test used to evaluate planning.
Results: The groups did not differ in FSIQ, VIQ, or PIQ. ADHD symptoms (t = - 2.19; p = .03) and anxiety symptoms (t = -1.95; p = .05), as measured by the CBCL, were higher in the group of children with ASD + ADHD in comparison to the group with ASD only. Moreover, after controlling for FSIQ, children with ASD + ADHD showed significantly lower scores, in comparison to children with ASD only, in Working Memory (F = 4.52; p = .04) and marginally significantly lower scores in the "Reading the Mind in the Eyes" Test (3.48; p = .70). There were not significant differences in the Purdue Pegboard Test or in the Tower of London Test between the groups.
Conclusions: Our results showed significant differences in the neuropsychological characteristics of children with ASD + ADHD in comparison to those with ASD only. This suggests that having ADHD brings further challenges to individuals with ASD. Our findings may have implications for clinical assessment as well as intervention.

143 **124.143** Overlapping Symptoms of Bipolar Disorder in Children and Adolescents with Autism Spectrum Disorder

G. Singh[1]*, E. Anabalagan*[2]*, K. Sohl*[3]*, C. P. Gregory*[1] *and R. M. Brown*[4]*, (1)University of missouri-columbia, columbia, MO, (2)UC Davis, San fransico, CA, (3)University of Missouri - Thompson Center, Columbia, MO, (4)University of missouri-columbia, Columbia, MO*

Background: ASD is a developmental disorder arising in early years, whereas BD is primarily a cyclic affective disorder it is estimated that 1 in 68 children have ASD. The prevalence of ASD has risen significantly leading to increased awareness and research. Research indicates an increased prevalence of psychiatric comorbidities in autism. However, there is limited research on the overlapping symptoms of conditions similar to ASD that may be confounding accurate diagnoses. In BD and ASD, there are numerous symptoms that have significant overlap, especially when diagnosed during childhood. Some studies have been done on the prevalence of the BD and ASD and their correlation but the conclusions are conflicting and no clear results are available.
Objectives: The objective of the study is to compare the clinical characteristics of Bipolar Disorder (BD) and Autism Spectrum Disorder (ASD). Children diagnosed with ASD often have mood lability, aggression and sleep disturbances. Thus, whether these presentations are an entirely separate entity or characteristics of ASD itself raises a question of the extent of the overlap of symptoms and its diagnostic significance.
Methods: Data was analyzed from 100 CYASD diagnosed with autism during the calendar year 2012-2013. All patients analyzed received diagnosis and care at an Autism Speaks Autism Treatment Network Center of Excellence, affiliated with an academic medical center. Demographic information and specific variables were analyzed including age of diagnosis, delays in social skills and communication, presence of repetitive behavior, restricted interests, sensory issues, aggression, mood lability, depression, mania, thought disorder, family history of BD, ASD or disorders, toilet training, pregnancy and IQ. The criteria for assessing mood lability was the presence of emotional dysregulation in the form of temper tantrums, difficulty with transitions, rigid behaviors, easy irritability, internalizing and externalizing behaviors.
Results: In our study, 50% of individuals had aggressive behavior, 95% had mood lability, 66 % had sleep disruptions and 5% of the children had depression but none of them had been diagnosed with classic mania, hypomania, hallucinations or thought disorder. 31% had family histories of BD and 29% had family histories of ASD
Conclusions: In our study, half of our patients had aggression, one third had sleep disruptions and 95% had symptoms of mood lability. Pediatric bipolar disorder seldom presents with classic cyclic symptoms of mania and depression and more often presents with mixed features and rapid cycling. These symptoms are similar to those that can be seen in pediatric bipolar disorder and may predispose them to over diagnosis of BD. Whether these presentations are a separate BD or characteristics of ASD is an area of controversy and scientific debate. Further investigation of patients with co-morbid ASD and bipolar disorder is needed on a larger scale to determine this. Current treatment of these two disorders differs greatly. This emphasizes the importance of prompt recognition and an accurate early diagnosis, which would allow for better, more economical, and more efficient outcomes benefiting both the physician and the patient.

144 **124.144** Parent, Teacher and Self-Report of Behavioral and Adaptive Functioning in Youth with ADHD and ASD

K. E. Wagner *and K. M. Antshel, Psychology, Syracuse University, Syracuse, NY*

Background: Autism spectrum disorder (ASD) and attention deficit / hyperactivity disorder (ADHD) are common neurodevelopmental disorders which share some similar symptoms of social, emotional, and attention deficits. Once considered an exclusionary criterion for ADHD, there is now compelling evidence that behavioral characteristics of ADHD are observed in a large proportion of individuals with ASD. While much data have been published about ADHD and ASD individually, far less data have been published about the comorbid state (ASD+ADHD) and those data that have been published have been plagued by a lack of information about school behavior and functioning as well as small sample sizes. Thus, large scale efforts to investigate ASD+ADHD that include teacher report are sorely needed, especially an investigation of how the comorbid state compares to ASD and ADHD in isolation.
Objectives: The current investigation is a descriptive study comparing parent, teacher and self-reported behavior and functioning in three groups of children and adolescents: youth with ADHD, youth with high levels of ASD symptoms and youth with ADHD+high levels of ASD symptoms. Rather than assess a dichotomous ASD diagnosis, a decision was made to consider a Research Domain Criteria (RDoC) framework for high levels of ASD symptoms using the RDoC domain of Social Communication.
Methods: Participants were recruited from several large outpatient child and adolescent psychiatry specialty clinics housed within an urban academic medical center. Each participant for the current study received a rigorous psychiatric diagnosis made with the Kiddie-Sads-Present and Lifetime Version (K-SADS-PL) for the ADHD cohorts and the Autism Diagnostic Interview - Revised (ADI-R) for the high levels of ASD symptom cohorts. Participants consisted of 364 youth with ADHD alone, 81 children with high levels of ASD symptoms alone, and 38 children with a clinical diagnosis of ADHD and a high level of ASD symptoms. The Behavior Assessment System for Children – 2nd edition (BASC-2) parent, teacher and self-report measures served as the primary outcome measure.
Results: With regard to behaviors, the profile of ratings were generally consistent between parents and teachers and were significant for an externalizing disorder profile with ADHD cohorts and an internalizing disorder profile within the ASD symptoms cohorts. Children in all three groups self-reported less behavioral symptoms than adults. With regard to functioning, the parent and teacher data suggest a linear relationship between the three groups: the ADHD group was rated as the least impaired and the ADHD+ASD symptoms group was rated as the most impaired.

Conclusions: Careful clinical evaluation for the presence of ASD symptoms in individuals with ADHD (and vice versa) is recommended. ADHD is associated with an externalizing profile in youth with high levels of ASD symptoms. This is consistent with ADHD in the non-ASD population. The comorbid state was the most functionally impaired. This finding suggests that treatments designed to intervene with this common comorbid state represent a clinically significant line of investigation.

145 **124.145** Comparison of Two Screening Instruments for Additional Psychopathology in Children with Autism Spectrum Disorder

S. Chandler[1], *G. Baird*[2], *F. Salazar*[3] *and E. Simonoff*[4], *(1)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (2)Guy's and St Thomas' NHS Foundation Trust, London, United Kingdom, (3)Department of Child Psychiatry, South London and Maudlsey NHS Foundation Trust, London, United Kingdom, (4)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom*

Background: High rates of co-occurring psychiatric disorders have consistently been reported in older children, adolescents and adults with autism spectrum disorders. These rates are four to six times higher than those reported in the general population and higher than those found in the studies with children with intellectual disability. The most commonly co-occurring disorders include anxiety, obsessive compulsive disorder and ADHD. More recent studies have reported similarly high rates in younger children with autism. Psychiatric disorders can worsen autism symptoms, interfere with education and reduce benefits of behavioural therapies. However, in younger children emotional and behavioural problems associated with these disorders are often assumed to be “part of autism” and are not systematically elicited by clinicians at diagnosis. Early identification of comorbid problems is crucial in the management of ASD as the impact of these additional problems can be reduced using a range of evidence-based interventions. A number of screening instruments are available for use in general populations but few have been validated for use with children with ASD.
Objectives:

- To explore whether the factor structures previously reported for the Developmental Behaviour Questionnaire (DBC) and the Profile of Neuropsychiatric Symptoms (PONS) in people with intellectual disability and general population samples, are found when used within a community sample of children with ASD.
- To test the validity of the DBC and PONS in relation to DSM-IV diagnoses elicited by a gold standard psychiatric diagnostic interview.
- To assess which questionnaire parent/carers found most suitable for describing their child’s emotional and behavioural problems.

Methods: The DBC and PONS were completed by parent/carers of 227 children with ASD, aged 4-9 years old. Intellectual ability and autism symptomatology were also assessed. DSM-IV psychiatric diagnoses were elicited for a stratified subsample of 101 children using the Preschool Age Psychiatric Assessment (PAPA).
Results: Exploratory factor analysis (EFA) of the DBC generated a 5-factor solution accounting for 53% of the total variance; the 5 factors were similar to the disruptive/antisocial, self-absorbed, communication, anxiety and social relating subscales previously reported. EFA of the PONS generated a 4-factor solution accounting for 93% of the total variance, broadly mapping onto the domains of neurodevelopmental disability, behaviour and emotional dysregulation, psychoses and personality dysfunction, anxiety and depression as previously reported. The relationship between the questionnaire measures and DSM-IV diagnoses as measured by the PAPA, will be presented using receiver operator characteristics (ROC) analysis and logistic regression.
61% of parents said they preferred the DBC to the PONS, 38% preferred the PONS and 1% expressed no preference.
Conclusions: The factor structures of the DBC and the PONS are similar in this ASD population to those already reported in other populations. The ROC analyses will determine the validity of both questionnaires in measuring additional psychopathology in young children with ASD, and thus point to whether either instrument could be recommended as part of the routine care of children with ASD at/following diagnosis.

146 **124.146** Personality Profiles in Intellectually Able Adults with ASD

K. B. Harrison[1], *M. Reddy*[2], *A. Engstrom*[1] *and K. A. Loveland*[3], *(1)Psychiatry & Behavioral Sciences, University of Texas Health Science Center Houston, Houston, TX, (2)Psychiatry and Behavioral Sciences, University of Texas Health Science Center Houston, Houston, TX, (3)University of Texas Medical School, Houston, TX*

Background:
Persons with high-functioning autism spectrum disorders (ASD) may go undiagnosed into adulthood, when they then present for evaluation because of increasing difficulties in adjustment or mental health. In addition to the social deficits of ASD, many experience clinically significant anxiety, depression, executive functioning deficits and other problems. However, the co-occurrence of other disorders with ASD in intellectually able adults can lead to confusion when they are assessed, resulting in misdiagnosis of disorders they do not have (e.g., bipolar disorder diagnosed because of outbursts), or a failure to detect ASD. Careful and clinically informed assessment is necessary to clarify the clinical picture.
The Personality Assessment Inventory (PAI, Morey 1991, 2007) is a valid, reliable self-report instrument often used to help identify psychopathology in adults, including adults with ASD. However, to date there are no studies that examine patterns of PAI scores of intellectually able persons with ASD.
Objectives:
This study is designed to investigate PAI scale and subscale patterns from responses of adults who meet DSM-IV/DSM-5 criteria for ASD, and then compare them to PAI scores from a smaller sample of adults with other clinical diagnoses to determine profile similarities and differences. A primary objective of this study is to provide evidence of PAI score patterns linked to ASD which can then be used for clinical application.
Methods:
Data were collected from 112 archival PAI records from two sources: an outpatient clinic which specializes in diagnosing ASD in adults, and a county psychiatric hospital. There were 75 participants with DSM-IV/DSM-5 ASD (33% F), and 25 participants with Other Psychopathology (32% F). Distribution of ages was similar between groups.
Data were analyzed from 11 clinical scales and associated subscales.
Results:
Adults with ASD had mean Borderline elevations on scales for Anxiety, Anxiety Related Disorders, Depression, and Schizophrenia. In the subscales, Cognitive and Affective Anxiety, and Cognitive and Affective Depression were Borderline elevated, and Schizophrenia Social Detachment was clinically elevated. MANOVA comparing the ASD and Other Psychopathology groups found significantly higher scores (greater psychopathology) for persons with ASD on the Anxiety scale and Cognitive and Affective Anxiety subscales and on the Schizophrenia Social Detachment subscale.
Conclusions:
Results suggest that on average, intellectually able adults with ASD have a distinct pattern of elevations on the PAI both when compared to norms for the PAI. The pattern identified suggests that significant anxiety and depression, especially the cognitive and affective symptoms of both, are likely to be reported by adults with ASD. The mean clinical elevation on the Schizophrenia scale in this group, when examined in light of the subscales, indicates that they are reporting withdrawal and detachment rather than psychosis. The comparison with the inpatient group, though preliminary, supports these findings. Further research comparing with other populations on the PAI as well as non-self-report instruments will be needed to confirm the validity of this pattern.

147 **124.147** Physical Growth Pattern from Birth to Age 6 of Children with Autism Spectrum Disorder Compared to Typically Developing Children

J. Zhang[1], *M. D. Fallin*[1,2,3], *H. E. Volk*[1,3], *D. M. Caruso*[4], *A. Riley*[1], *R. Landa*[2,5], *R. Angomas*[6], *C. Pearson*[6], *M. Silverstein*[6] *and X. Wang*[2,7], *(1)Johns Hopkins Bloomberg School of Public Health (JHBSPH), Baltimore, MD, (2)Johns Hopkins School of Medicine, Baltimore, MD, (3)Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD, (4)Center on the Early Life Origins of Disease, Department of Population, Family, Reproductive Health, JHBSPH, Baltimore, MD, (5)The Kennedy Krieger Institute, Baltimore, MD, (6)The Boston University Medical Center, Boston, MA, (7)Center on Early Life Origins of Disease, Department of Population, Family, Reproductive Health, JHBSPH, Baltimore, MD*

Background: Cross-sectional data suggest that children with autism spectrum disorder (ASD) may be at higher risk of being overweight or obese (OWO), but results from longitudinal studies are limited and inconsistent. There is a lack of prospective birth cohort studies on physical growth patterns in ASD as compared to typically developing (TD) children.
Objectives: To assess whether longitudinal physical growth patterns, measured by attained levels and velocity of body mass index (BMI), weight and height, differ between ASD children and TD children in the Boston Birth Cohort (BBC), where children were enrolled at birth and followed prospectively through childhood at Boston Medical Center in Massachusetts.
Methods: This study included a total of 1,927 children from the BBC. Weight and height were measured by trained medical staff during well-child visits from birth to age 7. Age-gender specific BMI, weight and height z scores were defined by the World Health Organization (0-2 years old) and the Center for Disease Control and Prevention (2-18 years old) growth charts; and were further categorized as < 5th percentile (underweight), 5th – 85th percentile (normal weight), 85th-95th percentile (overweight) and > 95th percentile (obese). ASD cases (n=107) were defined based on ICD-9 codes of physician diagnosis in the electronic medical records (over 80% were diagnosed by relevant specialists). Spline regressions were used to characterize the growth patterns from birth to age 7; and mixed effects models were used to estimate and compare the slopes of the BMI, weight and height z score trajectories of ASD and TD children respectively. Finally, logistic regressions were used to compare the odds of being OWO between ASD and TD children at birth, age 2 and age 6 respectively. Important covariates were adjusted in the regression analyses.
Results: The prevalence of OWO increased with age in both ASD and TD children. ASD children started with lower weight at birth, but manifested more rapid weight gain in the first year of life as demonstrated by their higher velocity of BMI (P=0.04) and weight z score (P<0.001) compared to TD children. The growth curve of ASD children crossed TD around age 1, and then surpassed that of TD children. Both crude and adjusted logistic regressions indicated that the ASD children had a higher risk of becoming OWO than TD children at age 6 (OR=1.68, 95%CI: 0.93-3.04, P=0.09). In contrast, the pattern of height growth was comparable between ASD and TD children during the first 6 years of life.

Conclusions: Despite lower weight at birth, children with ASD had faster weight gain during the first year of life, and their growth curve surpassed that of TD children by age 1 and remained higher through age 7. In addition, the risk of OWO was higher in ASD children comparing to their TD counterparts. In light of numerous health risks associated with OWO, our study highlights the need for early prevention of OWO among ASD children, in addition to further etiologic research into the overlapping pathways of physical growth and neurodevelopment.

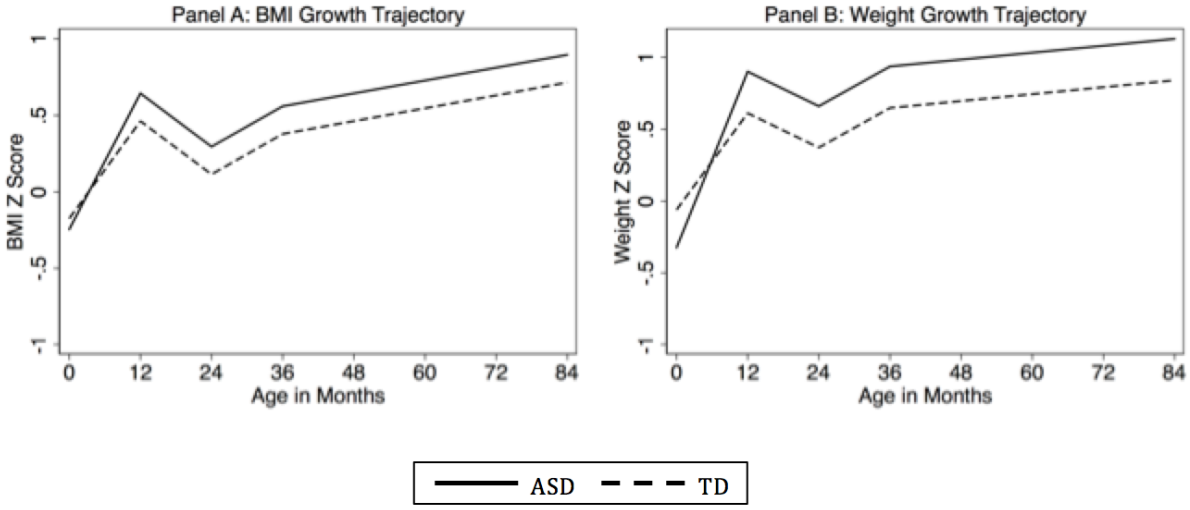


Figure1: BMI and weight growth trajectories

Table 1: Adjusted odds ratios of being overweight or obesity (OWO) comparing ASD to TD children at birth, age 2 and age 6*

	Odds Ratio	95% CI	P-value
Birth	0.79	(0.23,2.74)	0.71
Age 2	1.07	(0.61,1.90)	0.81
Age 6	1.68	(0.93,3.04)	0.09

*This model adjusted preterm birth and low birth weight status, maternal education, breastfeeding status, maternal smoking and drug use, maternal obesity and diabetes status.

148 **124.148** Predicting the Presence of Challenging Behaviours at 16 Years Old Using a Population Based Sample of Individuals with Autism Spectrum Disorder (ASD)

R. Kent[1], *V. Carter Leno*[2], *T. Charman*[3], *S. Chandler*[4], *C. Jones*[5], *F. Happé*[6], *G. Baird*[7], *A. Pickles*[2] *and E. Simonoff*[3], *(1)Institute of Psychiatry, Psychology & Neuroscience, London, United Kingdom, (2)Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (3)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (4)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (5)School of Psychology, Cardiff University, Cardiff, United Kingdom, (6)Social Genetic and Developmental Psychiatry, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (7)Guy's and St Thomas' NHS Foundation Trust, London, United Kingdom*

Background: 'Challenging behaviours' such as aggression, self-injury and non-compliance occur at high rates in children and adolescents with ASD and have been shown to significantly impact on caregivers' stress and individual's daily living and social development. Identifying risk and protective factors for challenging behaviours in individuals with ASD may increase our understanding of the causes and presentation of these behaviours, providing opportunities for interventions.
Objectives: To identify whether any characteristics frequently evaluated in youth with ASD can be used to predict challenging behaviours. Using a longitudinal sample, associations between participant characteristics measured at age 12 and later challenging behaviour at age 16 is explored.
Methods: A longitudinal, population-based cohort [The Special Needs and Autism Project (SNAP); Baird, Simonoff, Pickles, Chandler, Loucas, Meldrum & Charman, 2006] of youth with ASD (N=94) was used to study predictors of challenging behaviours. Challenging behaviours were measured at 16 years old using six parent rated items from the Profile of Neuropsychiatric Symptoms (PONS; Santosh, Gringas, Baird, Fiori & Sala, 2015): self-injury, aggression, labile mood, antisocial behaviours, oppositionality and explosive rage. A hierarchical multiple regression was used to investigate which participant characteristics at 12 years old predicted later Challenging Behaviour score. The variables in each step are described below:
1) Ability level: IQ, adaptive functioning (Vinelands Adaptive Behaviour Scales), receptive and expressive language (Clinical Evaluation of Language Fundamentals).
2) Autism severity: clinician ratings of ICD-10 symptoms, the Social Communication Questionnaire and the Social Responsiveness Scale.
3) Emotional and behavioural problems: Parent and teacher reports of hyper-activity, emotional symptoms and conduct problems were collected using the Strengths and Difficulties Questionnaire.
4) Additional psychiatric diagnoses: Diagnoses according to the Child and Adolescent Psychiatric Assessment (CAPA) were grouped into three categories: ADHD; oppositional or conduct disorder; any emotional diagnosis.
Results: Fifty one percent of parents reported adolescents with a clinical diagnosis of ASD to have one or more challenging behaviours that occurred frequently or interfered with everyday life. The most frequent behaviour was oppositionality (40%), followed by aggression (28%) and explosive rage (20%). IQ and language level did not significantly predict later challenging behaviour and nor did the addition of autism severity measures in Steps 1 and 2 of the hierarchical regression. The addition of teacher and parental reports of behavioural and emotional problems produced a significant predictive model and significantly improved the variance explained ($\Delta R^2 = 0.28$, $p<.01$). The addition of CAPA diagnoses improved the model further ($\Delta R^2 = 0.11$, $p<.05$.).
Conclusions: In this population-based sample, challenging behaviours at 16 years old were prevalent and predicted by previous co-occurring mental disorders and emotional and behavioural symptoms. The presence of co-occurring psychiatric disorders are predictive over and above parental and teacher reports of behaviour and therefore those meeting criteria for psychiatric diagnoses may be especially at risk of challenging behaviours. These findings are in contrast with findings from non-ASD

populations where lower IQ, functioning and language level predict challenging behaviours. With replication these findings may highlight behaviours to identify individuals for early interventions.

149 **124.149** Predictors of Poor Sleep Quality in Youth and Young Adults on the Autism Spectrum

ABSTRACT WITHDRAWN

Background: Poor sleep quality, primarily insomnia is known to be common in children and younger adolescents with autism, with up to 80% of individuals being affected. Emerging research indicates that sleep difficulties can have chronic course, continuing into older adolescence and adulthood. Research has started to explore the risk factors behind sleep difficulties in the autism population with findings suggesting that they may be associated with both core symptoms of autism, including sensory sensitivities and repetitive behaviours, and with comorbid conditions such as ADHD, anxiety, depression and gastro-intestinal symptoms. Recent proposals have particularly singled out the key role of anxiety and depression, at least in relation to insomnia symptoms.
Objectives: Our aim was to explore the relative contributions of anxiety and depression, sensory sensitivities, emotional awareness and somatic symptoms in predicting sleep quality in young people with autism.
Methods: Participants were drawn from the Autism CRC Longitudinal Study of School Leavers with autism (www.autismcrc.com.au), which commenced in 2015 and is ongoing. Currently 38 youth with autism, aged 15-25 years, 24 males (M_{age} = 17.46 years, SD = 2.15) and 14 females (M_{age} = 18.86 years, SD = 3.23) have completed demographic information, the Autism Quotient-28 item form (autism traits), COMPASS (somatic symptoms), DSM-5 dimensional anxiety scale, PHQ-9 (depression), Glasgow Sensory questionnaire (GSQ), and Levels of Emotional Awareness – short form (LEAS) and the Pittsburgh Sleep Quality Index (PSQI) as a measure of sleep quality.
Results: Full data for 32 participants are available to date; square root transformations were used for non-normal variables. Correlational analyses showed that all variables except autism traits, r = .31, p > .05, and emotional awareness, r = -.10, p > .05, were significantly (all p < .001) and strongly (all r > .50) associated with sleep quality. Next, a hierarchical multiple regression with sleep quality as the dependent variable was conducted. ASD traits were entered at step 1, and explained 10% of the variance, F (1, 30) = 3.34, p = .078. Sensory sensitivity was entered at Step 2, explaining an additional 19.2% of the variance, F change (1, 29) = 7.87, p = .009. The addition of anxiety and depression at step 3 explained an additional 23.8% of variance, R squared change = .24, F change (2, 26) = 6.84, p = .004. Somatic complaints was entered at step 4 but did not explain any additional variance, F change (1, 26) = 0.02, p = .891. The final model explained 53.1% of the variance in sleep quality, F (5, 26) = 5.88, p < .001, with depression being a unique significant predictor, $beta$ = .43, p = .047.
Conclusions: Preliminary results indicate that sensory sensitivity, anxiety and depression are strongly contributing to the maintenance of poor sleep quality in autism. This is in line with research in non-autistic populations suggesting that psychopathology and sleep are reciprocally related, while sensitivity to environmental stimuli can have a negative effect on sleep. These findings indicate potential future avenues for management of sleep problems in the autism population.

150 **124.150** Preliminary Findings from a Clinical Multi-Center Study on Individuals with Autism Spectrum Disorders, Intellectual Disability and Psychiatric Disorders

S. B. Helverschou[1], *E. Myrbakk*[2] *and T. L. Bakken*[3], *(1)Oslo University Hospital, Oslo, Norway, (2)Psychiatric Resource Team, Nordland Hospital, Bodø, Norway, (3)Psychiatric Department for intellectual disability / Autism, Oslo University Hospital, Oslo, Norway*

Background:
Despite the assumed higher prevalence of psychiatric disorders in individuals with Autism Spectrum Disorders (ASD) and intellectual disability (ID) compared to the general population, specialized mental health services for this population remain scarce and professional competence is limited. The development of psychiatric interventions adapted to the needs of individuals with ASD and ID is also a neglected area of research.
In Norway, a national network for professionals in charge of providing specialized and supplementary mental health services to individuals with ASD and ID was established in 2007. Eight centers which are spread around the whole country participate. A clinical treatment study was started in 2010 and recruitment is still in progress.
Objectives:
The study was established to contribute to valid psychiatric diagnoses and individually tailored services for individuals with ASD and ID in need of specialized mental health services. Specific aims were to report on and evaluate the characteristics by the participants and their environment, proportion of co-occurring psychiatric diagnoses, the delivery and adaptations of psychiatric interventions for these individuals, and differences in services between the centers.
Methods:
Patients with ASD and ID who are referred to one of the participating centers with behavior problems or suspicion of psychiatric disorders are recruited to the study. The patients are assessed three times, at referral, after one year and after two years.
Assessments include background and characteristics, behavior problems, psychiatric symptoms and diagnoses, environmental factors, interventions provided, and evaluation by care staff and family members.
Results:
More than 120 participants have been recruited, and some preliminary findings from the assessment at referral (T1) will be presented; background and characteristics including level of ID and ASD symptoms; distribution of psychiatric disorders, associations between behavior problems and mental disorders. Preliminary analysis indicate that about one third of the patients are female, the patients' age vary from 13 – 57 years (M=30.1, SD=10.1), about one third have severe / profound ID and two thirds have moderate / mild ID, and almost one third of the patients were not diagnosed with a co-occurring psychiatric disorder.
Conclusions:
The participants recruited to the study are a heterogeneous group. Mental disorders seem to be especially associated with behavior problems. The study design provide data that gives the possibility of addressing different research questions and may contribute to the understanding of psychiatric disorders in ASD and ID and potentially effective, and individualized interventions.

151 **124.151** Prevalence and Predictors of ADHD in Adolescent Males with FXS and ASD

S. L. O'Connor[1], *S. McGrath*[2], *J. Ezell*[2], *C. Smith*[2], *L. Abbeduto*[3] *and J. Roberts*[1], *(1)Psychology, University of South Carolina, Columbia, SC, (2)University of South Carolina, Columbia, SC, (3)MIND Institute, UC Davis, Sacramento, CA*

Background: Fragile X Syndrome (FXS) is the leading known genetic cause of Autism Spectrum Disorder (ASD). The behavioral phenotype of FXS is marked by challenging behaviors and symptoms such as inattention, hyperactivity, and hyper arousal related to Attention Deficit/Hyperactivity Disorder (ADHD). Approximately 60% of males with FXS, and 28-53% of children with ASD display features of ADHD. However, no study has determined diagnostic rates of ADHD in FXS or ASD with most studies relying on broad band rating scales reflecting the presence of specific behaviors. Also, no work has contrasted ADHD in FXS to idiopathic ASD (non-FXS).
Objectives: In the present study, we characterize the prevalence and predictors of ADHD using a DSM-based diagnostic interview with group contrasts. Our focus is on adolescent males with FXS and those with ASD given the high prevalence of ADHD in these populations.
Methods: Participants included 30 males with FXS and 7 males with ASD, 16-23 years-of-age. The Children's Interview for Psychiatric Symptoms-Parent Version (PChIPS), a DSM based semi-structured parental interview was used as a diagnostic measure of ADHD with Inattentive, Hyperactive and Combined types specified. Chronological age, Leiter-Revised nonverbal IQ growth scores, and severity scores from the ADOS-2 were used as predictors of ADHD diagnostic estimates in logistic regression models.
Results: Our results show that 40% of the FXS group met diagnostic criteria for a DSM diagnosis of ADHD, whereas 71% of the ASD group met (t (9.1) = 1.52, p > .05). Preliminary analyses indicate across the FXS and ASD groups respectively, 27% versus 57% met for Inattentive, 7% versus 14% met for Hyperactive, and 13% versus 0% met for Combined Type. Results from logistic regression models indicate that chronological age, nonverbal IQ and autism severity did not predict any type of ADHD in either the FXS or ASD group (p > .05). In logistic models reflecting predictors for individual subtypes in FXS, autism severity approached significance for Inattentive type (B=-0.35, p=0.08) with a moderate effect size (r = -0.33) and also for Hyperactive type (B=0.978, p= 0.11), with a large effect size (r=.67). In contrast these predictors did not approach significance for the ASD group.
Conclusions: These findings suggest that diagnostic rates of ADHD in adolescents with FXS are lower than symptom prevalence estimates reported in childhood, and higher in ASD although not to a significant degree. Our finding that the rate meeting diagnostic criteria in FXS is lower than symptom prevalence is consistent with general patterns of higher symptom presentation on screening, broad-band measures and lower prevalence on more discreet diagnostic criteria. Our rate of 71% meeting diagnostic criteria for the ASD group could reflect the small sample. A lack of relationship between autism features and ADHD suggests that these disorders are distinct indicating that both assessment and treatment efforts should potentially be tailored to surveil and treat both of these disorders. We aim to add an additional 10 participants with ASD by May 2016.

152 **124.152** Relationship Between Subtypes of Restricted and Repetitive Behaviors in Sleep Disturbance in Autism Spectrum Disorder

R. J. Hundley[1], *A. Shui*[2] *and B. A. Malow*[3], *(1)11101 Doctors' Office Tower, Vanderbilt University Medical Center, Nashville, TN, (2)Massachusetts General Hospital, Boston, MA, (3)Vanderbilt University, Nashville, TN*

Background: Sleep disturbance is common in children with autism spectrum disorder (ASD) and behavioral contributors often exist. We examined the association of two types of restricted and repetitive behaviors (RRBs), repetitive sensory motor (RSM) and insistence on sameness (IS), with sleep problems in children with ASD.
Objectives: The study aimed to detect RSM and IS behaviors within a registry of children with ASD. We sought to understand the association of latent RSM and IS variables with parent reported sleep disturbance. We hypothesized that higher rates of RSM would be associated with more sleep disturbance and that higher rates of IS would be

associated with better sleep. We controlled for prevalent markers of sleep disturbance in ASD, including age, cognition, and total autism severity.
Methods: Data were extracted from the Autism Speaks Autism Treatment Network (AS-ATN) registry. Registry participants included children ages 2-17 who met classification for an ASD based on the Autism Diagnostic Observation Schedule (ADOS) and DSM-IV-TR. Measures included the ADOS, Autism Diagnostic Interview-Revised (ADI-R), Vineland, and the Children's Sleep Habits Questionnaire (CSHQ). Standardized intelligence scales also were administered. The final dataset included 339 children whose parents had completed the ADI-R and CSHQ. As previous exploratory analyses support the construct validity of RSM and IS, a confirmatory factor analysis (CFA) was conducted for selected ADI-R RRB items. RSM and IS severity scores were calculated from the individual items and the mean score for each scale was computed. Total sleep problems from the CSHQ was regressed against RSM and IS severity scores, while controlling for previously determined correlates of sleep disturbance, including age, IQ, and measures of overall autism severity (i.e., communication scores from the Vineland and social affect totals from the ADOS). Potential covariates were included in the model if they were significant at the 0.15 alpha level.
Results: CFA of selected items from the ADI-R detected RSM and IS in this dataset. The proposed model fit well (CFI = 0.90, SRMR =.06, RMSEA = .05). All factor loadings were statistically significant (t values >3, p <.05; Table 1). IS was significantly associated with total sleep problems after controlling for other known markers. When controlling for communication ability, total sleep problems increased by about 2.3 units for each unit increase in IS. For each unit increase in RSM, total sleep problems increased by about three points. This association was no longer significant when controlling for communication skills. Comprehensive results, including association of RSM and IS to CSHQ bedtime resistance and sleep onset scales are presented in Table 2.
Conclusions: Our findings yield validity to previous research indicating that RRBs can be parsed into factors, including RSM and IS. To the best of our knowledge this was the first study to assess health behavior, specifically sleep disturbance, in relation to these constructs. The association of RSM, IS, sleep problems, and developmental functioning was complex and further study is warranted. Better understanding of the behavioral challenges of children with ASD at nighttime may contribute to better sleep and improved daytime functioning.

Table 1

CFA: Covariance Structure Analysis of Standardized Factor Loadings

	Standardized Factor Loadings			
	RSM	IS	Standard Error	t Value
Preoccupations	0.19		.06	3.13
Repetitive Use of Objects	.64		.05	11.77
Hand & Finger Mannerisms	.40		.06	6.99
Other Mannerisms	.41		.06	7.30
Unusual Sensory Interests	.66		.05	12.07
Compulsions/Rituals		.48	.05	8.82
Sensitivity to Noise		.40	.06	7.09
Abnormal response to sensory		.28	.06	4.75
Difficulties with change		.69	.05	12.94
Resistance to change		.41	.06	7.26
Circumscribed interests		.36	.06	6.31

Table 2

Unadjusted and Adjusted Model Results

	Dependent Variable	Independent Variable	Estimate or Odds Ratio	Standard Error or 95% CI	p-value
Unadjusted Results	Total Sleep Problems score	RSM	2.89	0.97	0.0031**
		IS	1.69	0.90	0.0612
	Bedtime Resistance score	RSM	1.00	0.35	0.0041**
		IS	0.02	0.32	0.9480
	Sleep Onset Delay (Y/N)	RSM	1.10	0.71-1.71	0.6729
		IS	1.07	0.70-1.63	0.7475
Adjusted Results	Total Sleep Problems score[1]	RSM	1.37	1.07	0.2018
		IS	2.32	0.93	0.0128*
	Bedtime Resistance score[2]	RSM	0.20	0.41	0.6340
		IS	0.46	0.36	0.2073
	Sleep Onset Delay (Y/N)[3]	RSM	0.87	0.51-1.49	0.6164
		IS	1.12	0.71-1.76	0.6330

[1]Controlling for Vineland communication standard score

[2]Controlling for age at time of CSHQ, IQ, and Vineland communication standard score

[3]Controling for ADOS social affect domain score and Vineland communication standard score

* $p<0.05$

** $p<0.01$

153 **124.153** Relationship of Weight Outcomes and Severity of Autism Spectrum Disorder (ASD) in the Study to Explore Early Development (SEED)

S. E. Levy[1], *T. V. Kral*[2], *J. L. Chittams*[3], *C. B. Bradley*[4], *K. N. Burbage*[5], *E. V. Jones*[6], *J. Pandey*[7], *A. T. Pomykacz*[8], *N. Rahai*[9], *A. Ramirez*[10], *A. M. Reynolds*[11], *E. Rubenstein*[12], *L. A. Schieve*[13], *S. K. Shapira*[13], *A. M. Thompson*[14], *W. Thompson*[13], *W. E. York*[15], *L. Young*[16] *and J. A. Pinto-Martin*[2], *(1)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (2)Biobehavioral Health Sciences, University of Pennsylvania School of Nursing, Philadelphia, PA, (3)Biostatistics Consulting Unit, University of Pennsylvania School of Nursing, Philadelphia, PA, (4)Epidemiology, University of North Carolina at Chapel Hill, Chapel Hill, NC, (5)Center for Autism and Developmental Disabilities Research and Epidemiology (CADDRE)/ Biobehavioral Sciences (BHS), University of Pennsylvania School of Nursing, Philadelphia, PA, (6)PA CADDRE, University of Pennsylvania School of Nursing, Philadelphia, PA, (7)Children's Hospital of Philadelphia, Philadelphia, PA, (8)Center for Autism Research, Children's Hospital of Philadelphia- Center for Autism Research, Philadelphia, PA, (9)Center for Public Health Initiatives, University of Pennsylvania, Philadelphia, PA, (10)Study to Explore Early Development, University of Pennsylvania School of Nursing, Philadelphia, PA, (11)University of Colorado - Denver, Aurora, CO, (12)Department of Epidemiology, University of North Carolina, Chapel Hill, NC, (13)National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention, Atlanta, GA, (14)Office of Nursing Research, University of Pennsylvania School of Nursing, Philadelphia, PA, (15)Nursing Research, University of Pennsylvania School of Nursing, Philadelphia, PA, (16)School of Nursing, PA-SEED, CADDRE, Philadelphia, PA*

Background: Being overweight (OW) or obese (OB) is common in the general population, with almost 1/3 of children affected. Existing literature indicates that school-age children with autism spectrum disorder (ASD) or developmental disorders (DD) are at greater risk for OW or OB. These findings and corresponding risk factors have not yet

been addressed in large populations of preschool children (< 6 years old).
Objectives: We examined child weight outcomes in preschool children, across ASD, DD, and population control (POP) groups and the association between severity of ASD symptoms and OW or OB.
Methods: The Study to Explore Early Development (SEED) is a multi-site case-control study of children (3-5 years), comparing 3 groups: ASD (n=668), DD (n=914), and POP (n=884). Children in the DD and POP groups did not have a diagnosis of ASD. All children had parent interviews (medical and treatment history), cognitive assessment, behavioral screening questionnaires and child anthropometric measurements (during dysmorphology exam). Children in the ASD group had comprehensive ASD diagnostic evaluations (ADOS and ADI-R) and clinician-completed DSM-5 checklists with severity of symptoms noted, ranging mild to severe. Child age- and sex-specific BMI percentiles and z-scores were calculated using CDC Growth Charts 2000, and classified with BMI-for-age: underweight (UW) <5th percentile; normal-weight 5th to <85th percentile; OW and OB > 85th percentile. Associations between group membership and demographics were determined using chi-square tests. The association between obesity and group membership and severity of ASD symptoms was measured using a logistic regression model, with a p-value of <0.05 as significant. All analyses were conducted in SAS version 9.3 (SAS Institute, Cary, NC).
Results: Children in the ASD group had the highest percentage of males (81.7%) compared to DD (65.1%) and POP (53.1%) and were less likely to be white (57.5%), compared to DD (65.1%) and POP (69.9%). A chi-square test found a significant association between group membership and child weight status (p<0.0005). Children with ASD and DD had the highest frequency of OW or OB (ASD 27.5%, DD 25.0%) compared to POP children (19.5 %). Compared to POP children, children with ASD had 1.57 (CI: 1.24, 2.00) times the odds of being OW or OB (p= 0.002), and children with DD had 1.38 (CI: 1.10, 1.72) times the odds of being OW or OB (p = 0.001). There was a significant positive association between severity of ASD symptoms and weight status based on the Mantel-Haenszel chi-square test (p = 0.026).
Conclusions: Our findings suggest that children aged 3-5 years with ASD or DD have higher odds of being OW or OB than children in the POP group. Children in the ASD group with more severe symptoms of ASD were more likely to be OW or OB. Further analyses will be completed to parse out the contribution of other demographic, medical, developmental, behavioral, and treatment factors to the increased risk of OW or OB. Understanding factors associated with or contributing to excess weight gain will provide important information for clinicians and families caring for children with ASD and DD.

154 **124.154** Reliability and Validity of the Autism Spectrum Addendum to the Anxiety Disorders Interview Schedule (ADIS/ASA)

C. M. Kerns[1], *P. Renno*[2], *E. Crawford*[3], *R. Mercado*[3], *B. Garvin*[4], *J. Danial*[5], *P. C. Kendall*[6], *J. J. Wood*[2] *and E. Storch*[7], *(1)A.J. Drexel Autism Institute, Philadelphia, PA, (2)University of California Los Angeles, Los Angeles, CA, (3)Temple University, Philadelphia, PA, (4)AJ Drexel Autism Institute, Drexel University, Philadelphia, PA, (5)UCLA, Woodland Hills, CA, (6)Psychology, Temple University, Philadelphia, PA, (7)University of South Florida, St. Petersburg, FL*

Background: Assessing anxiety in autism spectrum disorder (ASD) is inherently challenging due to overlapping (e.g. social avoidance, repetitive behavior) and ambiguous symptoms across these conditions. Ambiguous features include social fearfulness without awareness of social evaluation, excessive worry about novelty and change, and phobic responses to unusual stimuli, such as men with beards, specific sounds, or toilets. How such symptoms are conceptualized across measures and clinicians may have an impact on research findings, especially given that the majority of anxiety measures are neither designed nor validated in ASD samples. Notably, data regarding the prevalence and characteristics (e.g. cognitive ability, age, ASD severity) associated with anxiety in youth with ASD is inconsistent (Van Steensel et al., 2011), partially due to inconsistent measurement and differentiation of symptoms across studies (Kerns & Kendall, 2012). The *Autism Spectrum Addendum* (ASA) is a set of clinical guidelines and supplementary items designed to facilitate use of the *Anxiety Disorders Interview Schedule – parent version*(ADIS; Silverman & Albano, 1996), a semi-structured diagnostic interview, for children with ASD. The ASA provides a structured approach to differentiating traditional anxiety disorders (i.e. Social Phobia, Separation Anxiety, Generalized Anxiety) in ASD and also measures the ambiguous fears and worries that arise in this population.
Objectives: To assess inter-rater reliability as well as convergent and discriminant validity of the ADIS/ASA.
Methods: The parents of 70 cognitively-able (IQ>70) children (ages 8-13 years, *M*age=10.67, *SD*=1.64) with ASD completed the ADIS/ASA along with a battery of other behavioral measures as part of a screening evaluation for a randomized clinical trial comparing two cognitive-behavioral therapies for anxiety. A second rater independently observed and scored recordings of the original interviews. Inter-rater reliability as well as convergent and discriminant validity of the ADIS/ASA with other measures were assessed.
Results: Inter-rater agreement for specific ASA items (ICC=.82-.96), traditional anxiety (ICC=.85-.98), and ambiguous anxiety severity ratings (ICC=.87-.95) was excellent. Agreement was also good to excellent regarding principal diagnoses (κ =.82), the presence of clinically significant traditional anxiety (κ =.67-.91), and ambiguous anxiety (κ =.77-.90). Pearson correlations indicated convergence of the most severe ADIS/ASA anxiety severity ratings (traditional or ambiguous) with Pediatric Anxiety Rating Scale totals (PARS; *r*=.52, *p*<.01). ADIS/ASA traditional anxiety ratings converged with the Child Behavior Checklist (CBCL) anxiety subscale (*r*=.35, *p*<.01), but diverged from Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) comparison scores (*r*=-.02, *n.s.)* and CBCL Attention (*r*=.023, *n.s.*) and Aggression subscales (*r*=-.16, *n.s*). By comparison, the severity of ambiguous ADIS/ASA symptoms was significantly correlated with ADOS-2 severity ratings (*r*=.31, *p<.02)*, but not the CBCL anxiety (*r*=.03, *n.s.*), Attention (*r*=.08, *n.s.*) or Aggression (*r*=.11, *n.s.*) subscales.
Conclusions: Findings indicate that the ADIS/ASA provides consistent measurement of traditional as well as more ambiguous anxiety-like symptoms in children with ASD across different raters. Additionally, the ADIS/ASA shows adequate convergent and discriminant validity with other measures. Implications for future studies of the treatment, prevalence and phenomenology of anxiety in ASD will be discussed.

155 **124.155** Resting Autonomic Activity in Children with Autism Spectrum Disorders and Matched Controls with and without Comorbid Anxiety

V. Parma[1,2,3], *N. Cellini*[4], *L. R. Guy*[5], *A. McVey*[6], *K. Rump*[7], *J. Worley*[8], *J. C. Bush*[9], *J. Miller*[10] *and J. Herrington*[11], *(1)SISSA, Trieste, Italy, (2)CHOP, Center for Autism Research, Philadelphia, PA, (3)Clinical Neuroscience, Karolinska Institutet, stockholm, Sweden, (4)Department of General Psychology, University of Padova, Padova, Italy, (5)TEACCH Autism Program, University of North Carolina at Chapel Hill, Greensboro, NC, (6)Marquette University, Milwaukee, WI, (7)The Center for Autism Research, Philadelphia, PA, (8)CHOP, Blue Bell, PA, (9)Indiana University, Bloomington, IN, (10)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (11)The Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA*

Background: Anxiety disorders are common among children with autism spectrum disorder (ASD). Both anxiety and ASD are associated with abnormal physiological activity. To date, few studies have investigated the autonomic profile of participants with ASD at rest and none has systematically assessed how the co-occurrence of formal anxiety disorders and ASD modulates resting physiological activity.
Objectives: The aim of the present study was to evaluate sympathetic and parasympathetic activity at rest in children and adolescents with ASD with and without comorbid anxiety. We also aimed to compare their autonomic profile, as well as parental and subjective reports of anxiety symptomatology, with the profiles of typically developing controls (TDC), matched for gender, age and presence of clinically relevant anxiety.
Methods: ASD was determined based on results from the ADOS, developmental interview or ADI-R, and clinical judgment. Both ASD and TDC participants received the Anxiety Disorders Interview Schedule (ADIS). Based on these data 4 subgroups were identified: ASD with comorbid anxiety (ASDanx, N=22), ASD and no anxiety (ASDnon, N=15), TDC with comorbid anxiety (TDCanx, N=16) and TDC and no anxiety (TDCnon, N=22). Participant ages ranged from 8 to 17 years old and were comparable across groups. In only the ASDanx group, males significantly outnumbered females. Autonomic parameters were assessed during a 5-minute resting state collected while the child was watching neutral nature scenes. Skin conductance level (SCL), a stable proxy for sympathetic activity in children with ASD (Schoen et al. 2008), and the proportion of high frequency component of heart rate variability (HRV), a proxy of parasympathetic activity, were calculated. Parents and children were asked to complete the Screen for Child Anxiety Related Emotional Disorders (SCARED); the overall score was used as a subjective evaluation of anxiety.
Results: Reduced sympathetic and parasympathetic activity at rest was found in ASD as compared to TDC. In particular, the analysis of sympathetic activity revealed a paradoxical hypo-arousal in ASDanx participants. Moreover, the analysis of the parasympathetic cardiac activity showed that in TDC (but not in ASD) anxiety promotes tachycardia. Overall, ASD groups showed lower parasympathetic activity, in line with the idea of inflexible physiological reactivity. Regression analyses suggest that the concurrent consideration of physiological responses as well as parent, and self-reports allows for an efficient categorization of the 4 subgroups.
Conclusions: Anxiety in ASD was associated with abnormal sympathetic and parasympathetic activity which, in association with parent and self-reports, allowed for efficient diagnostic categorization. As expected, the TDCanx group showed elevated levels of sympathetic activity. On the contrary, children with ASD and comorbid anxiety presented an atypically blunted autonomic profile. This suggests that anxiety in ASD may be related to different mechanisms than in TDC. In addition, the combination of autonomic profile and anxiety report measures might constitute a marker of anxiety in ASD. These findings emphasize the need for further investigations of the physiological activity of ASD and anxiety, since identification may facilitate the selection of effective treatments.

156 **124.156** Risk and Protective Factors of Depression in Children with ASD Tendency in Japan

N. Takayanagi[1], *M. Adachi*[1], *S. Yasuda*[1], *S. Yoshida*[1], *M. Kuribayashi*[1] *and K. Nakamura*[2], *(1)Research Center for Child Mental Development, Hirosaki University, Hirosaki, Japan, (2)Hirosaki University Graduate School of Medicine, Aomori, Japan*

Background: Children with ASD were tend to have difficulties in social communications and friendships in school, therefore they are at risk of secondary disabilities such as depression. Previous studies showed that rumination such as repetitive focus on their distress would increase depressive mood and skills of problem solving would decrease it. It is necessary to examine risk and protective factors of depression in children with ASD.
Objectives: The present study aims to examine risk and protective factors of depression in children with ASD tendency.
Methods: 3,678 children (1,868 boys, 1,810 girls) in public schools completed the Japanese version of the Depression Self-Rating Scale for Children short-form, the Strengths and Difficulties Questionnaire (peer problems subscale), the Social Maladjustment Scales (achievement, teacher and family), the Social Support Scales (peer and

adult) and the Response Style Questionnaire for Middle School Students (problem solving, rumination, avoidance and distraction), and their parents completed the Autism Spectrum Screening Questionnaire short-form.
Results: We divided the children into two groups according to the ASSQ short-form cut-off score; 367 boys in ASD tendency group (ASDtG-boys), 1501 boys in control (control-boys), 227 girls in ASDtG (ASDtG-girls) and 1583 girls in control (control-girls). We conducted a gender × ASSQ group ANOVA on the DSRS-C total score. Main effects of gender and ASSQ group were significant, but interaction was no significant. The result showed that girls were more depressive than boys ($F(1,3674) = 48.07$, $p < .001$, $\eta^2 = .013$), and ASDtG was more depressive than control ($F(1,3674) = 130.12$, $p < .001$, $\eta^2 = .034$). Then, we conducted a multiple regression analysis to examine whether these variables affect depression in each gender and ASSQ groups. In the results, these variables explained a significant amount of the variance of depression in all groups ($R^2 = .458–.613$). In the all groups, SDQ peer problems (β = .235–.329, $p < .001$) and rumination (β = .227–.309, $p < .001$) showed positive effects on depression significantly, and peer support (β = -.247–-.166 $p < .001$) and distraction (β = -.229–-.125, $p < .001$) showed negative effects significantly. Regarding ASD tendency in the same gender, ASDtG-boys showed avoidance as a positive effect (β = .108, $p < .001$) significantly and adult support as no significant effect on depression. On the other hand, avoidance did not show significant effect and adult support showed a negative effect (β = -.160, $p < .001$) significantly in control-boys. In addition, ASDtG-girls showed that grade and problem solving were no significant, although grade was a significant positive effect (β = .118, $p < .001$) and problem solving was a significant negative effect (β = -.107, $p < .001$) in control-girls.
Conclusions: The current study showed that children with ASD tendency would have different risk and protective factors of depression from controls, although they had the same factors partially. Peer support and distraction would decrease depression in all children, and for children with ASD, suitable coping strategy and support would be effective.

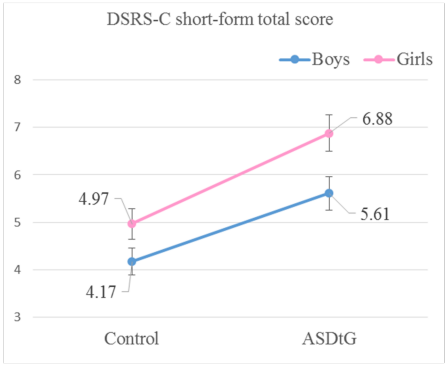


Figure 1

Results of Analysis of Variance for Gender and ASSQ Group on Depression

Table 1

Results of Multiple Regression Analysis of Depression

	Boys						Girls					
	Control (n = 1395)			ASDtG (n = 345)			Control (n = 1500)			ASDtG (n = 211)		
Predictor	*B (SE)*	*B* 95% CI	β	*B (SE)*	*B* 95% CI	β	*B (SE)*	*B* 95% CI	β	*B (SE)*	*B* 95% CI	β
Grade	.146 (.039)	[.071, .222]	.082***	.248 (.079)	[.091, .404]	.109**	.233 (.039)	[.156, 310]	.118***	–		.051
Peer problems	.429 (.041)	[.348, .510]	.235***	.574 (.070)	[.436, .712]	.329***	.603 (.043)	[.518, .687]	.292***	.597 (.106)	[.388, .807]	.322***
Achivement	.080 (.031)	[.018, .141]	.059*	–		-.037	.093 (.032)	[.030, .157]	.061**	–		.025
Teacher	–		-.037	–		-.026	–		.017	–		.036
Family	.138 (.039)	[.062, .215]	.084***	.276 (.072)	[.134, .417]	.143***	.139 (.039)	[.063, .214]	.076***	–		.104
Peer support	-.123 (.019)	[-.161, -.086]	-.166***	-.160 (.032)	[-.224, -.097]	-.204***	-.214 (.020)	[-.253, -.175]	-.244***	-.196 (.049)	[-.292, -.099]	-.247***
Adult support	-.105 (.017)	[-.138, -.072]	-.160***	–		-.052	-.036 (.018)	[-.071, -.001]	-.045*	-.145 (.043)	[-.230, -.060]	-.176**
Problem solving	-.098 (.018)	[-.134, -.062]	-.130***	-.156 (.037)	[-.230, -.083]	-.167***	-.093 (.018)	[-.130, -.057]	-.107***	–		-.042
Rumination	.208 (.021)	[.167, .249]	.227***	.309 (.039)	[.231, .386]	.299***	.259 (.021)	[.219, .300]	.258***	.346 (.053)	[.242, .451]	.309***
Avoidance	–		-.040	.117 (.041)	[.035, .198]	.108**	–		.008	–		.045
Distraction	-.150 (.026)	[-.201, -.099]	-.125***	-.336 (.066)	[-.466, -.207]	-.229***	-.206 (.030)	[-.265, -.148]	-.136***	-.253 (.088)	[-.427, -.080]	-.141**
Adjusted R^2	.455			.604			.536			.549		
F	130.18***			66.63***			186.07***			52.20***		
df	9, 1385			8, 336			9, 1490			5, 205		

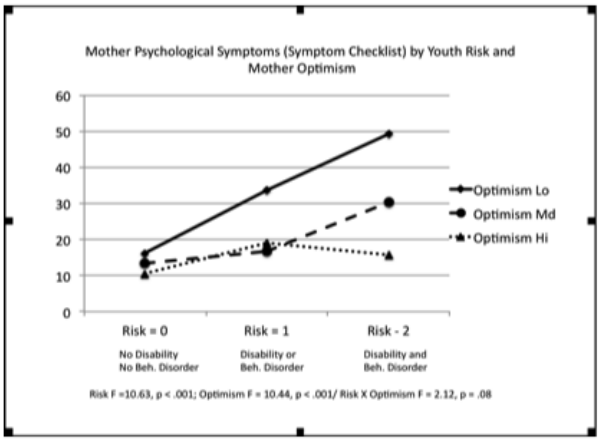
*p <.05, **p <.01, ***p <.001

Note. ASDtG; ASD tendency group (above ASSQ short-form cutoff score), CI; confidence interval, –; non significant values

157 **124.157** Silver Linings: Optimism and Positivity As Buffers of Stress and Lower Well-Being in Mothers of Adolescents with ASD and Co-Morbid Disorders

J. Blacher[1] *and B. L. Baker*[2]*, (1)University of California - Riverside, Riverside, CA, (2)UCLA, Los Angeles, CA*

Background:
Evidence suggests that dispositional optimism is beneficial to one's health (Carver et al., 2010; Peterson, 2000) and helps maintain positivity during adverse times (Taylor et al., 2010). Specific to mothers of children with ASD or intellectual disability, maternal optimism relates to increased positive affect, decreased negative affect, and more adaptive coping strategies (Blacher et al., 2013). However, these youth have heightened behavior disorders relative to youth with typical cognitive development (Baker & Blacher, 2015), and their parents have further heightened stress related to these disorders. Little is known about how maternal optimism buffers the increased stress and lower sense of well-being experienced by mothers of adolescents with ASD and co-morbid behavior disorders.
Objectives:
We will consider the role of optimism in mothers of teens: (1) Does mothers' optimism relate to disability status (ASD, intellectual disability (ID) and typical development (TD)? (2) Does optimism buffer the increased stress and psychological difficulties experienced by mothers of youth presenting varying levels of risk? (3) Does the relationship between youth behavior disorders and parenting stress hold across adolescence (ages 13 to 15), and does optimism moderate this relationship at both time-points?
Methods:
This report is drawn from the Collaborative Family Study, a 15-year longitudinal study of behavior and mental disorders in children with or without ID/ASD. We report findings from age 13 and 15 assessments; the sample (N=195) contains youth with TD (IQ >84, n=100), ID (IQ <85, n=40), and ASD (n=58). The primary measure of behavior disorders was the Child Behavior Checklist. Other measures included the Family Impact Questionnaire Positive and Negative sub-scales; Symptom Checklist; and Life Orientation Test. A three-level risk index was determined from the presence of (a) ID and/or ASD, and (b) disruptive behavior diagnoses ADHD and/or ODD. Risk = 0/low (Neither a nor b); 1 (either a or b), or 2/high (both a and b).
Results:
Q1. Mothers' optimism was modestly (but significantly, p=.04) related to group status (TD>ID>ASD). The presence or absence of co-morbid disruptive behavior disorders (ADHD or ODD) was not related to dispositional optimism. **Q2**. To study the personality trait of dispositional optimism as a buffer of the relationships between child challenges and maternal well-being, we divided optimism scores into high (optimistic), medium, and low (pessimistic) thirds. The figure (one example) illustrates that psychological symptoms increased dramatically with increasing child risk. Optimism did not make a difference at "low-risk", but at "high-risk" mothers with low optimism (pessimism) reported a greater than 2.5 times increase in psychological symptoms. **Q3**. Youth behavior disorders and mothers' stress both *decreased* significantly from age 13 to 15, and significantly moreso in the ASD group. We will report the role of maternal optimism in these changes over time.
Conclusions:
Child disability status and child behavior problems/mental disorders take a psychological toll on mothers. However, the personality trait of dispositional optimism buffers these (child risk - parent adjustment) relationships. Not all parents are impacted similarly by youth disability and/or problem behaviors; there is a silver lining for those with more positive perceptions.



158 **124.158** Suicidality in Adolescents and Adults with and without an Autism Spectrum Condition

L. Van Dongen[1] *and S. A. Cassidy*[2]*, (1)Maastricht University, Maastricht, Netherlands, (2)Coventry University, Coventry, England, United Kingdom*

Background: Recent research has shown that adults with Autism Spectrum Conditions (ASC) report significantly increased rates of suicidality compared to the general population and other clinical groups. Self-reported autistic traits and history of depression have been shown to be significant risk factors for suicidal ideation, plans and attempts in this clinical group (Cassidy et al., 2014). However, there is still very little research exploring suicidal ideation, suicide plans, suicide attempts or non-suicidal self-injury in those with ASC and the associated risk factors. It is also unknown whether autistic traits are a risk factor for suicidality in the general population.
Objectives: 1) To compare the rate of suicidality, and non-suicidal self-injury in adolescents and adults with ASC to; a) typically developing (TD) adults, and b) a previous patient sample diagnosed with Asperger Syndrome (AS) in adulthood; 2) To explore risk factors for suicidality and non-suicidal self-injury in adolescents and adults with and without ASC.
Methods: 25 adolescents and adults with ASC were recruited from a Belgium clinic, and 43 adolescents and adults without ASC were recruited from online adverts. Participants completed an online survey including the Autism Spectrum Quotient (AQ), age diagnosed with ASC, lifetime experience of suicidal ideation, suicide plans, suicide attempts, and non-suicidal self-injury.
Results: Mean age of ASC diagnosis was 21.4 years (range 13-45, SD 10.7). Participants with and without ASC were matched on age (p=0.2) and education status (p=0.6). Self-reported rates of suicidal ideation in the current ASC sample (60%) were not significantly different to rates reported in a UK clinic sample diagnosed with AS in adulthood (66%, p=0.5). Compared to the TD group, participants with ASC were significantly more likely to report lifetime experience of suicidal ideation (60% vs 25.6%, OR 1.8, p<0.01); suicide plans (32% vs 4.7%, OR 3.5, p<0.01); and non-suicidal self-injury (28% vs 7%, OR 2.3, p=0.02); but not suicide attempts (16% vs 4%, p=0.1). In the TD group, self-reported autistic traits were significantly correlated with lifetime experience of suicidal ideation (p=0.01), suicide plans (p<0.001), and suicide attempts (p<0.01), but not non-suicidal self-injury (p=0.26).
Conclusions: Results confirm consistently high rates of suicidal ideation in adolescents and adults with ASC, in approximately two thirds of patients. Participants with ASC in the current sample were significantly more likely to have experienced suicidality and non-suicidal self-injury than age and education matched controls. Self-reported autistic traits were also a significant risk factor for suicidality in the general population. These results suggest an association between autistic traits, and increased risk of suicidality. This highlights the need for heightened vigilance for suicidality in people with ASC.

159 **124.159** The Longitudinal Course of Mood and Psychosocial Functioning in Youth with Comorbid Bipolar and Autism Spectrum Disorders

X. Borue[1]*, C. A. Mazefsky*[2]*, T. Goldstein*[1]*, B. Rooks*[3]*, M. K. Gill*[1]*, M. Strober*[4]*, M. B. Keller*[5]*, D. Axelson*[6]*, S. Yen*[5]*, R. S. Diler*[1]*, D. A. Axelson*[1]*, B. Goldstein*[1] *and B. Birmaher*[1]*, (1)Western Psychiatric Institute and Clinic, University of Pittsburgh School of Medicine, Pittsburgh, PA, (2)Department of Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA, (3)University of Pittsburgh, Pittsburgh, PA, (4)David Geffen School of Medicine, University of California, Los Angeles, CA, (5)Butler Hospital, Brown University School of Medicine, Providence, RI, (6)Nationwide Children's Hospital, The Ohio State University College of Medicine, Columbus, OH*

Background: Autism Spectrum Disorder (ASD) is often clinically associated with disturbances of mood and emotion. There is growing evidence of elevated rates of comorbidity between ASD and other psychiatric disorders, particularly Bipolar Disorder (BP). The recognition and treatment of comorbid BP in individuals with ASD, despite its clinical importance, has been hampered by a dearth of phenomenological data. A small number of cross-sectional studies suggest increased impairments and a higher prevalence of atypical features, but little is known about the longitudinal course of BP in youths with ASD.
Objectives: To provide the first longitudinal characterization of mood and psychosocial functioning in youth with comorbid ASD and BP.
Methods: The Course and Outcome of Bipolar Youth (COBY) study recruited youths ages 7 to 17 years with DSM-IV BPI, II, or operationally-defined BP-NOS. Subjects were comprehensively assessed using structured diagnostic interviews and a wide range of non-overlapping measures covering multiple dimensions of functioning. This study included a total of 368 youths with at least 4 years of follow-up (average ~9 years) using the Longitudinal Interval Follow-up Evaluation. Subgroup analysis was conducted, comparing youth with (BP+ASD) and without ASD on clinical presentation, percentage of time with mood symptomatology, and psychosocial functioning.
Results: Thirty youth (~8%) met DSM IV criteria for ASD. Duration of BP symptoms prior to entry into the study was ~4 years for both groups, but BP+ASD youth were, on average, 2 years younger at symptom onset and intake. As is typically observed in clinical cohorts, the male to female ratio was ~1:5 for BP+ASD youth vs 1:1 for BP youth. Additional diagnostic comorbidity was common, with 87% of BP+ASD youth also meeting criteria for ADHD. Similar to previous studies, BP+ASD youth had significantly higher T-scores on several syndrome scales of the intake Child Behavior Checklist including; withdrawn, social, thought, and attention problems. Over time, the proportion of predominantly euthymic youth in both groups increased and episode recurrence decreased. BP+ASD youth spent significantly more time with sub-syndromal mixed symptoms and had worse psychosocial functioning, especially with respect to friendships. Distribution between BP subtypes and lifetime worst episode severity were similar for both groups. BP+ASD youths exhibited typical BP mood symptoms but were found to have a higher prevalence of social withdrawal, poor mood reactivity (activity-related transient improvements in negative mood), and a broad range of manic symptoms (e.g. grandiosity, elated and labile mood, distractibility, and motoric activation). Differences between BP and BP+ASD youth on most factors were most prominent during the first few years and decreased over time.
Conclusions: Youth with comorbid BP and ASD exhibited typical BP mood symptoms but earlier onset, mixed symptom presentation, and additive functional impairments. Significant amelioration of clinical symptoms and psychosocial impairment occurs over time, suggesting that early recognition and treatment of mood disorders in youth with ASD may improve clinical outcomes.

160 **124.160** The Presence of Gastrointestinal Symptoms in Parents of Individuals with Autism Spectrum Disorder

J. Barstein[1]*, A. Bedell*[2]*, N. Dunbar*[1]*, L. Keefer*[2] *and M. Losh*[1]*, (1)Department of Communication Sciences and Disorders, Northwestern University, Evanston, IL, (2)Division of Gastroenterology and Hepatology, Northwestern University Feinberg School of Medicine, Chicago, IL*

Background: Gastrointestinal (GI) symptoms are four times as common in ASD than controls (McElhanon, 2014), and may exacerbate the behavioral and psychosocial

symptoms of the disorder (Mazurek, et al. 2013; Maenner et al. 2012; Peters et al. 2014). However, it is unclear how GI symptoms relate to the underlying causes of ASD. Evidence suggests an association between GI symptoms and ASD candidate genes (Campbell et al., 2006; Bernier et al., 2014), and family studies show aberrations in intestinal bacteria in siblings (Finegold et al., 2010; Gondalia et al., 2012; Parracho et al., 2005). This study built on previous work by examining the presence of GI symptoms in both individuals with ASD and their parents.
Objectives: To examine the familiality of GI symptoms in ASD by investigating the rate of symptoms in individuals with ASD and their parents, and how such features may relate to behavioral and psychosocial features.
Methods: Seventeen individuals with ASD and 35 parents (22 mothers, 13 fathers) were administered a battery of questionnaires to characterize a range of GI symptoms associated with functional or organic disorders of the digestive system. Functional disorders (FGID) include those that cannot be explained by structural or tissue abnormality (e.g., Irritable Bowel Syndrome, IBS) while organic disorders have known, physical, etiology (e.g., Crohn's Disease). GI symptoms were examined in relationship to previously collected phenotypic assessments of depression, anxiety, executive functioning, sensory sensitivity, pragmatic language, and social cognition.
Results: Forty three percent of individuals with ASD and more than half (63%) of parents met criteria for a GI disorder. While epidemiological studies have not been conducted to establish population based rates, this is substantially higher than 10-20% prevalence rates reported for IBS (the most common of FGIDs) in the general population. Higher rates of pragmatic language differences were noted among both individuals with ASD ($p=.07$) and parents ($p<.05$) who met criteria for a GI disorder, compared to those without a GI disorder. Parents who met criteria for a GI disorder also demonstrated greater sensory sensitivity, a higher likelihood of generalized anxiety disorder, and stronger social cognitive abilities (p's < .05) relative to ASD parents without GI disorders. Parents with a GI disorder were significantly more likely to have children with a GI disorder ($p<.05$).
Conclusions: Results document a high prevalence of GI disorders in individuals with ASD as well as their parents, suggesting studying GI symptomatology may help further our understanding of the complex etiology of ASD. The relationship between pragmatic language deficits and GI disorders is consistent with prior studies in ASD and adds to our understanding of underlying causes of ASD from a familial perspective. The presence of GI symptoms in parents corresponds with important behavioral and psychosocial profiles, complementing prior studies documenting relationships between GI symptoms and features of ASD in probands. This study contributes to a growing body of research supporting evidence of the gut-brain connection in ASD (Hsiao, 2013).

161 **124.161** The Relation Between Autism Symptom Severity and Family History of Psychiatric and Neurodevelopmental Disorders

D. Morriss[1,2], *H. Tokajian*[3], *A. H. Gerber*[2], *E. M. Morrow*[2,4], *T. F. Anders*[2] *and S. J. Sheinkopf*[2,3], *(1)Alpert Medical School of Brown University, Providence, RI, (2)Rhode Island Consortium for Autism Research and Treatment (RI-CART), Bradley Hospital, East Providence, RI, (3)Brown Center for the Study of Children at Risk, Women & Infants Hospital, Providence, RI, (4)Department of Molecular Biology, Cell Biology and Biochemistry and Institute for Brain Science, Brown University, Providence, RI*

Background: It is known that Autism Spectrum Disorder (ASD) is associated with family history of psychiatric disorders in addition to rates of autism and other neurodevelopmental disorders. Studies disagree about which psychiatric disorders are most prevalent in families of those with ASD, although epidemiological studies support a link between autism and familial mood and anxiety disorders (Smalley, McCracken, & Tanguay, 1995). Research indicates relationships between positive family history and higher IQ or increased functional ability (Mazefsky, Williams, Minshew, 2008; Robinson, et. al 2014). Studieshave yet to examine how family psychiatric history may correlate to measures of autism severity.
Objectives: To investigate whether the presence of psychiatric and neurodevelopmental disorder history in first- and second-degree relatives in a population of children and adolescents diagnosed with ASD is related to autism severity in the proband.
Methods: Participants were children and adolescents with ASD (n = 338, 3-17 years old) selected from a state-wide autism patient registry (80.5% male, mean age 9.9 years). ASD diagnoses were confirmed by the Autism Diagnostic Observation Schedule (ADOS). Family history of psychiatric and neurodevelopmental disorders was obtained through parental interviews. The presence of psychiatric and neurodevelopmental disorders in first- and second-degree relatives was summed to create four composite variables (i.e, sum of psychiatric disorders and neurodevelopmental disorders in 1^{st} and 2^{nd} degree relatives). The psychiatric family history composite consisted of fifteen disorders (e.g., mood and anxiety disorders), and the neurodevelopmental disorder composite consisted of eight disorders (e.g., ASD, Learning Disabilities, Intellectual Disability). Estimates of proband symptom severity were based on the caregiver-completed Social Responsiveness Scales, 2^{nd}Ed. (SRS-2) total T scores and the ADOS standardized severity score. Gender-controlled linear regression was used to investigate the relationship between family history of psychiatric and neurodevelopmental disorders and autism severity scores.
Results: First-degree family history of psychiatric disorders was related to increased symptom severity on the SRS-2 measure (*beta* = .159, $p = 0.009$). There was no significant relation between first- or second-degree family history of neurodevelopmental disorders and SRS-2 severity measure, nor a significant relation between family history of neurodevelopmental disorders or psychiatric disorders and ADOS symptom severity. Follow up analyses of psychiatric disorders revealed that first-degree family history of depression was significantly associated with higher SRS-2 scores, even after statistical correction ($t(290) = -3.31$, $p = .001$), while no other disorders showed a statistically significant trend.
Conclusions: The increase in presence of family history of psychiatric disorders in first-degree relatives was related to an increase in severity of social deficits in the autism spectrum measured by the SRS-2. These findings implicate a positive psychiatric family history as a higher genetic liability toward autism severity, but we also must consider the possibility that an increase in more "problematic" behaviors in children may contribute to a reporting bias in parental psychiatric disorders such as depression or anxiety. Our results support existing research that stresses the importance of investigating psychiatric family history as a potential contributing factor to behavioral ASD phenotypes.

162 **124.162** The Relationship Between Food Selectivity, Gastrointestinal Dysfunction and Biomarkers in Autism Spectrum Disorder

R. Enten[1], *E. Gal*[2] *and Y. Latzer*[3], *(1)Occupational Therapy, University of Haifa, Haifa, Israel, (2)University of Haifa, Timrat, Israel, (3)Public health, University of Haifa, Haifa, Israel*

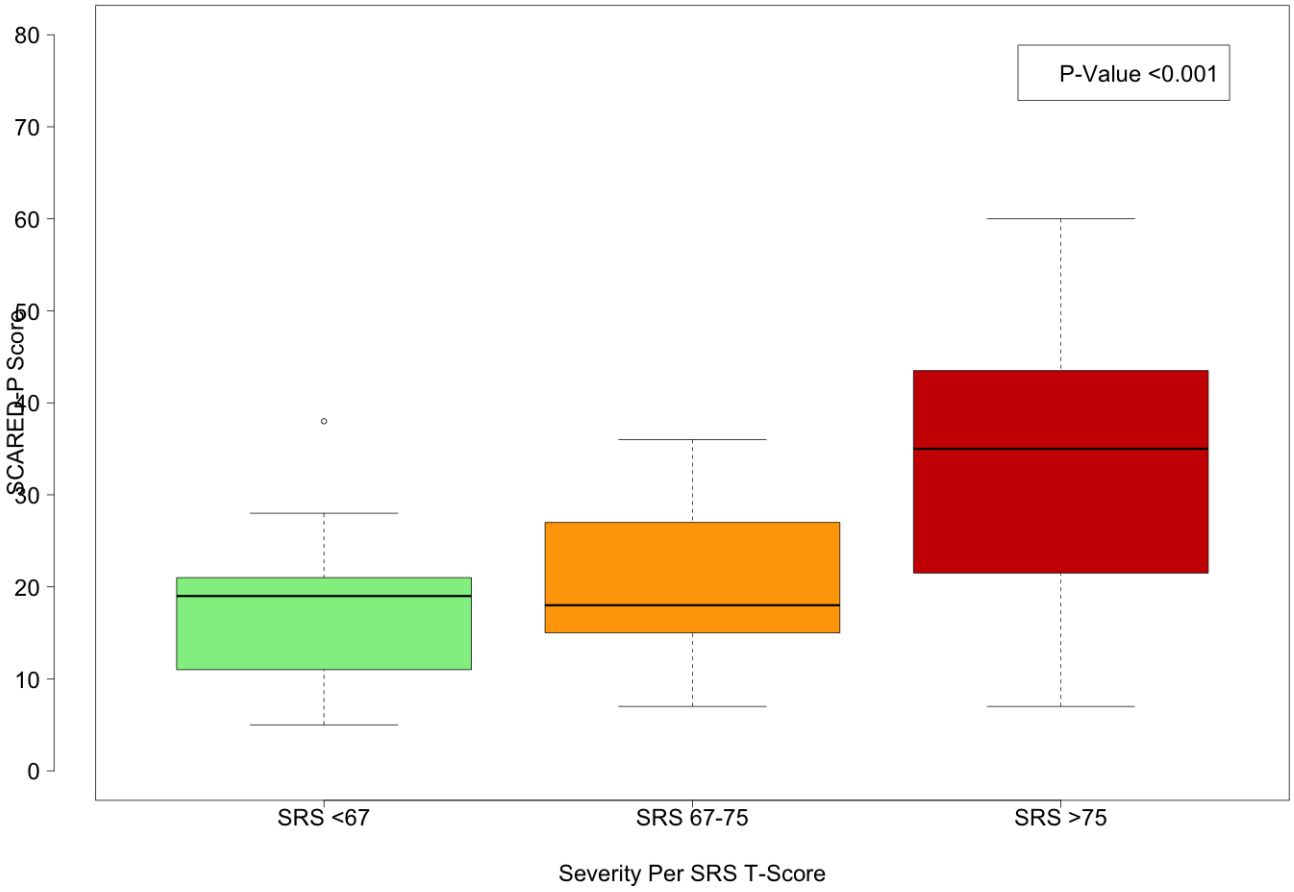
Background: Autism spectrum disorder (ASD) is a clinically heterogeneous, multi-system disorder with a variety of comorbidities, commonly including eating and feeding problems, with many children on the autistic spectrum suffering from some manifestation of food selectivity or picky eating. Though these problems are typically addressed through behavior-based, therapeutic approaches, increasing evidence shows they may be organic in nature, and linked with underlying gastrointestinal dysfunction (GID) and other biochemical imbalances such as immune dysregulation, inflammation, impaired detoxification, oxidative stress, mitochondrial disease/dysfunction and more. While eating problems in ASD are thought to cause health problems and can even, at times, be life threatening, it has not yet been investigated whether food selectivity is related to specific biomarkers appearing in early childhood, nor has the connection between food selectivity and GI function been explored.
Objectives: The aims of the study were to: (1) identify & characterize urine-based biomarkers of children with ASD (2) identify whether specific biomarkers and GI problems in children with ASD are correlated with food selectivity.
Methods: An anonymous review of the clinical charts of 68 children with a diagnosis of ASD, was performed. Participant ages ranged from 3-7 years. Descriptive statistics were used to illustrate the percentage of participants whose results were above the normal range for each metabolite. Metabolites for which greater than 25% of the children had elevated levels are reported in this study. Chi square test was used to assess the correlations between parental report of food selectivity and elevated metabolites as well as parental report of GI symptoms and elevated metabolites.
Results: All 68 children had at least one elevated organic acid metabolite, and the mean number of elevated metabolites was 9.5 (SD = 5). Of the 53 metabolites assessed, 15 metabolites were elevated in 25% or more of the population studied and 20 metabolites were elevated in between 10-24% of the population. The rest of the metabolites were elevated in under 10% of the population. Parents of 60% of children reported food selectivity. 47% of parents who reported food selectivity also reported GI symptoms in their children. Food selectivity was found to be correlated with elevated Vanillylmandelic acid (VMA) (28.1% elevated; $^{2}\chi_{(1)}=4.24$, P=0.4)), Suberic acid (26.9% elevated; 2χ)(1)=4.89, P=0.3)), 3-oxoglutaric acid (43.5% elevated; $2\chi(1)=3.59$, P=0.6), Arabinose (80.9% elevated; $2\chi)(1)=3.73$, P=0.05), and Oxalates (43.3% elevated; $(2\chi)(1)=3.77$, P=0.5).
Conclusions: This study highlights the relationship between food selectivity, GID and select organic acid metabolites, raising the possibility that food selectivity, at least among certain cases of ASD, may be the result of unbalanced gut bacteria, and associated symptoms. Future studies should explore whether the presence of elevated biological metabolites related to GI health may be able to predict food selectivity.

164 **124.164** The Relationship of Anxiety and Reciprocal Social Impairment in Autism: A Comparison Study of the Scared and SRS

W. D. Lohr[1], *T. Wiemken*[2], *R. Kelley*[2], *K. Daniels*[3], *P. G. Williams*[1], *G. M. Kuravackel*[1] *and L. L. Sears*[1], *(1)Pediatrics, University of Louisville School of Medicine, Louisville, KY, (2)Medicine, University of Louisville School of Medicine, Louisville, KY, (3)Psychology, Spalding University, Louisville, KY*

Background: There is increased recognition and interest in psychiatric comorbidity in Autism Spectrum Disorders (ASD). Anxiety is frequently seen in ASD but it is not clear if the two conditions are separate or if symptoms of anxiety are part of the essential features of ASD such as social impairment and restrictive, repetitive behaviors. The complex interplay of anxiety and core social communication deficits in ASD warrants additional attention.
The Screen for Child Anxiety Related Disorders (SCARED) is a well-established screening instrument for anxiety in youth and shows promising results in its application to children with ASD. The Social Responsiveness Scale (SRS-2) has been used to identify and study the severity of social communication deficits in ASD in a quantitative fashion. Comparing results of these two instruments in subjects with ASD provides opportunities to better understand the relationship between ASD and anxiety in this population.
Objectives: The purpose of the study was to determine how parental and child reports of anxiety and are related to social impairment in subjects with ASD. By examining

how individual items and treatment subscales of the SRS-2 relate to measures of anxiety on the SCARED, we hoped to understand better which core symptoms of ASD were most highly associated with parent and child reports of anxiety.
Methods: 100 patients age 8 to 18 years with a clinical diagnosis of ASD without intellectual disability were recruited from clinic sites. Participants and parents completed the SCARED child and parent forms and the SRS-2. SCARED parent and child total scores and diagnostic factor subgroups were compared to SRS-2 categories of severity by using the Mann-Whitney U-test or Analysis of Variance. Random Forest models were used to identify individual SRS items important for classifying children as anxious for parent and child SCARED scales separately. Poisson regression models measured the predictive ability of each of those variables to detect anxiety.
Results: Parents rated children with ASD and more severe levels of social impairment as having more anxiety. This pattern holds across all diagnostic subtypes represented by the SCARED. There were no significant correlations between levels of social impairment and child reports of anxiety.
Random Forest analysis associated parents' reports of restrictive, repetitive behavior and emotional dysregulation on the SRS-2 with high parental ratings of anxiety. However, regression analysis showed none of these items significantly predicted anxiety based on parent SCARED.
Random Forest analysis associated parent reports of preoccupations and lack of observed social behavior on the SRS-2 with high child reports of anxiety. Parental reports of clinging to adults and having unusual sensory interests or stereotypical play significantly predicted child ratings of the presence of an anxiety disorder.
Conclusions: The SCARED and SRS-2 can be used to understand the nature of anxiety in ASD. Ratings of anxiety in autism correlate with core autistic symptoms as well as externalized behavior. Parents and children associate anxiety with different types of social impairment. The relationship of anxiety and autism may be best understood by non-linear measures.



165 **124.165** Threat Interpretation and Anxiety in Autistic Children and Their Mothers

L. E. Neil, *A. E. Croydon and E. Pellicano, Centre for Research in Autism and Education (CRAE), UCL Institute of Education, University College London, London, United Kingdom*

Background:
Anxiety has been shown to be associated with cognitive biases such as negative interpretations of ambiguous situations in non-autistic individuals. Children on the autism spectrum often experience high levels of anxiety but well validated self-report measures of anxiety-related cognitions in this population are lacking.
Objectives:
We investigated for the first time the validity of an ambiguous scenarios interview, widely used in studies of anxiety in non-autistic children (Barrett et al., 1996; Creswell et al., 2014; Waite et al., 2015), with a group of autistic children. We also examined the relationship children's interpretations had with their own and their mothers' levels of anxiety.
Methods:
Twenty-six cognitively able children with autism, aged between 6 and 14 years, were presented with a series of 12 ambiguous scenarios such as: "You see the school principal walking around the playground and s/he has been asking other children where you are". Children were asked how upset they would be in the situation (on a scale of 1-10) and offered a choice between a non-threatening and threatening interpretation of what was happening (coded 0 or 1). Eighteen mothers completed the same questions in regards to their autistic child. Typically developing children completed the same questions for comparison.
Children and mothers completed the Spence Children's Anxiety Scale (SCAS). Mothers completed the Beck Anxiety Inventory.
Results:
Autistic children's reports of how upset they perceived they would be in response to the 12 scenarios showed good internal consistency (α = .87) as did their threat interpretations (α = .80). Autistic children's reports of how upset they perceived they would be in response to the scenarios showed a significant, positive association with their self-reported anxiety (r = .56, p =.01); but their threat interpretations did not (r = .21, p = .27). Mothers reported that autistic children would be significantly more upset (t (17) = 3.13, p =.01), and would perceive significantly more threat (t (17) = 2.53, p = .02) in the scenarios than autistic children self-reported. While maternal and self-reported child threat interpretations correlated significantly (r = .48, p = .046); reports of how upset children would be did not (r = .22, p = .38). In a multiple regression analysis, only mothers' own anxiety (β = .86, p =.01), and not mothers' reports of their children's anxiety (β = -.05, p =.85), significantly predicted mothers' reports of how upset children would be in the scenarios. There was a trend for children with autism to perceive greater levels of threat (M = 4.15; SD = 3.06) than a smaller group (N = 15) of typical children (M = 2.67; SD = 2.23; t (39) = 1.65, p = .11) across the 12 situations.
Conclusions:
The ambiguous scenarios interview is a viable tool for assessing threat-related cognitions in autistic children. Given evidence which suggests maternal expectations of children's distress can promote the development of anxious cognitions in non-autistic children over time (Creswell et al., 2006), maternal cognitions, in addition to children's cognitions, may prove useful targets for intervention.

166 **124.166** Verbal Ability and Worry in Children with Autism Spectrum Disorder

P. Renno[1], *J. J. Wood*[1], *J. Danial*[2], *S. E. Whitham*[3], *S. Klebanoff*[4] *and K. Zielinski*[5], *(1)University of California Los Angeles, Los Angeles, CA, (2)UCLA, Woodland Hills, CA,*

(3)University of California, Los Angeles, Los Angeles, CA, (4)Education, UCLA, Los Angeles, CA, (5)University of California Los Angeles, Hermosa Beach, CA

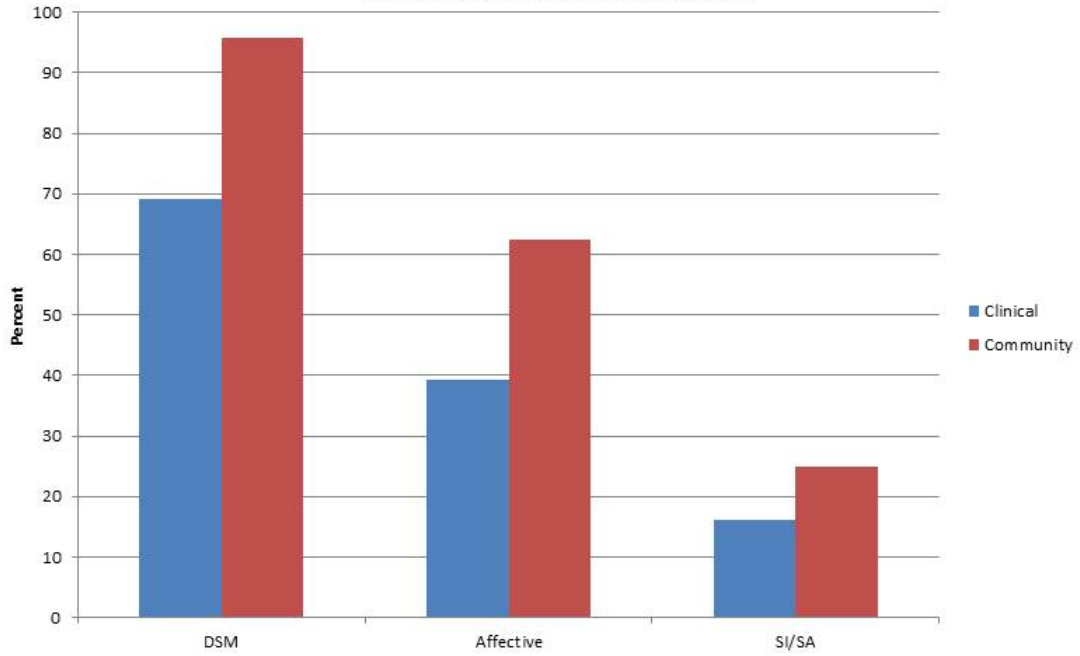
Background: Recent reports suggest anxiety disorders co-occur in 40% of children with autism spectrum disorder (ASD; van Steensel et al., 2011); however, the relation between anxiety and ASD is still being examined. The literature suggests several factors, such as cognitive ability and functional language, which may be related to greater anxiety and worry in children with ASD (Sukhodolsky et al., 2008). While some studies have found anxiety to be more common in children with ASD and average to high intellectual abilities (Sukhodolsky et al., 2008), other studies have found anxiety to be more prevalent in children with ASD and lower intellectual abilities (van Steensel et al., 2011).
Objectives: The current study aimed to investigate the relation between anxiety symptoms, cognitive ability, and verbal fluency in children with ASD.
Methods: Participants were 65 children with ASD (IQ > 70), aged 8-13. Cognitive ability was assessed with the Wechsler Intelligence Scale for Children-IV (WISC-IV) and verbal fluency was assessed with the Delis-Kaplan Executive Function System (D-KEFS). A parent-report of anxiety symptoms (Child & Adolescent Symptom Inventory-4) was also collected.
Results: Correlational analyses indicated strong relations between verbal fluency and the CASI-4R generalized anxiety subscale ($r = 0.411$, $p < 0.01$) and the CASI-4R 20-item anxiety subscale ($r = 0.371$, $p < 0.01$). Additionally, verbal scores on the WISC-IV were significantly correlated with the CASI-4R generalized anxiety subscale ($r = 0.362$, $p < 0.01$).
Conclusions: These findings suggest that in youth with ASD and IQ > 70, higher verbal ability is associated with greater anxiety and generalized worry. These results suggest that children with ASD who have strong verbal skills may be more susceptible to verbally-based types of anxiety and preservative thought. Future research should continue to look at other factors, (e.g., impaired executive functioning) which may be related to increased risk of anxiety in youth with ASD.

167 **124.167** Who Are We Missing: Why Would a Community-Derived Sample of Children with ASD Have Higher CBCL Symptoms Than Clinic-Based Samples?

A. C. Armour[1], *J. F. Strang*[2], *K. M. Dudley*[3], *L. Mohamed*[4], *R. E. Shafran*[5], *C. Rothwell*[6,7], *J. Safer-Lichtenstein*[8], *J. L. Martucci*[9], *A. Verbalis*[10], *S. Seese*[6], *L. Kenworthy*[11] *and L. G. Anthony*[10], *(1)Children's National Medical Center, Arlington, VA, (2)Children's National Medical Center, Silver Spring, MD, (3)TEACCH Autism Program, University of North Carolina at Chapel Hill, Carrboro, NC, (4)Yale Child Study Center, New Haven, CT, (5)Department of Psychology, Columbia University, New York, NY, (6)Center for Autism Spectrum Disorders, Children's National Medical Center, Rockville, MD, (7)Catholic University of America, Washington, DC, (8)Georgetown University, Washington, DC, (9)Neuropsychology, Children's National Health System, Rockville, MD, (10)Children's National Medical Center, Rockville, MD, (11)Children's Research Institute, Children's National Medical Center, Rockville, MD*

Background: Children with Autism Spectrum Disorders (ASD) have increased rates of mood and anxiety symptoms and suicidal ideation and attempts (SI/SA). The available literature indicates demographic characteristics (age 10+, male, African American/Black, Hispanic/Latino, low SES) and psychological characteristics (depression, teasing/bullying, aggression, impulsivity and anxiety) as risk factors for SI/SA in ASD. In order to probe levels of disparity of care, a school-based program that did not require previous diagnosis of ASD was compared to a group of youths who received clinical evaluations in a specialty clinic or were referred from a clinical setting for research testing.
Objectives: To compare Child Behavior Checklist (CBCL) syndrome scales, DSM scales, and SI/SA item endorsement between clinical and community groups and among different levels of maternal education.
Methods: Parents of 147 youth with ASD (female=19), age 5.92-19.17 (M=10.29, SD=2.5), FSIQ 62-149 (M=103.79, SD=19.43), who met CPEA criteria for 'broad ASD' on the ADI-R and/or ADOS, completed CBCL on their children. 123 families were evaluated in a clinical setting, and 24 families were evaluated in a community setting. Maternal education in 7 categories was used as a proxy for SES; 74.8% of mothers in the clinic sample and 56.5% of mothers in the community sample have a college or graduate education. Clinical and community groups did not differ significantly on sex or IQ; 11.6% of the clinical sample and 21.7% of the community sample is African American/Black. Group differences were explored with Chi-square and independent sample t-tests.
Results: 15.6% of individuals had parent-reported SI/SA. 83.7% of individuals showed clinical elevation on CBCL syndrome scales overall, 73.6% showed clinical elevation on CBCL DSM scales overall, and 43.1% showed clinical elevation on the affective problems scale. Endorsement of SI/SA items was associated with significantly higher CBCL anxiety ($t(26.42) = -2.36$, $p<.05$) and depression t-scores ($t(145) = -2.81$,$p<.01$).
There was no significant difference between clinical and community groups on endorsement of suicide items and overall CBCL syndrome scale elevation. Among maternal education levels, there were no significant differences on CBCL syndrome and DSM scales or SI/SA endorsement, possibly because such a large percent of the group was highly educated.
There is a significant difference ($p<.01$) on overall CBCL DSM scale elevation between community and clinical groups (chi square). Examination of DSM scale categories indicated that significant differences exist between clinical and community groups on CBCL clinical level affective problems (t-score ≥65, $p<.05$) (chi square). This holds true when considering the continuous CBCL affective problem data with an independent sample t-test ($t(142) = 2.49$,$p<.01$).
Conclusions: Although significant differences based on SES were not found, there were differences between clinical and community samples (see Figure 1). Based on a relatively small sample of community data, significantly more DSM symptomatology was reported by parents. Future directions include expanding the sample size of the community group and understanding what services this group is and is not receiving.

Figure 1: Percent of ASD youth with elevations for CBCL overall DSM Scale, Affective Problems, and SI/SA items in clinical and community groups.



168 **124.168** "Emodiversity" in Individuals with Autism Spectrum Disorder

A. C. Samson[1], *J. Bryjova*[2], *J. M. Phillips*[3], *J. Gross*[4] *and A. Y. Hardan*[3], *(1)Swiss Center for Affective Sciences, University of Geneva, Geneva, Switzerland, (2)Department of Psychology, University of Fribourg, Fribourg, Switzerland, (3)Stanford University, Stanford, CA, (4)Department of Psychology, Stanford University, Stanford, CA*

Background: There is mounting evidence that individuals with Autism Spectrum Disorder (ASD) have emotional disturbances, difficulties identifying and labeling own emotions (alexithymia), and emotion dysregulation. However, the precise nature of emotional disturbances in ASD is still not very well understood.
Objectives: The goal of the present study is to examine "emodiversity" for the first time in ASD. This is an emotional index that measures richness and complexity of an individual's emotional experiences, taking into account the degree to which an individual can characterize an emotional experience with precision (emotional granularity). Our goals were to: (1) document differences between individuals with ASD and typically developing (TD) participants, (2) relate emodiversity in positive and negative emotions to emotion understanding of positive and negative emotions, alexithymia, and ASD symptom severity; and (3) assess the extent to which positive and negative emodiversity, alexithymia, and ASD symptom severity contributed to problematic behavior.
Methods: Forty-one high functioning individuals with ASD and 35 gender and age group-matched typically developing (TD) controls (age range 8-20 years) as well as their parents were interviewed to assess positive and negative emodiversity and emotion understanding. In addition, parents filled out questionnaires to assess symptom severity (Social Responsiveness Scale), alexithymia (Toronto Alexithymia Questionnaire) and problematic behavior (Child Behavior Checklist). All analyses were controlled for participant's age, sex, and IQ.
Results: Compared to TD participants, individuals with ASD had lower positive and higher negative emodiversity, lower emotion understanding of positive and negative emotions, increased levels of alexithymia, symptom severity, and problematic behaviors. Positive emodiversity was positively associated with understanding of positive emotions and negatively with symptom severity. Negative emodiversity was negatively associated with the understanding of positive emotions and positively with symptom severity. Emodiversity (positive and negative) was not associated with alexithymia, indicating that both capture different emotional components. Interestingly, besides ASD symptom severity, parent reported emodiversity significantly predicted problematic behaviors in multiple regression analyses. Alexithymia did not further contribute to the explanation of problematic behavior in the present study.
Conclusions:
Emodiversity seems to be an important new concept to study in ASD and might have clinical relevance. However, additional investigations are needed to better understand emodiversity in ASD and how it is related to other emotional components in larger samples that include lower functioning individuals.

Poster Session
125 - Service Delivery/Systems of Care
5:30 PM - 7:00 PM - Hall A

169 **125.169** A Mixed Methods Approach to Describing Family Navigation As a Service Model within the Autism Speaks Autism Treatment Network

K. Kubicek[1], *D. S. Murray*[2], *K. Kuhlthau*[3], *D. L. Coury*[4], *D. Zand*[5] *and M. D. Kipke*[1], *(1)Children's Hospital Los Angeles, Los Angeles, CA, (2)Autism Speaks, Boston, MA, (3)General Academic Pediatrics, Massachusetts General Hospital, Newburyport, MA, (4)Nationwide Children's Hospital, Columbus, OH, (5)Saint Louis University, St Louis, MO*

Background:
Family navigation (FN), is an effective service model used across medical specialties, to assist families in accessing the clinical and support services for pediatric patients as well as relevant family members.
In 2014, the Autism Speaks Autism Treatment Network (ATN) required funded sites to integrate FN services into their clinic sites. Given the variation in services across the network and the limited research in the use, effectiveness and scope of FN services in ASD, the ATN initiated a study to better understand the current implementation of FN across the Network.
Objectives: 1) Develop an operational definition of FN for the network**, 2**) Describe the common service models of FN within the ATN; and 3) Identify potential best practices and appropriate outcome measures to evaluate the effectiveness of a FN model for children with autism spectrum disorders.
Methods: The ATN convened a workgroup comprised of parents and professionals to develop the appropriate research design. A mixed-methods approach was determined to be the most appropriate to capture both breadth and depth of the FN service models across the currently funded 14 ATN sites. This included: a survey of the primary family navigator at each site (N=13); three focus groups with family navigators (N=26); a survey of the site principal investigators at each site (N=12) and two focus groups with parents (N=12). Data were triangulated to fully describe the FN model across the ATN.
Results: We identified a number of similarities and differences across sites. Family navigators spend most of their time providing referrals for community services (100%),

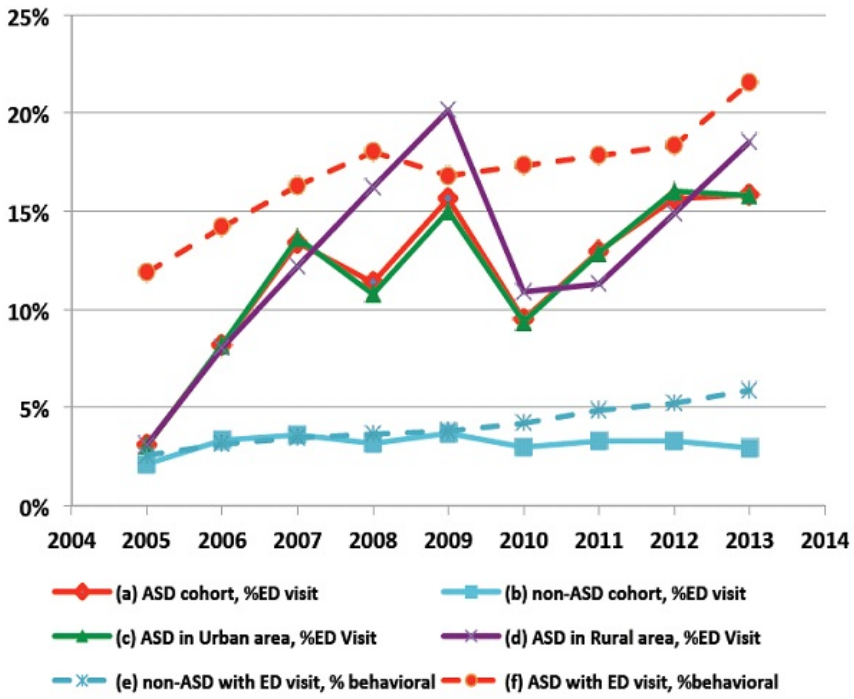
educating parents on available options and the service system (92%) and helping to empower families (62%). They felt that coaching parents to be effective advocates is one of their most important responsibilities. Social workers or similar professional staff are used as family navigators at most sites. Most sites agreed that a parent or similar paraprofessional offers different insights and empathy for family members; however given that some referrals must be made by a licensed or certified individual, a hybrid model was identified as being the most promising. Navigators often experience challenges meeting the needs of diverse families including linguistic needs and understanding cultural norms. Navigating school systems and IEPs are among the most common needs of parents followed by respite care, access to services and education. Few sites are currently tracking outcomes related to FN.
Conclusions: Respondents agreed that FN is an important and valuable service for families. Next steps include identifying appropriate outcome measures (parental stress, activation, satisfaction, impact on cost, access) and service delivery strategies (e.g., referrals to FN, staffing, education) through a new prospective study. This will assist in identifying core components of FN best practices that can be shared across the Network.

170 **125.170** A Profile on Emergency Department Visits in Adolescents with Autism Spectrum Disorders

G. Liu[1], *L. Kong*[1], *D. Leslie*[1] *and M. Murray*[2], *(1)Public Health Sciences, Penn State College of Medicine, Hershey, PA, (2)Psychiatry, Penn State Hershey, Hershey, PA*

Background: The prevalence of ASD started to increase dramatically about a decade ago, and now the first wave of these children have approached adolescence and early adulthood. While early diagnosis and intervention have been the focus of scientific and clinical community, the population of adolescents with ASD has not received the same attention. Although various ASD related healthcare services have been designed to better serve this population, it is relatively unknown how well they are being served.
Objectives: In this study, we use a large, national healthcare claims database to compare the healthcare utilization history (in-/out-patient medical records) of adolescents with and without ASD, with a focus on emergency department (ED) visits. The goal of this study is to provide an understanding of the physical and mental health well-being of adolescents with ASD.
Methods: Using the healthcare claims data from MarketScan®, we identified subjects aged 12-21 during each year of 2005-2013. In each annual cohort, we constructed an ASD cohort of adolescents with at least two separate diagnoses of ASD (ICD 9 codes 299.0x and 299.8x) through the entire study period (2005-2013) and a non-ASD cohort of those without ASD diagnosis during the study period. We constructed the following annual measures: (a) proportion of adolescents with ASD having ED visit ; (b) proportion of adolescents without ASD having ED visit; (c) proportion of urban adolescents with ASD having ED visit; (d) proportion of rural adolescents with ASD having ED visit; (e) proportion of adolescents having a behavioral ED visit among those non-ASD adolescents with any ED visits; and (f) proportion of adolescents having a behavioral ED visit among those ASD adolescents with any ED visits.
Results: We observed a consistent increase in the percentage of ASD patients among all adolescents who visited emergency department, from 0.28% in 2005 to 0.85% by 2013. While the percentage of subjects in non-ASD cohort who had ED visits have been fairly stable at around 3%, the percentage in ASD cohort steadily increased from 3.1% in 2005 to 15.8% by 2013. Although rural adolescents with ASD showed a similar pattern in ED visit to those living in urban areas, it took a sharp jump from 14.9% in 2012 to 18.5% in 2013, compared to 16% among urban adolescents with ASD. Among subjects with ED visits, behavioral health service-related ED visits increased from 11.9% in 2005 to 21.6% by 2013 among adolescents with ASD, compared to a more modest increase from 2.6% to 5.9% among adolescents without ASD.
Conclusions: Our study showed a disconcerting increase in the proportion of adolescents with ASD who had ED visits over the recent decade or so. We also observed a drastic increase in ED visits primarily associated with behavioral health service, suggesting an ASD-related mental health crisis. Finally, adolescent ASD patients living in rural areas experienced a large increase in ED visits, suggesting that this may be a particularly vulnerable population.

Figure 1. Pattern of Emergency Department (ED) visit during 2005-2013: % of ED visits (a)-(d), and % of behavioral ED service in those with ED visit (e)-(f).



171 **125.171** A Statewide Needs Assessment Survey for School-Age Children with Autism Spectrum Disorder

S. Trost[1], *S. Srinivasan*[2], *L. O'Regan*[1], *A. Ekbladh*[3], *B. Freedman*[4] *and A. N. Bhat*[2], *(1)Physical Therapy, University of Delaware, Newark, DE, (2)University of Delaware, Newark, DE, (3)Center for Disability Studies, University of Delaware, Newark, DE, (4)University of Delaware Center for Disabilities Studies, Newark, DE*

Background:
Autism Spectrum Disorder (ASD) is a multisystem disorder leading to primary impairments in social communication development as well as comorbidities in perceptuo-motor, cognitive, and behavioral skills (American Psychiatric Association, 2013; Bhat, Landa, & Galloway, 2011). In recent years there has been an increase in prevalence of ASD, with 1 in every 68 children in the US being diagnosed with ASD (Centers for Disease Control and Prevention, 2014). Given this increasing prevalence, there is a pressing need to understand the specific health care needs of children with ASD and their families as well as the challenges and barriers they face in accessing health care services.
Objectives:
In 2011, the Center for Disabilities Studies (CDS) at the University of Delaware conducted a statewide comprehensive needs assessment survey for caregivers of school-age children with ASD. The survey was meant to guide the formulation of a strategic plan to improve services for children with ASD and their families.
Methods:
277 caregivers of school-age children with ASD completed the needs assessment survey in online or paper form. The survey obtained information about areas related to the diagnosis, educational status, living status, service needs, and community participation of school-age children with ASD.
Results:
Over half of this sample had a diagnosis of ASD and another quarter had a diagnosis of Asperger Disorder. In addition, over 80% of this sample had additional diagnoses, most commonly, developmental delay, attention deficit hyperactivity disorder, learning disability, anxiety, obsessive compulsive disorder, and intellectual delay. In terms of

living status, around 95% of children lived with their parents or relatives. In terms of educational status, around 90% children had an individualized education plan (IEP) and around 65% caregivers were satisfied with their child's IEP. The survey suggested that around 90% children were independent in feeding themselves and around 60% were independent in dressing themselves, requesting things, and indicating their needs to caregivers. In terms of health care services, caregivers indicated the need for more speech therapy, physical/occupational therapy, social skills training, and behavioral interventions over and above what the children were currently receiving. The survey also revealed that the various barriers faced by families of children with ASD in terms of accessing health care services included cost of services, shortage of service providers, as well as transportation and scheduling issues.
Conclusions:
Results of the survey highlighted the main issues faced by children with ASD and their families. Caregiver responses to the survey indicated a dire need for specific medical and rehabilitation services for school-age children with ASD.

172 **125.172** A Survey on Mitigating Barriers to Dental Care for Children with Special Health Care Needs By Providing Dental Treatment Under General Anesthesia

L. Orsini[1], *R. Turchi*[2], *S. Shah*[2], *M. Kondrad*[3], *J. J. Kim*[4] *and D. L. Robins*[5], *(1)Pennsylvania Chapter of the American Academy of Pediatrics, Media, PA, (2)Drexel University, Philadelphia, PA, (3)St. Christopher's Hospital for Children, Philadelphia, PA, (4)Department of Epidemiology, Drexel University, Philadelphia, PA, (5)AJ Drexel Autism Institute, Drexel University, Philadelphia, PA*

Background: Children and youth with special health care needs (CYSHCN) experience unique challenges in accessing health care. Among the greatest unmet needs among this population is dental care. Dental caries is the most common chronic disease in children, and children with developmental disabilities are more likely to have unmet dental needs than typically developing children[i],[ii]. Barriers for CYSHCN accessing dental care may include but are not limited to: body movements, repetitive behaviors, and self-injurious behavior. Some CYSHCN experience excessive sensitivity involving their face/mouth influencing diet, nutrition, teeth brushing, speech, and routine dental check-ups. Providing dental treatment to this population may be challenging, thus warranting general anesthesia as the only mechanism to deliver the necessary dental treatment. This study seeks to examine and understand the experience and satisfaction of parents/caregivers of CYSHCN requiring general anesthesia for routine dental examinations.
Objectives: The purpose of this preliminary study was to review survey results from parents with CYSHCN to understand the barriers of dental care for CYSHCN and to evaluate the effectiveness of providing dental and medical treatment under general anesthesia. This pilot study may inform future clinical procedures of CYSHCN by facilitating comfort of the patient and family.
Methods: Parents/caregivers of CYSHCN (*n*=25; 14 with ASD, the other 11 with neurological, genetic, and developmental disorders) completed a survey to understand: CYSHCN's experience with dental treatment under general anesthesia, barriers they encountered, and other feedback regarding their clinical encounter. In this sample of parents, 10 (4 with ASD) had children who were placed under general anesthesia and 15 reported on general issues but not a specific experience.
Results: The majority of respondents indicated challenges in accessing routine dental treatment for their child (76%). The most common barrier to getting dental treatment for a CYSHCN was intolerance of the child for dental treatment (76%). Other frequently listed barriers included: paucity of experienced dentists to treat CYSHCN (20%), inconvenient appointment time (8%), transportation challenges (8%), unaccepted dental insurance (4%), and unable to obtain medical clearance for dental treatment (4%). Of the 10 parents (40%) with children who had undergone dental treatment under general anesthesia, seven (70%) reported an excellent experience (on a five-point scale from excellent to poor) with the services and the remainder (30%) reported a very good experience with these services.
Conclusions: Survey responses confirm CYSHCN experience a variety of challenges in accessing routine dental care. The most significant barriers to address, include the child's intolerance to dental care and lack of dentists experienced with CYSHCN. Additionally, these responses demonstrate resounding satisfaction of the parents whose children received dental care under anesthesia, although the small study warrants replication. Overall, when CYSHCN cannot tolerate dental procedures, anesthesia is a feasible strategy to support this needed care.

173 **125.173** ASD-Related Networks: The Rare Epilepsy Network

J. M. Buelow*, Epilepsy Foundation, Landover, MD*

Background:
Patient-Centered research is now will improve the quality and relevance of research for those it is meant to serve. While most national research organizations have tried to incorporate a patient- or participant-centered approach, the Patient-Centered Outcomes Research Institute is focused on research and outcomes that matter to patients. PCORnet is a national patient-centered research network of databases of patient-driven data. At the very core of PCORnet—and the differentiating factor between PCORnet and other data bases—is the patient. PCORnet has the potential to change the way research is conducted. The Rare Epilepsy Network is one such database that is driven by and for patients or their caregivers. Autism is known to be a comorbid condition in epilepsy.
Objectives: This panel is aimed at 1: Informing participants about patient-centered research and related national initiatives; 2. Discussing and demonstrating current rare epilepsy participant-centered programs and research; 3. Discussing synergy between patient-centered research networks; and 4. Discussing opportunities and challenges for integration of patient-centered and clinic/hospital-centered outcomes
Methods: N/A
Results: N/A
Conclusions: N/A

174 **125.174** Age of Diagnosis of Autism Spectrum Disorder in an Ethnically Diverse Population before and after the 2007 AAP Recommendation for Universal Screening

M. D. Valicenti-McDermott[1,2], *L. H. Shulman*[1,2] *and R. M. Seijo*[1,2], *(1)Pediatrics, Montefiore Medical Center, Bronx, NY, (2)Albert Einstein College of Medicine, Bronx, NY*

Background: Children with Autism Spectrum Disorder(ASD) benefit from early diagnosis and intervention services. In 2007 the American Academy of Pediatrics(AAP) recommended pediatricians perform screening for ASD at the 18 and 24 month child visits. However, the U.S. Preventive Services Task Force recently concluded there is not enough evidence to recommend universal autism screening of young children for whom no concerns of ASD have been raised by their parents or clinical provider. Children who are Latino or African American are already being diagnosed later and families may be less aware of ASD symptoms, the impact of such recommendation on the age at diagnosis in an ethnically diverse population is important, but unknown.
Objectives: To compare the age at diagnosis of ASD in two groups, those children born before 2005, prior to universal screening recommendations, and those born in 2005 or later, who would have been of age to undergo ASD screening by 24 months based on the 2007 AAP recommendation.
Methods: Review of all children initially diagnosed with ASD from 2003 to 2012 in a University Affiliated Developmental Center. Data included demographic and clinical characteristics. Statistics included chi-square, t-test, non parametrics, and logistic regression
Results: We identified 512 children,78% boys, 16%White, 47%Hispanic, 26%African-American, 38% bilinguals(English/Spanish). Of 512, 295(58%) were born before 2005 and 217(42%) were born during 2005 or after. The mean age at diagnosis of children born before 2005 was 46±15months and those born during or after 2005 was 31±12 months($p<.001$). The percentage of children diagnosed with ASD after age 3 decreased from 63% in the group born before 2005 to 26%($p<.001$). This decline occurred across all ethnic groups (White 55% to 27%; Hispanic 76% to 23%; African-American 73% to 32%). The association between diagnosis with ASD after age 3 and being born before 2005 remained significant after adjusting for demographics and clinical characteristics (OR=4.2;95thCI 1.7-10.3).
Conclusions: In this ethnically diverse population, children who were born before the AAP recommendation for universal screening were diagnosed with ASD significantly later that those born after the AAP recommendation. It is unclear at this point if this was entirely the result of pediatrician universal screening but, since 2007, children are being diagnosed with ASD earlier.

175 **125.175** An ASD-Specific Training Model for Medical Staff to Support Provision of ASD-Friendly Medical Care

L. Dewey[1] *and E. Bernabe*[2], *(1)Nemours/Alfred I duPont Hospital for Children, Wilmington, DE, (2)Nemours/AIDHC, West Chester, PA*

Background: Children with Autism Spectrum Disorder (ASD) often present with complex medical concerns necessitating use of a medical home model in providing comprehensive care for these patients. However, providing medical care through an ASD-friendly framework is more challenging than with other children with complex medical needs (Brachlow et al., 2007). Children with ASD present with unique behavioral needs when requiring medical procedures and prolonged inpatient hospitalizations. Medical providers often need to modify how care is delivered to support patients with ASD by implementing behavior management strategies (e.g., use of visual schedules, choices about care, behavioral motivators, preparation before procedures, etc.; Thompson & Tielsch-Goddard, 2014). However, medical staff often lack the training and confidence to provide medical care through an ASD-friendly framework that includes empirically-validated behavioral interventions.
Objectives: The objectives of the study were to: 1) describe an ASD-specific training model and potential feasibility in a hospital setting; and 2) preliminarily explore if staff's confidence improved after ASD-specific training.
Methods: Social workers in a children's hospital attended two one-hour trainings two weeks apart provided by ASD-focused psychologists during the social workers' weekly rounding meetings. The first training focused on understanding ASD (n=18), and the second training focused on empirically-validated behavioral interventions (n=14). At both trainings, the social workers completed a questionnaire (6 questions on a 1-5 Likert Scale; summed for total score) developed by the authors that assessed

understanding and confidence of ASD-friendly care. At the second training, two additional questions focused on utility of the training were included. The data were analyzed using descriptive statistics and independent sample t-test (due to the anonymous completion of the questionnaires at both trainings).
Results: Social workers found both trainings to be useful (M = 4.2 out of 5, SD = .91; M = 4.5 out of 5, SD = .51) and reported a high likelihood of using the information (M = 4.1 out of 5, SD =.99). Additionally, preliminary data from the questionnaires suggested that staff confidence in providing ASD-friendly care and implementing behavioral interventions showed non-significant improvement (training 1: M = 17.33, SD = 4.2; training 2: M = 23.5, SD = 3.99; p = .877).
Conclusions: ASD-focused training for medical staff is feasible; training can be provided during convenient times for staff by professionals with pre-existing ASD knowledge. Encouragingly, medical staff found the trainings useful, and they reported a high likelihood to implement the behavioral interventions discussed during the trainings. Preliminary data suggest that ASD-specific training might improve staff confidence, which has been identified as a barrier for medical staff in providing medical care through an ASD-friendly framework. Results of this study support training endeavors to meet the unique needs of hospitalized patients with ASD.

176 **125.176** Autism and Vaccines: Are Siblings Affected?

E. Agbese[1,2]*, D. Velott*[1] *and D. Leslie*[1,2]*, (1)Public Health Sciences, Penn State College of Medicine, Hershey, PA, (2)Center for Applied Studies in Health Economics, Penn State College of Medicine, Hershey, PA*

Background: After a 1998 study in England incorrectly showed a link between autism and the measles, mumps and rubella (MMR) vaccine, parents became concerned about vaccinating their children. This study led to a decrease in vaccination rates and an increase in measles, mumps, rubella and other vaccine-preventable diseases in England and other countries. Although the original article has since been invalidated by several studies and subsequently retracted, the decrease in vaccination rates persists. In the United States, parents can easily obtain both medical and non-medical exemptions from school vaccine requirements for their young children. Communities with low vaccination rates continue to be at higher risk for disease outbreaks. Although previous studies have documented that parents with at least one child with autism spectrum disorder (ASD) may delay or decline vaccination for subsequent children, these studies suffer from the limitations of small sample sizes and parent self-report.
Objectives: To compare the vaccination rates of the immediate younger siblings of children with ASD to those of immediate younger siblings of children without ASD using a large national healthcare claims database.
Methods: Data for the study came from the MarketScan® Commercial Claims and Encounters database, a national health insurance claims database of over 40 million privately insured individuals. Immediate younger siblings of children with ASD aged 0 to 6 were identified and matched to immediate younger siblings of children without ASD. Children in both groups were matched based on age, sex and order of birth. Vaccination rates for both groups were determined using ICD-9 codes to identify receipt of any recommended vaccine (any vaccine) and individual vaccines of interest (MMR, influenza, hepatitis A/B, and chicken pox). The proportions of children who received studied vaccines were compared across groups using t-tests. In addition, generalized estimating equations regression was used to determine whether the effect of group (ASD vs. control) remained after controlling for other child and family characteristics.
Results: A total of 5,048 case-control pairs were included in the study. Vaccination rates for all studied vaccines were significantly lower among children with an older sibling with ASD than among matched controls. After controlling for other covariates, immediate younger siblings of children with ASD remained significantly less likely to receive any vaccine (OR=0.86; 0.79-0.93), MMR (OR=0.72; 0.66-0.80), influenza (OR=0.79; 0.73-0.86), hepatitis A/B (OR=0.82; 0.75-0.90), and the chicken pox vaccines (OR=0.80; 0.73-0.87).
Conclusions: Immediate younger siblings of children with ASD are significantly less likely to receive recommended vaccinations compared to immediate younger siblings of children without ASD. This is especially true of the MMR vaccine, the subject of the invalidated 1998 study. Our results suggest that in addition to their current efforts, public health officials and clinicians need to tailor vaccine education specifically to parents of children with ASD.

177 **125.177** Barriers and Facilitators to Treating Sleep Problems in Children with ASD: Gathering Parent and Health Care Professional Perspectives Via Online Synchronous Focus Groups

K. M. Tan-MacNeill[1]*, I. M. Smith*[2] *and P. Corkum*[3]*, (1)Dalhousie University, Halifax, NS, Canada, (2)Dalhousie University / IWK Health Centre, Halifax, NS, Canada, (3)Dalhousie University & IWK Health Centre, Halifax, NS, Canada*

Background: Sleep problems are prevalent in children with autism spectrum disorder (ASD), occurring in 50-85% (Reynolds & Malow, 2011). Behavioural sleep problems (i.e., insomnia) have a widespread negative impact on children and their families. Although behavioural interventions are recommended to treat insomnia in children with ASD, little is known about parents' and healthcare professionals' (HCPs) beliefs about sleep problems in ASD, and access to, uptake of, and implementation/provision of insomnia treatments.
Objectives: 1) To explore barriers and facilitators experienced by parents of children with ASD in access to and uptake of behavioural treatments for children's insomnia. 2) To explore barriers and facilitators experienced by HCPs in accessing and providing behavioural insomnia treatment. 3) To explore the utility of online, synchronous audio/video focus group methodology.
Methods: We used a mixed-methods, online focus-group/interview design, recruiting participants from Canadian rural and urban communities. Participants were 22 parents of 4- to 12-year-olds with ASD and behavioural sleep problems (without intrinsic physiological sleep disorders) and 16 healthcare professionals (occupational therapists, clinical psychologists, developmental paediatricians, nurses) who work with children with ASD and sleep problems. Parents and HCPs participated separately in focus groups or individual interviews, which followed semi-structured topic guides focusing on sleep knowledge, familiarity with evidence-based sleep treatment (HCPs only), access to sleep treatment, uptake (parents) and implementation (HCPs) of treatment. Perceived acceptability of an online parent-directed behavioural sleep intervention was the final topic for both parents and HCPs. Participants completed a user feedback survey to assess the utility of the online method. Focus groups/interviews were transcribed and qualitatively analyzed in NVivo using conventional content analysis (coding for key themes). Descriptive statistics were used to characterize the sample. Additional interviews with Board Certified Behaviour Analysts (BCBAs) are in progress (ending November 2015).
Results: Preliminary coding revealed key themes emerging from both parents and HCPs: 1) sleep problems and treatment are perceived as exceptionally challenging, intensive, involved, and demanding compared to other problems and their treatment; 2) consistency with routines and perseverance are keys to success; 3) the multifactorial nature of sleep problems complicates treatment; 4) treatment must be highly individualized; 5) recognizing sleep's impact on the whole family is important; 6) awareness of sleep and how to access help is limited. Individual barriers and facilitators were identified for the following topic areas: A. Parents – Seeking and accessing treatment; B. Parents – Uptake/implementation of treatment; C. HCPs – Knowledge about and access to evidence-based treatment; D. HCPs – Providing evidence-based treatment.
Conclusions: Preliminary results suggest that parents and HCPs endorse common barriers and facilitators to effective treatment of sleep problems in children with ASD. Major barriers are lack of knowledge/awareness and support, and systematic limitations; flexibility, education, and support are major facilitators. Online synchronous audio/video focus groups had utility as a research method, but effectiveness and user experience were subject to factors beyond the researcher's control (e.g., participants' internet connections). Results will inform the development of an online behavioural intervention for insomnia, *Better Nights, Better Days for Children with Neurodevelopmental Disabilities*.

178 **125.178** Building Specialized, Elderly-ASD Specific Residential Care for People with ASD Moving into Old Age

L. A. Jensen[1] *and D. Allen*[2]*, (1)Specialist Area Autism, Hinnerup, Denmark, (2)GHA Autism Supports, Albemarle, NC*

Background:
The first generation of children diagnosed with ASD is now becoming elderly. Very little consideration has been given to ASD housing for those aging with ASD even though the people with ASD are becoming elderly now and the decades to come. Therefore *X*, Denmark and *Y*, US have inspired each other on minding the gap on how to build residential care to meet the unique needs of this target population based on their knowledge and experience with elderly individuals with ASD due to the fact that ASD manifests itself in different ways being elderly.
Objectives:
To build new residential care facilities based on *X's* and *Y'*sown collection of results on elderly with ASD with the aim of enhancing the target group's overall quality of life and supporting the challenges of aging like lack of mobility and ill-health.
Methods:
Based on the Danish "Model Program for Sheltered Housing Designed for Elderly People with Autism", which the Danish organization Realdania helped to develop in 2010, *X*has built Seniors House. Ever since the initial brainstorming of the construction there has been a focus on user involvement, including core employees with key knowledge on elderly individuals with ASD, elderly people with ASD and their relatives. Also in the project steering group Autism Denmark and the Danish National Board of Social Services have been involved.
In the US *Y*has done intense studies on nursing homes and other long-term care options and discovered that there are no programs in the US designed and/or equipped to meet the medical, neurological, and safety needs of aging individuals with ASD.
Results:
In 2014 *X* opened Seniors House - Denmark's first specialist environment designed uniquely for four elderly people with ASD. The involvement of people with ASD in Seniors House is evident in the choices made in both architecture and interior design. For example, *X's* research showed that elderly people with ASD liked the idea of having dark, somewhat sheltered rooms, wooden materials, overall the colour green, having a sitting area outside their door so that they can be part of a group from a distance, watching the life outside their home, minding their social challenges which are more profound being elderly.

In the US *Y* has developed its building-model for individuals with ASD who are aging and have significant medical issues which includes on-site health care services, telemedicine, health-monitoring, new technology and farm animals. The facilities break ground in late 2016 or early 2017.
Conclusions:
X's Seniors House in Denmark and the future *Y's* Long Term Care Project in the US, both serve as important building projects on how to create specialized long-term care for aging individuals with ASD. The vision of the two building projects is to function as knowledge platforms and sources of inspiration for other buildings for the similar target group.

179 **125.179** Challenges for Translating Early Intervention Evidence into Practice in ASD Community Settings

T. Iacono[1], *K. Hudry*[2], *J. L. Spong*[1], *C. Dissanayake*[3], *D. Trembath*[4] *and S. Erickson*[5], *(1)La Trobe University, Bendigo, Australia, (2)Olga Tennison Autism Research Centre, Melbourne, Australia, (3)Olga Tennison Autism Research Centre, La Trobe University, Melbourne, Australia, (4)Menzies Health Institute Queensland, Griffith University, Gold Coast, Australia, (5)La Trobe University, Melbourne, Australia*

Background: Translating evidence-based diagnostic and intervention practices for Autism Spectrum Disorders (ASD) into community settings is especially challenging in low-resource settings, even those situated in high-income countries. Successful translation will depend on funding streams that dictate service-delivery, and the knowledge, skills and attitudes of service providers. The focus of this study was on the potential to translate ASD early interventions found effective in research settings to a community setting.
Objectives: Our aim was to explore the ASD service delivery context within a regional town (population 107,000). We further sought to evaluate the potential use of telehealth to upskill clinicians in evidence-based intervention delivery, and consider its potential uses in supporting service provision for families located at least 2 hours by private or public transport from the nearest metropolitan centre.
Methods: Restricting the study to one regional town, we obtained data on all ASD services in a geographic area, whose residents ranked high on a disadvantage scale (983, SEIFA). Mixed methods included structured interviews with a senior representative of each service, and surveys of clinicians and families about service access and provision, and attitudes towards telehealth. Five organisations participated, providing 15 services to children aged 0-6 years. Fifteen clinicians and 19 families completed surveys. Eight clinicians (Early Childhood Advisors, Occupational Therapists, Speech-Language Pathologists) from one service participated in semi-structured interviews.
Results: *Service models*: Most services were funded through autism support packages (with caps per child); two were fully fee-paying. Two provided a diagnostic service only and among the others, assessments for goal setting either were not provided, or only if requested by families for a fee. Most provided multi-disciplinary supports, but clinicians tended to work as individuals providing centre-based and in-home direct intervention, and consultation services. Referral pathways to diagnostic services varied, but often began with a GP. One diagnostic service used telehealth. *Diagnosis and Interventions*: The mean age of ASD diagnosis was reported by both clinicians and families as 3 years. Interventions were described in broad terms only (e.g., behavioural, family-centred), without evidence of structured or evidence-based programmatic approaches. Most families received an hour a week of intervention per fortnight; many received less. *Attitudes to Telehealth*: Both clinicians and families were open to telehealth, but largely for consultative services. Interviewed clinicians were interested in learning new skills and finding out about new strategies, and some wanted to learn about recent research. They saw telehealth as a possible way to link with expertise, but few saw value in its use in delivering their services.
Conclusions: Most families in this regional town received services that were far removed from best practice regarding early diagnosis, frequency and intensity of intervention, and evidence-based strategies. This situation is likely to reflect that found elsewhere in this and in other developed countries. Shifting service provision towards evidence-based practices requires fundamental changes to funding mechanisms, and expert support to service providers. Knowledge gained from efforts to translate best-practice into low-resource settings in high-income countries offers the potential to inform translation into settings in low-income countries.

180 **125.180** Characteristics of Patients with Autism Spectrum Disorders Who Successfully Initiate Behavioral Intervention Services

N. M. Shankute[1], *M. N. Davignon*[2], *C. K. Yoshida*[1], *M. L. Massolo*[1] *and L. A. Croen*[1], *(1)Division of Research, Kaiser Permanente, Oakland, CA, (2)Kaiser Roseville Medical Center, Roseville, CA*

Background: Evidence-based treatments rooted in Applied Behavior Analysis (ABA) have been shown to lead to favorable outcomes in children with autism spectrum disorders (ASD). Research evaluating the effectiveness of behavioral treatments is vast but very little is known about which individuals benefit the most from these treatments. As the prevalence of ASD continues to increase and with most states expanding insurance mandates to provide evidence based behavioral treatments, it would be advantageous to characterize the barriers and facilitators to treatment in order to better serve this population.
Objectives: To describe the patient characteristics associated with initiating behavioral treatments among a large and diverse insured ASD population referred for behavioral intervention services.
Methods: The study population is comprised of 380 Kaiser Permanente (KP) members from northern California with ASD aged 2-22 years who were referred for ABA treatment services to Easter Seals Bay Area (ESBA) between February-May 2014. ESBA is the largest vendor providing ABA treatment services for KP northern California members. Patients were grouped based on whether they ever initiated or never initiated treatment within 12 months of the date of referral to treatment. We compared the ever versus never initiated treatment groups with respect to sex, race/ethnicity, age at referral to treatment, and ASD status of siblings using chi-squared tests. Mean age at referral to treatment was compared between the two groups.
Results: The majority of patients referred for ABA were between the ages of 5-11 years of age (32% 2-4, 48% 5-11, 14% 12-15, 6% 16-22), male (82%), white (37%), and the

only child in the family with an ASD diagnosis (88%). Overall, 12% of patients referred for ABA never initiated treatment. Among those, 56% never completed the first step, which is an in-person assessment by the vendor; the remaining 44% completed the assessment and were recommended a treatment plan but failed to initiate treatment. Among the 88% of referred patients who started treatment, 25% subsequently discontinued treatment within 12 months of the referral. Patients who initiated treatment were similar to patients who did not initiate treatment with respect to sex (male: 81% vs 82%) and race/ethnicity (White: 37% vs 38%; Asian: 29% vs 27%; Hispanic: 17% vs 22%; Black: 6% vs 7%; Other: 10% vs 7%), and having a sibling with ASD (12% vs 9%). However, patients who initiated treatment were more likely than patients who did not initiate treatment to be <5 years of age at referral (34% vs 20%). The mean age at treatment referral (7 years vs 9 years) was lower among individuals who initiated treatment compared to those who didn't.
Conclusions: Demographic characteristics did not distinguish between the ever versus never initiated treatment groups. Other factors that may contribute to treatment initiation and engagement, including referral sources, parental characteristics, and timing of services will be presented.

181 **125.181** Co-Located Behavioral Assessment Services for Children with ASD in Pediatric Primary Care Settings

***K. Herrington**, J. F. Hine and Z. Warren, Vanderbilt University, Nashville, TN*

Background: Within primary care, use of an integrated delivery model is on the rise as being the optimal method of providing behavioral-health services. Research suggests co-located behavioral-health providers within primary care settings result in earlier diagnosis and management of a range behavior problems (Chomienne, et al., 2011). Furthermore, physician satisfaction research shows that having the ability to refer patients for rapid assessment and intervention has a major positive impact on their practice (Clatney, et al., 2008). Few studies have examined physician satisfaction of integrated ASD-specific behavioral services into pediatric primary care practices
Objectives: The current work examined (1) the feasibility of incorporating ASD-specific assessment and brief treatment services in two primary care clinics (academic faculty clinic, resident clinic) and (2) physician satisfaction with services.
Methods: We physically embedded a psychology provider in two separate primary care clinics associated with our academic medical center (faculty practice, resident clinic). These providers were physically present in the primary care setting one day per week and made explicitly available for the purposes of providing follow-up to ASD-related concerns (e.g., screening failures, diagnostic issues, behavioral consultation). To assess feasibility we tracked the nature and type of referrals, show rates, age/latency rates related to diagnosis, and surveyed providers about the benefits and challenges of the embedded service. Surveys included a 1-5 point Likert Scale assessing satisfaction with these services meeting the needs of the referred families, the quality of services, and collaborative practices. Physicians were also asked their level of agreement with statements regarding whether integration of behavioral-health providers improves the quality and continuity of healthcare, frees up more time to address medically related issues, reduces added healthcare costs, increases show rates, and increases their own ability to identify and manage behavioral health concerns.
Results: Across the initial 32 weeks of implementation, the integrated behavioral services program was able to see over 60 children with a wide range of behavioral and developmental concerns – with some children seen across repeated sessions. Show rates for the embedded behavioral service program were considerably higher (91.7%) than those within affiliated tertiary referral clinics at the host university (<75%). For children referred for assessment of ASD, latency to evaluation and diagnosis was considerably shorter. All patients referred for ASD evaluation received a diagnosis within 1-2 months of referral with current wait-times for tertiary clinic assessment averaging 6-12 months. Provider feedback indicated significant improvements related to quality and continuity of care and decreased waits for service. However, this feedback also indicated concerns regarding financial viability of the program over time, as well as concerns about limited nature of referral service (i.e., 65% of referral issues for embedded service were not related to ASD.
Conclusions: This study provides preliminary support for the value of embedded, co-located behavioral services in meeting the needs of children with ASD in primary care settings. Such models of care may reduce waits, age of diagnosis, and reduce other service barriers encountered by individuals with ASD and their families seeking services through referrals to traditional tertiary care facilities.

182 **125.182** Combining Web-Based Learning, Interactive Instruction and Remote Supervision to Train Community-Based Providers in a Parent Coaching Intervention for ASD

***A. Wainer**[1], K. Pickard[2] and B. Ingersoll[2], (1)Rush University Medical Center, Chicago, IL, (2)Michigan State University, East Lansing, MI*

Background:
There is increasing evidence supporting the effectiveness of parent coaching interventions targeting social communication skills in young children with autism spectrum disorder (ASD), and both parents and providers hold positive views about this intervention approach. Unfortunately, formal parent coaching programs are highly under-utilized in community settings. A challenge to dissemination and implementation is that a provider must demonstrate knowledge of the intervention strategies, and the skills to effectively teach and support parents in their use of the strategies. Many early intervention providers are trained to work directly with children, yet are not as familiar with adult learning principles or methods for providing parents with feedback and coaching. Recent advances in distance learning suggest that the use of computer and internet technology may help to increase access to training and support for community-based providers. Prior to large scale dissemination of these training protocols, a better understanding of the extent to which providers learn and effectively use parent coaching strategies from such a protocol is critical.
Objectives:
An innovative and systematic training protocol was developed to introduce community-based providers to Project ImPACT, a parent coaching intervention aimed at increasing social communication skills in young children with ASD. The protocol includes web-based instruction, brief interactive workshops, and remote skype consultation/supervision. Initial research suggests that this training protocol is feasible, acceptable and effective for learning the Project ImPACT intervention techniques. The current research aimed to determine the extent to which providers found the same protocol to be acceptable and effective for learning the *parent coaching strategies*. Additionally, this research examined the sustainability of Project ImPACT after the use of this training protocol.
Methods:
Fifteen community-based providers participated in the study. The training protocol included: 1) a web-based Project ImPACT tutorial; 2) a one-day interactive workshop about the intervention techniques; 3) three remote skype supervision/feedback sessions about intervention techniques ; 4) a one-day interactive workshop about parent coaching; and 5) three remote skype supervision/feedback sessions about parent coaching. Providers completed questionnaires and videotaped provider-family interactions at 6 time points: *Time 1* (baseline); *Time 2* (after the web-based tutorial); *Time 3* (after the first interactive workshop); *Time 4* (before the second interactive workshop)*; Time 5* (after the second interactive workshop); and *Time 6* (six-month follow-up).
Results:
The community-based providers found this training protocol to be feasible, acceptable and effective. Providers also demonstrated improvements in fidelity of the Project ImPACT intervention techniques and parent coaching strategies. The majority of providers have continued to use Project ImPACT; however, some barriers to training and to the sustainability of the parent coaching program were identified.
Conclusions: This study provides evidence for the acceptability and effectiveness of a training protocol integrating internet-technology, in-person instruction and remote supervision to train community-based service providers in an evidence-based parent coaching intervention for children with ASD. Results suggest that a program like this may serve to overcome barriers to the use of parent coaching programs in community settings, and may ultimately increase access to evidence-based intervention services for children with ASD in the community.

183 **125.183** Community Training Outreach: The Utah Network for Early Autism Response

***S. S. Manwaring**[1], T. Cardon[2], A. J. Fischer[1], S. Cunningham[1], A. Stevens[1], A. V. Kirby[1], R. West[3], S. Iverson[4], B. Robinson[5], C. Guy[6], M. Reidy[7], D. Burgon[1] and T. P. Gabrielsen[8], (1)University of Utah, Salt Lake City, UT, (2)Utah Valley University, Vineyard, UT, (3)Utah State University, Logan, UT, (4)Washington State University, Pullman, WA, (5)Primary Children's Hospital, Salt Lake City, UT, (6)Wyoming Institute for Disabilities (WIND), University of Wyoming, Laramie, WY, (7)University of Texas Medical Branch, Galveston, UT, (8)Brigham Young University, Provo, UT*

Background: The rising prevalence of autism spectrum disorder (ASD) creates critical need for widespread expertise to recognize and respond to earliest signs of the disorder. The Autism and Developmental Disabilities Monitoring Network (ADDM; Biao, 2014) reported that Utah had the lowest proportion (33%) of children with ASD receiving comprehensive evaluations prior to age 3 among eleven sites surveyed (based on health/education records). The median age of ASD diagnosis in Utah, as reported by ADDM, was 53 months of age. Solving these problems requires novel solutions to capacity issues, roles, and gaps in knowledge about screening and early symptoms among the broader early childhood community.
Objectives: The aim of this study was to examine professional practices and competencies around early identification and treatment of ASD prior to and following a one-day, intensive, interactive training to professionals across Utah who work with children under 5 years of age. We sought to improve recognition of subtle signs and ASD symptoms in early childhood, increase comfort levels talking about ASD risk with parents, and increase knowledge about systematic screening, follow up and referral.
Methods: A free, one-day, interdisciplinary training was offered in 3 urban/suburban and 3 rural/semi-rural locations statewide during summer 2015. Participants included pediatric health care providers, early childhood educators, and early intervention and special education professionals, totaling approximately 500 statewide. Training was provided by ASD specialists (all faculty members at major universities) with extensive training and clinical experience in early diagnosis and treatment of ASD. Prior to the workshop, attendees completed a survey (based on Swanson et al., 2013) about current practices, prior knowledge and participation in early ASD identification and intervention. The survey is also being administered at 4, 8 and 12 months post-workshop, to identify changes in practice. The first two follow-up phases will be completed by 12/28/15 and 4/28/16, respectively.
Results: Preliminary data analyses indicated that prior to training, the majority of professionals reported they were not comfortable identifying risk for ASD (72%), screening

for ASD (66%), or discussing ASD diagnoses with families (74%). Twenty percent of professionals reported they currently screen children for ASD using the M-CHAT; 33% of those who screen reported using the M-CHAT follow-up questionnaire, and 15% using the M-CHAT reported they screen all children they see. Other screeners were used by 53%, primarily the Ages and Stages Questionnaire. Following positive screens, 49% of respondents reported they typically refer to early intervention or for further evaluation. In relation to treatment of ASD, 65% of attendees reported they were "not at all" comfortable speaking to parents about ASD evidence-based practices. Post-workshop changes in each of these areas will be reported.
Conclusions: The need for early child professionals to increase their level of training and comfort in screening, early identification, and evidence-based practice statewide is substantial and may be related to the identification of children younger than 3. Community training outreach from specialists at university centers may be one effective approach to address these needs and increase ASD identification rates before age 3.

184 **125.184** Concern May Not Equal Action: Outcome Data in a Universal ASD Screening Sample

T. P. Gabrielsen[1], *M. E. Villalobos*[2], *M. Farley*[3], *L. Speer*[4], *N. Buerger*[5] *and J. Miller*[6], *(1)Brigham Young University, Provo, UT, (2)TEACCH Autism Program University of North Carolina Chapel Hill, NC, Asheville, NC, (3)Waisman Center-University of WI, Madison, WI, (4)Cleveland Clinic, Cleveland, OH, (5)University of Utah, Salt Lake City, UT, (6)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA*

Background: Recently, the US Preventative Services Task Force (USPSTF) issued a call for more research on effects of universal screening for autism spectrum disorder (ASD). This call came in a draft statement indicating insufficient evidence exists for recommending autism screening for all children. Instead, the USPSTF supported screening for ASD in the presence of a concern. The American Academy of Pediatrics immediately issued a re-affirmation that universal screening of toddlers at 18 and 24 months was best practice in addition to screening any time there is a concern. Although studies have looked at universal screening, and others have looked at outcomes from early intervention, no studies have been conducted that link children identified through universal screening to their outcomes.
Objectives: This study provides a detailed examination of actions and outcomes within a small group of screen-identified children from a large community sample, including re-evaluations after third birthdays.
Methods: Participants (n=42, aged 15-33 months) were typically developing controls and children who screened positive following universal autism screening within a large community pediatric practice (n=796). Three children in the sample were referred for ASD evaluation prior to universal screening. Diagnostic evaluations including ADOS at time of screening (n=42) and after 36 months of age (n=22) were performed to determine group status (autism [n=14], language delay [n=14], or typical [n=14] after initial evaluation). Licensed psychologists with toddler and autism expertise, unaware of group status, analyzed 10-minute video samples of participants' original autism evaluations. Raters were asked for autism referral impressions based solely on observations to determine concern about atypical behaviors. Data regarding medical histories, concerns, and risk factors at the time of screening, and eventual actions following screening and evaluation were gathered, as were assessments of cognitive and adaptive abilities at initial evaluation and at follow up during the fourth year of life.
Results: Although concerns of parents or others were prevalent in the autism group (12/14 children), the presence of concerns did not translate to action for many parents (only 7/14 in the autism group had discussions with physicians prior to screening). Prior to universal screening, 3 of the children were referred to early intervention based on concerns for ASD, 2 were referred for speech or feeding. Following universal screening, 9 children were enrolled in services, 1 did not enroll, 1 was eventually not diagnosed with ASD, and 3 Spanish-speaking families were lost to follow up after identification, so outcomes are unknown. In the language delay group, 5 families enrolled in speech services following universal screening, 2 did not, 1 enrolled prior to screening, 6 were lost to follow up. Children in language and autism groups had improved or stable cognitive scores with few exceptions, and mixed adaptive score changes.
Conclusions: Screening in the presence of concerns is supported, but many parents within the sample did not take action on concerns prior to universal screening. The universal screening process may have accelerated identification of children with ASD, resulting in earlier intervention enrollment and stable or improved cognitive and adaptive outcomes.

185 **125.185** Cost-Effectiveness Analysis of Wait Time Reduction for Intensive Behavioral Intervention in Ontario

C. Piccininni[1] *and M. Penner*[2], *(1)Queen's University, Kingston, ON, Canada, (2)Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada*

Background: In Ontario, the Autism Intervention Program funds intensive behavioral intervention (IBI) for children severely affected by autism spectrum disorder (ASD). Accessing IBI before age four is associated with significantly better outcomes compared with later access; however, the average wait time (WT) for this program is 2.7 years. There have been no analyses modeling the lifetime cost-effectiveness of reducing the WT for IBI.
Objectives: The objective of this study was to perform a cost-effectiveness analysis (CEA) comparing WT reduction and elimination to the current status quo over the lifetime from both provincial government and societal perspectives.
Methods: Published wait list statistics were used to calculate the average IBI starting age for the current WT, reduced WT (halved), and eliminated WT. CEA model inputs were derived from published literature. The target population was children diagnosed with severe ASD. The outcome modeled was independence measured in dependency-free life years (DFLYs) to age 65. To derive this, the mean expected IQ was modeled for each comparator based on probability of early (< age 4) or late (4 or older) access to IBI. Probabilities of having an IQ in the normal (70+) or intellectual disability range (< 70) were calculated. Each IQ stratum was assigned a probability of achieving an Independent (60 DFLYs), Semi-Dependent (30 DFLYs) or Dependent (0 DFLYs) outcome. Costs were determined for both provincial government and societal perspectives and were taken from government publications. Parameters were inputted into a decision analytic model, with an annual discount rate of 3% applied to costs and DFLYs. Incremental cost-effectiveness ratios (ICERs) were determined for each strategy from both perspectives. One-way and probabilistic sensitivity analyses were performed to assess the impact of uncertainty in the model.
Results: From the provincial government perspective, eliminated wait time dominated the other two strategies, generating the most DFLYs for $6,500 less per individual to age 65 than current wait time and $2,700 less than the reduced wait time. From the societal perspective, eliminated wait time again dominated the other strategies, generating the most DFLYs with lifetime savings of $38,000 per individual compared with current wait time and $16,200 in savings compared with reduced wait time. From both perspectives, ICER outputs were most sensitive to uncertainty in the probability of achieving a post-treatment IQ score greater than 70 and the probability of an Independent outcome when post-treatment IQ was greater than 70. Probabilistic sensitivity analyses comparing the eliminated to reduced WT strategies from both perspectives each showed a 57% probability of a positive ICER (increased costs and DFLYs), with a 21% probability of cost-savings and increased DFLYs.
Conclusions: The results suggest that an investment to eliminate wait times could produce eventual cost-savings as well as improved independence. Funding expanded program capacity would optimize the likelihood of positive outcomes, improve future independence, and lessen the lifetime cost burden from provincial and societal perspectives.

186 **125.186** Depression in Parents of Children Diagnosed with Autism Spectrum Disorder

A. Cohrs[1,2] *and D. Leslie*[1,2], *(1)Public Health Sciences, Penn State College of Medicine, Hershey, PA, (2)Center for Applied Studies in Health Economics, Penn State College of Medicine, Hershey, PA*

Background: Raising a child with autism spectrum disorder (ASD) can be challenging for many parents and may potentially have an impact on their personal health. The challenges in identifying, accessing, and paying for ASD services, given the nature of these children's needs, available resources, and complex financing arrangements, can place a substantial burden on caregivers. Previous studies have examined how ASD in children can affect parents' health, but they are limited by small sample sizes and patient self-report.
Objectives: The objective of this study was to determine whether there is an association between having a child with ASD and diagnosis of depression in the child's mother and/or father. We also determined whether the age of the child, as well as the number of children in the family, was associated with a diagnosis of depression in the parents.
Methods: Retrospective analysis of health insurance claims data from the 2011 MarketScan database was performed. ICD-9 codes were used to determine a primary or secondary diagnosis of ASD in children ages 0-17 and a diagnosis of depression in the parents of those children. Rates of parental depression among children with ASD were compared to those of an age and gender matched control group of children without ASD. Chi-square and logistic regression analyses were performed to determine the association of having a child with ASD on parental depression, controlling for child and parent characteristics.
Results: There were 42,662 case-control dyads, resulting in 85,324 unique families. Among all families, 12,237 (14.3%) had at least one parent with a diagnosis of depression. A diagnosis of depression was more than twice as common in parents of children with ASD (20.2%) than in parents who did not have a child with ASD (8.5%). After controlling for other child, parent, and family characteristics, having a child with ASD almost tripled the odds (OR: 2.83; 95% CI: 2.71-2.96) of parental depression. Mothers of children with ASD were 3 times more likely to have a diagnosis of depression than mothers of children without ASD (OR: 3.01; 95% CI: 2.86-3.17), and fathers of children with ASD were 2.4 times more likely to have a diagnosis of depression than fathers of children that did not have ASD (OR: 2.44; 95% CI 2.27-2.62). In addition, risk of depression increased when there was more than one child with ASD in the family (OR: 1.42; 95% CI: 1.27-1.60) and with child age.
Conclusions: Both mothers and fathers of children with ASD were at increased risk of having depression than parents of children without ASD. Furthermore, the risk of depression increased if the parents had more than one child with ASD and with child age. Support and education should therefore be provided to both mothers and fathers of children with ASD.

187 **125.187** Determinants of Wait Time for Autism Spectrum Disorder Diagnostic Assessment in Canada

M. Penner[1], *E. Anagnostou*[2] *and W. Ungar*[3], *(1)Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada, (2)University of Toronto, Toronto, ON, Canada,*

(3)Hospital for Sick Chidlren, Toronto, ON, Canada

Background: The increasing prevalence of autism spectrum disorder (ASD) diagnoses and a shortage of skilled practitioners have contributed to substantial wait times for diagnostic assessment. These wait times occur during an important window for social learning and may result in suboptimal developmental outcomes. Identifying factors related to provider characteristics and assessment practices may help to streamline the assessment process, reducing wait times.
Objectives: The objective of this study was to identify determinants of wait times for ASD diagnostic assessment in Canada.
Methods: An online national survey was conducted through the Canadian Paediatric Society's Developmental Paediatrics, Community Paediatrics, and Mental Health sections, which were identified as the groups of pediatricians most likely to encounter children with suspected ASD. Participants were asked for demographic information and whether they diagnosed ASD. Those who diagnosed ASD were asked about the elements of their assessment, duration of assessment, and wait times. A linear regression was performed using natural log transformed total wait time (time from referral to communication of the diagnosis to the family) as the dependent variable. Hypothesized explanatory variables included assessment duration, type of assessor (general pediatrician, developmental pediatrician, other), use of a multi-disciplinary team, accepting referrals from primary care physicians, catchment area, province of practice, and number of years in practice.
Results: The overall response rate for the survey was 14% (91 completed surveys out of 639 individuals solicited). Fifty-seven participants indicated that they diagnosed ASD in their practice (62.6%) and were included in the analysis. This sample was 66% female (n=38, versus 19 males) with a median age of 52 (range 29 to 77). The median reported total wait time was 208 days (interquartile range 119, 365). Bivariate analyses for total wait time identified assessment duration (Spearman r = 0.31, p = 0.02), type of assessor (Kruskal Wallis chi-squared = 3.66, p = 0.16), and province (Kruskal Wallis chi-squared = 13.67, p = 0.19) as potential explanatory variables. Assessment duration was significantly associated with type of assessor (Kruskal Wallis chi-squared = 5.59, p = 0.003) so these variables were not tested together in the model. Assessment duration was the only variable that remained significant when tested in the regression model (p = 0.002) and accounted for 15% of the variance in the model. The back-transformed mean adjusted total wait time was 254 days (95% confidence interval 214, 302).
Conclusions: Canadian wait times for ASD diagnostic assessment are substantial, encompassing over eight months from referral to communication of the diagnosis to families. The amount of time spent on the assessment is a significant determinant of wait time, highlighting the need for efficient assessment practices.

188 **125.188** Development of a Clinically Integrated Return of Results Protocol for Genetics Research in Autism

I. Peltekova[1,2,3], *L. Stern*[4], *D. Buhas*[5] *and M. Elsabbagh*[6], *(1)Integrated Program in Neuroscience, McGill University, Montreal, QC, Canada, (2)Developmental and Behavioural Pediatrics, Montreal Children's Hospital, Montreal, QC, Canada, (3)Psychiatry, Autism Research Program, Montreal, QC, Canada, (4)Montreal Children's Hospital, Montreal, QC, Canada, (5)Genetics, Montreal Children's Hospital, Montreal, QC, Canada, (6)McGill University, Montreal, PQ, Canada*

Background: The rapid advancement of genomic research in autism is due to the growing participation of children with autism and their families, and to the implementation of increasingly powerful genomic tests. Some tests, namely microarrays, are now a standard part of the clinical assessment of children with autism. Results of these tests may have significant value for families, as they can impact diagnosis, prognosis, health surveillance and reproductive decisions. Within large-scale genetic research studies, disclosure of incidental findings is a standard ethical conduct. However, the increasing complexity of individual child and family results, coupled with their variable clinical significance, present a challenge for how and when to communicate genetic findings (Knoppers et al. 2010). Despite several theoretical discussions, there is very limited empirical research tracking impact of genetic findings on clinical care (Fernandez et al. 2013, Johnson et al. 2012).
Objectives: Consistent with recent recommendations for large scale research studies to declare a specific process for Return of Results (RoR) (Knoppers et al. 2010, Wolf et al. 2012), our goal was to develop a contextually-sensitive protocol, that considers local health systems characteristics and constraints.
Methods: We convened a work group to develop a RoR protocol for a data collection site that participated in two large-scale genetics studies. Over 400 families have been enrolled in studies where advanced sequencing methods are increasingly revealing complex individual child and family results.
Results: The work group considered that general ethical standards, such as confidentiality and protection of minors, were insufficient to fully inform RoR. They identified and formulated more specific directives to guide the RoR protocol: (1) families must have consented to receiving individual findings, (2) findings must be clinically actionable, (3) care pathways potentially resulting from RoR must be clear and accessible to families, (4) likelihood of family confusion and stress resulting from the findings or due to delays in access of subsequent care must be monitored and minimized, and (4) potential impact on health systems resources must be monitored.
Conclusions: Our resulting RoR protocol is contextually sensitive and integrates RoR from research with healthcare capacity and constraints. Current empirical application of this protocol provides guidance for the integration of next-generation sequencing methods into clinical care.

189 **125.189** Do Teachers Teach Social Skills to Students with Autism Spectrum Disorder and Students with Intellectual Disabilities?

K. Kemp[1] *and H. M. Chiang*[2], *(1)Rhode Island College, Providence, RI, (2)Teachers College Columbia University, New York, NY*

Background: Individuals with autism spectrum disorder (ASD) and individuals with intellectual disability (ID) have social skills deficits. Students with ASD and students with ID are eligible to receive free and appropriate special education and relevant services under the Individuals with Disabilities Education Act. However, little is known if these students receive social skills interventions in schools and the types of social skills interventions that they receive in school.
Objectives: This study aims to answer these research questions: (1) Do teachers of students with ASD or ID teach social skills to their students? (2) Are there relationships between teacher characteristics and whether or not teachers teach social skills to these students? (3) Are there relationships between student characteristics and whether or not teachers teach social skills? (4) What are the student and teacher factors predictive of social skills of these students? (5) What kind(s) of social skills instructional strategies do teachers use? (6) What are the barriers that teachers face when teaching social skills to these students? (7) What resources or supports do teachers need?
Methods: Fifteen general education teachers and 51 special education teachers participated in this study. They were asked to complete a questionnaire about their use of social skills instructional strategies in their classroom, and a social skills assessment for their student. A total of 51 students with ASD (mean age = 10.85 years) and 15 students with ID (mean age = 11.9 years) who ranged in age from 5-18 years were identified by participating teachers.
Results: This study found (1) Of the 66 participating teachers, 71.2% reported that they taught social skills to students with ASD or ID. (2) There was no significant difference between special education teachers and general education teachers in offering social skills interventions to their students. (3) There was no significant difference between student characteristics and whether or not teachers provided social skills interventions to them. (4) No teacher characteristics were predictive of students' social skills. (5) Having friends and showing more than 20 functional words were predictive of students' social skills. (6) The three most frequently used strategies were prompting, reinforcement, and modeling. (7) The two most infrequently used strategies were Pivotal Response Training and video modeling. (8) Teachers tended to rank the strategies which are easy to use as effective. (9) The most common barriers for teaching social skills in schools were a lack of time for designing social skills interventions and a lack of appropriate curriculum. (10) Time and curriculum were reported as the most needed resources.
Conclusions: Teachers did provide social skills interventions to students with ASD and students with ID. However, not every teacher of students with ASD or students with ID did so. Lack of time and curriculum seem to be the reasons accounting for this. Thus, supports in relation to these two areas should be provided to teachers. Teachers tended to rank the strategies that were not easy to use as less effective. Thus, usability should be considered when developing new social skills interventions.

190 **125.190** Early Intervention Providers in the Field: Barriers and Incentives to Professional Development and Coaching in Evidence-Based Practices for Autism Spectrum Disorder

E. Chapman[1], *N. D. Bond*[1], *S. K. Fuhrmeister*[1], *J. L. Stapel-Wax*[2], *T. Ryan*[3], *S. E. Gillespie*[4], *M. Costo*[1] *and K. Terry*[1], *(1)Marcus Autism Center, Atlanta, GA, (2)Emory University School of Medicine, Atl, GA, (3)Marcus Autism Center, Duluth, GA, (4)Marcus Autism Center, Children's Healthcare of Atlanta, and Emory University School of Medicine, Atlanta, GA*

Background: Minimal information is known about factors that influence early intervention providers' participation in professional development. Exploring these factors can help predict participation in adult learning activities that are designed to promote the utilization and implementation of evidence-based practices for children with Autism Spectrum Disorder (ASD). Evidence-based early intervention plays a vital role in helping children at risk for developing ASD obtain their fullest developmental potential. Professional development that includes coaching is linked to immediate skill development and an increased chance that newly learned skills are sustained over time in the real-world setting (Rusby et al. 2013).
Objectives: This project aimed to explore barriers and incentives that might influence Early Intervention Providers' participation in a 30-hour online course on evidence-based practices for infants and toddlers with Autism Spectrum Disorder (ASD) and/or 12 months of coaching on evidence-based practices for ASD in a hybrid format which includes both face-to-face coaching and virtual coaching. Factors examined in this exploratory study include demographic variables, education level and interpersonal factors such as family obligations and lack of time.
Methods: This study examined barriers and incentives to participation in both the online training modules and coaching for 45 early intervention providers across the state of Georgia who voluntarily participated in an Early Intervention Providers Needs Assessment Survey. This was a convenience sample. The survey utilized consisted of 9 questions, which were a combination of multiple choice/multiple answers. Participants were also given the opportunity to provide text responses to reflect barriers and incentives that were not listed.
Results: Statistical results of the survey indicate that lack of time and work obligations are often the greatest barriers to participation in both the online training modules and coaching for this population. Being able to earn CEUs and financial incentives were the best motivators for participating in both forms of professional development (online training and coaching). Only 1/5 (20%) of the providers surveyed had completed all four modules of the online training. However, 2/3 (66.7%) of the participants indicated that they had the desire to be coached on evidence-based practices for infants and toddlers with ASD.

Conclusions: These findings offer a preliminary look at the unique factors influencing early intervention providers' participation in professional development related to evidence-based practices for infants and toddlers with ASD. Results from this study can lead to further research on professional development and training tailored to fit the needs of this population.

191 **125.191** Echo Autism: Bringing Best Autism Care to Primary Care

K. Sohl[1], *A. Curran*[2], *R. M. Brown*[3] *and M. O. Mazurek*[4], *(1)University of Missouri - Thompson Center, Columbia, MO, (2)University of Missouri, Columbia,, MO, (3)University of Missouri, Columbia, MO, (4)University of Missouri - Columbia, Columbia, MO*

Background:
Children with Autism Spectrum Disorder (ASD) have limited access to comprehensive medical care in their communities. Children from underserved populations and regions face even greater disparities in access to diagnostic and treatment services. Primary care providers (PCP) report low self-perceived competency and a high need for education about medical management of children with autism. Given limited resources for specialty care, there is a need to increase capacity for PCPs to provide best practice autism care in primary care. Extension for Community Healthcare Outcomes (ECHO®) is a model of telehealth that builds local capacity by teaching best practices using case-based learning, video technology, and outcome evaluation. ECHO Autism was developed in partnership with The Autism Intervention Research for Physical Health/ Autism Treatment Network (AIRP/ATN) to disseminate evidence-based screening and management guidance to community providers.
Objectives: The objective of this project was to recruit PCPs to participate in a 6 month pilot of ECHO Autism to determine if this model was effective in 1) increasing PCP self-efficacy with identification of ASD symptoms in children between 12 months and 18 years of age and 2) increasing PCP self-efficacy in assessing and treating common medical and psychiatric comorbidities in children with autism.
Methods: Fourteen PCPs were recruited to participate in ECHO® Autism clinics facilitated by an interdisciplinary team of autism and behavioral experts. During two hour, biweekly clinics, the expert team facilitated discussion and provided feedback for two PCP generated case-based presentations and delivered a didactic presentation, augmenting case-based learning. Practice behavior and self-efficacy in screening and medical management of children with ASD were measured at baseline and post-intervention. Wilcoxon signed-rank tests were performed with significance set at $p < 0.05$.
Results: Improvements in Total Self-Efficacy from pre-test (M = 177.15, SD = 46.59) to post-test (M = 227.43, SD = 21.59; $Z = -3.06$, $p = .002$) were noted. Improvements in Self-Efficacy were also observed in each of the subscales, including Screening, (Z = -260, p = .009). Resources (Z = -3.11, p = .002), Medical (Z = -2.68, p = .007), Psychiatric (Z = -3.06, p = .002), and Additional (Z = -2.87, p = .004). The percentage of pediatricians reporting full compliance with American Academy of Pediatrics (AAP) guidelines for autism screening increased from 30% to 60% following participation in ECHO Autism.
Conclusions:
The ECHO Autism model is an effective model to improve primary care provider self-efficacy with identification and management of autism. This real-time, interactive model offers an efficient and effective support system and fosters networking between all participants. As cases are presented and didactics delivered, PCPs increase their comfort, knowledge and confidence in screening, assessing and treating children and youth with ASD and other developmental concerns. ECHO Autism also is a promising model to improve compliance with AAP screening guidelines. Future research should focus on demonstrating sustainable practice change in primary care that results in improved access and outcomes for individuals with autism.

192 **125.192** Emergency Psychiatric Service Use and Continuity of Care Among Youth with Autism Spectrum Disorder

L. Kalb *and E. Stuart, Johns Hopkins School of Public Health, Baltimore, MD*

Background: Previous research suggests youth with Autism Spectrum Disorder (ASD) are at increased risk for emergency psychiatric service use, including both inpatient psychiatric hospitalizations and psychiatric emergency department (ED) visits. However, the few studies that have addressed this topic suffer from serious methodological limitations and are quite limited in scope.
Objectives: To examine differences in the probability and conditional rate of both inpatient psychiatric hospitalization and psychiatric ED visits between youth with ASD and youth with Attention Deficit-Hyperactivity Disorder (ADHD). Additional outcomes included differences between groups regarding: 1) the likelihood of readmission within 30 days, 2) length of stay, and 3) probability of an outpatient mental health appointment 30 days before and after service use.
Methods: Data for this study came from 64,700 and 529,662 adolescents (ages 12-17 years) with ASD or ADHD, respectively, enrolled in the 2010-2013 MarketScan Commercial Claims Database. To be included, youth must have at least two ICD-9-CM claims of ASD (299) or ADHD (314), at least 1 year of continuous enrollment, and no history of substance abuse or stay in a long-term residential facility. Psychiatric services were identified by the presence of a primary psychiatric diagnosis (290-314.XX) or E/V code (e.g., suicide). The Area Resource File (ARF) was joined to the Marketscan dataset to provide information on geographical indicators of race, income, and density of outpatient and inpatient services. A multivariate two-part regression model was used to assess the probability (logit) and conditional rate (gamma) of service use while adjusting for demographic, enrollment, and geographic characteristics. All other objectives were addressed using multivariate linear or logistic regression models.
Results: 1 in 12 adolescents with ASD used an urgent psychiatric service, representing greater than a two-fold higher probability of use for psychiatric hospitalization (5% vs. 2%; aOR = 2.5, 95% CI: 2.4-2.6) and for psychiatric ED visits (4% vs. 2%; aOR = 2.2, 95% CI: 2.1-2.3) compared to those with ADHD. Conditional on service use, the ASD group had a 14% and 11% increased rate of hospitalization (IRR = 1.14, 95% CI: 1.1-1.2) and ED (IRR = 1.11, 95% CI: 1.08-1.44) visits, respectively. Longer inpatient and ED stays, and an increased likelihood of re-visiting both settings within 30 days was also found among youth with ASD (all p<.001). Receipt of an outpatient mental health services 30 days before or after an ED visit or hospitalization was high (~80%) and similar between groups (p>.05).
Conclusions: This is the first prospective cohort study to assess the interplay between inpatient, ED, and outpatient psychiatric service use among youth with ASD or ADHD. Youth with ASD used more emergency psychiatric services for longer periods of time compared to youth with ADHD. Increased psychiatric ED use among those with ASD is particularly disconcerting since only 10% of these visits resulted in hospitalization, leaving the family to manage the difficult behavior at home without additional resources or treatment options. These data also challenge the notion that emergency psychiatric services use is simply due to poor connections to outpatient mental health providers.

193 **125.193** Enhanced Screening Methods Increase Percentage of Children with ASD Diagnosed in a Clinical Setting

C. Hall *and S. Hoffenberg, Marcus Autism Center, Children's Healthcare of Atlanta, and Emory University School of Medicine, Atlanta, GA*

Background:
Current guidelines from the Academy of Pediatrics (2010) recommend that children suspected of having Autism Spectrum Disorders (ASD) should receive a comprehensive evaluation. As one of the only specialty clinics in our state, and one that serves a diverse and often economically disadvantaged population, our clinic is faced with high demand for diagnostic assessments. Historically, all children referred for an autism evaluation received a full psychological assessment in our clinic, which led to very long waiting lists. In 2012, 896 children were referred for diagnostic assessment, and 299 of these were evaluated during a one year period. Of those children, only 53% were found to meet DSM Criteria for ASD. Given this high rate of children who did not have ASD, significant changes were made in 2013/2014 to our screening and triage efforts, with the goal of focusing our diagnostic assessment appointments on children who were most in need of diagnostic assessment, specifically to assess for ASD.
Objectives:
The present study examines whether specific methods of triage and screening helped to reserve diagnostic testing appointments for children with symptoms specific to ASD. More specifically, it examines the utility of reviewing records and conducting a comprehensive diagnostic interview prior to full evaluation.
Methods:
During 2013/2014, we added new procedures to our intake process. First, we began to request records (e.g. school IEP's, previous testing, pediatrician's notes and rating scales) at the beginning of the process. Records were reviewed by a clinical intake team that determined whether the child showed symptoms indicative of ASD. Children whose records indicated that an evaluation was warranted were scheduled for a diagnostic interview. A full assessment (i.e., cognitive/development measure, adaptive measure, and ADOS-II) was scheduled after the interview only when clinically indicated.
Results:
In the year subsequent to the intake changes (October 2014 to October 2015), 2,346 referrals were reviewed by the team. Based on the review of records, 860 children were referred out to community providers or referred straight to treatment programs in the center, rather than being scheduled for an assessment. Of the remaining children, 920 received a diagnostic interview and 632 (69%) of these were brought back for a full testing battery. Of those receiving full diagnostic assessments, 68% met diagnostic criteria for autism spectrum disorder.
Conclusions:
Utilizing an initial record review and diagnostic interview enabled the clinic to refer out a full 1061 children (45% of the initial referrals) to more appropriate services. Of the children who were scheduled into full diagnostic assessment appointments, 68% met criteria for ASD, as compared to the 53% who met criteria previous to the enhanced intake efforts. These procedures have refined our ability to identify children who are showing red flags for ASD and helped to reserve lengthy testing appointments for children most in need. As the need for autism assessment and treatment planning rises across the globe, this work furthers the goal of finding ways to efficiently and accurately identify children with ASD so that important intervention efforts can begin as soon as possible.

194 **125.194** Examining Transition and Vocational Pathways in ASD: Perspectives of Individuals with ASD and Parents

D. B. Nicholas[1], *M. Clarke*[2,3], *L. Zwaigenbaum*[4], *K. C. Lowe*[2,5], *S. Hodgetts*[4], *W. Mitchell*[6], *C. A. McMorris*[7], *R. Zulla*[1] *and T. M. Jubenville*[5], *(1)University of Calgary,*

Edmonton, AB, Canada, (2)Sinneave Family Foundation, Calgary, AB, Canada, (3)Uni, Calgary, AB, Canada, (4)University of Alberta, Edmonton, AB, Canada, (5)University of Calgary, Calgary, AB, Canada, (6)The Ability Hub, Calgary, AB, Canada, (7)York University, Toronto, ON, Canada

Background: Adolescents with Autism Spectrum Disorder (ASD) are at risk for suboptimal trajectories to and within adulthood, potentially leading to marginalization, underachievement, and an impaired quality of life. Beyond the potential imposition to basic human rights, investments made earlier in development are at risk of misalignment if a successful transition to, and opportunities within, adulthood are not in place. Further straining transitional and vocational processes, supports for adults with ASD are currently constrained. Despite often having marketable skills, adults with ASD are often deemed unable to gain meaningful employment.
Objectives: To address these gaps, two complementary studies have explored: (i) the transition from adolescence to adulthood and (ii) vocational support pathways in ASD. Study objectives include examination of the process of transition to adulthood in ASD as well as employment. Aims of this program of research entail an evidence-informed model for effective transitioning, as well as factors that inhibit or conversely promote effective supports for employment access and retention.
Methods: Utilizing a grounded theory approach (within a larger study), qualitative interviews were conducted with a sample of youth and adults with ASD and parents. Findings from interviews with adults with ASD (>17 years of age) and their parents will be presented. Interviews address participant experiences and aspirations relative to their transition to adulthood in ASD and salient issues associated with employment success and barriers. Recommendations and guidelines are being iteratively developed for enhanced transition and vocation planning in ASD.
Results:
Findings offer a portrayal of impediments and determinants to positive outcome. Young adults with ASD and their caregivers characterize existing services as insufficient or inappropriate relative to individual need and desire for comprehensive support in adulthood. Services are deemed to often be inaccessible and/or not well-known. There is a reported lack of available knowledge about existing services and travel to/from services are prohibitive for some individuals/families. Services are reported as insufficient for addressing broader social issues that affect employment sustainability and community integration (e.g., social reciprocity, coping skills, mental health, navigation). Parents report multiple challenges including uncertainty and worry about the future of their adult child; difficulty trusting others as part of the 'circle of care', and struggles 'letting go' regarding the adult child's transition to greater independence and/or integration in the community. Adults with ASD similarly describe services they receive as not sufficiently meeting the scope of their support needs and are deemed to be variably inaccessible.
Preliminary results guide transition and vocation planning, and identify these program components as crucial for youth and adults with ASD and their families. Transition and vocation support emerges as requisite and incremental in nature, with a focus on actual and anticipated need, goal setting, and activity/targeted outcome planning. Recommendations for transition and vocation support delivery will be offered in the presentation, as will implications for program and policy development.
Conclusions: Critically examining and recalibrating aims, methods and outcomes related to transition and vocation are integral to optimizing the developmental trajectory of youth and adults with ASD.

195 **125.195** Exploring the Relationship Between Referral Source, Evaluation Setting, and Cognitive/Behavioral Characteristics in Children Referred for Psychological Evaluation

E. L. Wodka[1]*, A. Pittenger*[2] *and S. Erklin*[3]*, (1)Kennedy Krieger Institute, Baltimore, MD, (2)The Kennedy Krieger Institute, Baltimore, MD, (3)Outpatient Pediatrics, Northwestern Medicine, Winfield, IL*

Background: There has been little research completed to better understand the process by which children are referred for psychological evaluation. Some have argued that pediatricians and primary care physicians are in a unique position to identify (and refer) "at-risk" children. Other research suggests that parental concerns may serve as a useful tool in the identification and referral of children with developmental and behavioral concerns.
Objectives: This study aims to explore the demographic and clinical characteristics of children who were seen for (neuro)psychological evaluations in a large clinical outpatient specialty setting. We hypothesize that caregiver-referred children will present with a different symptom profile than those referred by professionals.
Methods: Participants included 845 children (M_{age}=10.5, *SD*=3.3, *Range*=5-21 years) who received (neuro)psychological evaluation and were diagnosed with autism spectrum disorder (n=94), attention deficit hyperactivity disorder (ADHD; n=620), and/or anxiety (n=41). Demographic information (age, race, sex, and type of insurance) and clinical information (cognitive, behavioral, and adaptive functioning) were extracted from our clinical database. Chart review was completed to confirm diagnosis, assess for missing data, and document referral source (coded as either "caregiver" or "professional"). Cognitive functioning was measured using one of the Wechsler Scales (i.e., WPPSI-IV, WISC-IV, or WAIS-IV). Participants with both Verbal and Performance IQ < 70 were excluded (FSIQ: *M*=88.5, *SD*=16.0). Information on externalizing, internalizing, and adaptive behaviors was obtained using composite scores on the Behavior Assessment Scale for Children (BASC-2) and Adaptive Behavior Assessment System (ABAS-2).
Results: Referral groups were defined as those referred by professionals (63%) or caregivers (29%). There were no significant differences in behavioral symptoms or intelligence scores between referral groups. However, children referred by caregivers had significantly better adaptive scores (ABAS-2, General Adaptive Composite: *M*=76.8, *SD*=16.5) than those referred by professionals [(*M*=73.9, *SD*=16.3), *t*(742)=2.3, *p*=.03]. Results show a significant difference in both the number of diagnoses (single versus comorbid) based on referral source (X^2 (1, *N*=773) = 10.4, *p*<.01), as well as the type of diagnosis (autism versus ADHD) (X^2 (1, *N*=698) = 11.4, *p*<.01), with professionals being more likely to refer children with comorbidities and ADHD. Professionals were also more likely to refer children with public insurance than private insurance (X^2 (1, *N*=771) = 8.0, *p*=.02).
Conclusions: Overall, professionals were more likely to refer children for (neuro)psychological evaluation than their caregiver. Those children referred by professionals were somewhat more involved, having lower adaptive functioning, increased diagnostic comorbidities, and lower SES. Additionally, professionals were more likely to refer children with ADHD than their caregivers, while parents and professionals were equally likely to refer children with ASD. While, there is not a predominant difference in clinical presentation that is associated with referral source, professionals should be aware that families of lower SES may not be effectively recognizing or voicing their child's needs. Further, parents of children with ASD may be in a better position to recognize more subtle symptoms of ASD that do not present in brief office visits. Future investigation into effects of age and type of referring professional (e.g., medical provider vs. school personnel) is suggested.

196 **125.196** First Steps: Parent Education to Support Family Empowerment

J. Mancini*, Seattle Children's Autism Center, Seattle, WA*

Background:
Receiving the news that your child has been diagnosed with autism spectrum disorder (ASD) can be a devastating moment for many families. Immediately after the diagnosis, a common model of care is to conduct a feedback session to provide information related to autism, recommendations related to therapies and school services, and a list of resources. Families do not process that information well and often, families do not receive adequate follow-up care. To help fill this void of information following a diagnosis, a model to provide parent education (entitled First Steps) has been developed at our center that includes small group psycho-educational classes designed to provide relevant information. First Steps is an important component of our service delivery model which includes step one: the diagnostic evaluation, step two: First Steps Parent Education, and step three: routine follow-up care with medical providers.
Objectives:
The objective of this poster is to present a model of parent education and support that has been developed to provide information to professionals at other centers serving children with ASD. Specifically, details related to a three-part psychoeducational class will be provided including information related to content, structure, cost, support, and objectives for parent learning. Data collected via completion of pre- and post-class questionnaires by participants will be presented to provide information related to changes regarding feelings of parental stress and family empowerment. Information will also be provided regarding adapting the curriculum for non-Native English speakers and multi-cultural families and video-teleconferencing to increase participation for distant families.
Methods:
Two measures, the Parenting Stress Index/Short Form (PSI/SF) and the Family Empowerment Scale (FES) were completed by a subset of class participants pre- and post-participation to provide information related to possible changes in these areas. The independent variable is participation in the psycho-educational class. The dependent variables are, 1) Scores on the PSI/SF, and 2) Scores on the FES. Paired samples t-tests were used to analyze changes in these dependent variables.
Results:
Findings indicate that parents experienced increased feelings of empowerment following participation in the psycho-educational class. Results indicate statistically significant improvement as measured by the FES ($p < .01$). Results did not indicate statistically significant change as a group as measured by the PSI/SF ($p > .05$) though results of some questionnaires completed post-participation indicated a decrease in stress in some families.
Conclusions:
The follow-up care for families receiving the news that their child has ASD is often insufficient. Participation in a series of classes designed to provide information and support has been developed and will be presented here as a model for other centers serving individuals with ASD. Results indicate that changes can occur in a parent's feelings of empowerment following participation in the classes, which can lead to positive outcomes. Parent education can be an important component to service delivery to support families who have children with ASD.

197 **125.197** Foster Care Placement Among Medicaid-Insured Children with Autism

Z. Cidav[1]*, M. Xie*[1] *and D. S. Mandell*[2]*, (1)University of Pennsylvania, Philadelphia, PA, (2)University of Pennsylvania School of Medicine, Philadelphia, PA*

Background: Existing literature suggests that children with disabilities are at increased risk for child maltreatment and subsequent involvement with child welfare. Little is known, however, about how entry into foster care differs for children with autism spectrum disorder (ASD) compared with children with other disabilities and children without disabilities.
Objectives: to estimate the risk of foster care placement among children with autism ages 2 to 18 years and compare it with the risk for children with intellectual disabilities (ID) and children without either diagnosis.
Methods:
We used National Medicaid claims data from 2001 through 2007. The sample included 117310 children who had been diagnosed with ASD (ICD code 299.xx) during the study period, 192378 children who had been diagnosed with intellectual disability (ICD codes 317.xx – 319.xx), 31487 children who had been diagnosed with both, and a sample of 336549 children who had been diagnosed with neither, matched to the rest of sample on state of residence. A washout period of 12 months was used to ensure that children in the sample had no previous foster care placement. The dependent variable, entry into foster care, was defined as three continuous months in which the reason for Medicaid eligibility was specified as "foster care."
We compared the unadjusted risk of entering foster care for each of the four groups. Discrete time logistic regression analysis was used to estimate the adjusted associations between diagnostic group and risk of foster care entry, controlling for age, sex, race/ethnicity, other diagnoses and healthcare service use. In secondary analyses, we examined specific patterns of healthcare service use that were associated with foster care placement among children with autism.
Results: Analyses are ongoing. Preliminary results suggest that 3.5% of children diagnosed with ASD entered foster care during the study period, compared with 1.6% of other children. Among children with ASD, those who experienced a psychiatric hospitalization or were on multiple psychotropic medications were more likely to end up in foster care. Those whose families received respite care were less likely to end up in foster care.
Conclusions:
Children with ASD are at twice the risk of entering foster care than other children. Hospitalizations especially may be an important warning sign of a family in crisis, and the need to provide additional supports. The results of this study beg the question of why children with ASD are entering foster care, and what treatments, family supports and policies could be put in place to prevent it.

198 **125.198** Gender Disparities in the Allocation of Special Education Services

M. Dean[1], *J. Williams*[2], *R. Harwood*[3] *and C. Kasari*[4], *(1)California State University, Channel Islands, Camarillo, CA, (2)Semel Research Institute, UCLA, Los Angeles,, CA, (3)Maternal and Child Health, Health Resources and Services Administration, Rockville, MD, (4)University of California Los Angeles, Los Angeles, CA*

Background:
Research suggests that our difficulties identifying and diagnosing girls with ASD without cognitive impairment (Girelli et al, 2010; Shadduck et al., 2009) may be due to a male bias in our perception of ASD. Girls are described as being better able than boys to "camouflage" their symptoms of ASD (Dworzynski et al., 2012), and yet, The Liability Threshold Model suggests that the less frequently affected gender will be more severely impacted (Tsai, Stewart, & August, 1981). Both perceptions highlight a gap in our ability to recognize ASD in girls. While practitioners look for severe presentations of ASD symptoms, girls with milder forms of ASD mask their challenges. Consequently, girls with ASD are at risk for under identification, and a lack of access to services. Research is needed to examine possible gender discrepancies in the allocation of special education services at school.
Objectives:
The purpose of this study is to examine gender-related disparities in the provision of special education services for students with ASD. If girls receiving special education services have severe symptoms of ASD, then gender differences will be evident in the number of related services listed in the Individual Education Plans (IEP) of children with ASD who are primarily educated in the general education setting.
Methods:
We examined the related services listed in the IEPs of children with ASD (n=3,966) in a large urban school district. Related services refer to additional supports needed for students with disabilities to benefit from special education. There were a total of 34 categories. Categories were coded as "resource", or "non-resource". "Resource" is only available for children with disabilities who are educated in the general education setting. Students qualifying for "resource", require additional academic (language arts or math), or other (social skills, prevocational education etc.) supports in order to benefit from their placement. "Non-resource" services are available to all children with disabilities, regardless of placement. There were a total of 31 non-resource services, including speech and language therapy, occupational therapy, adapted physical education, physical therapy, or behavior intervention.
This study examined IEP data from children with ASD who received resource services, and were therefore educated in the general education setting (pre-k=75, elementary=2064, secondary=1827). We combined the types of services ("resource'; "non-resource") to calculate the total number of related-services a child received in one school year. We used ordinal logistic regression to examine the effect of school category (pre-k, elementary, secondary) on gender and related services, and gender on related services.
Results:
Gender differences were evident; boys received significantly fewer related services than girls ($p < 0.02$). School category was not significant, and there was no interaction of school category and gender.
Conclusions:
These findings suggest that when girls are identified, their presentation of ASD symptomatology is severe. More research is needed to determine if the under-representation of girls with ASD without cognitive impairment is due to girls masking their symptoms, and due to staff bias in finding only girls with more significant issues.

199 **125.199** Impact of the New DSM-5 Criteria for ASD on the Number of Children Receiving Autism Specific Funding: An Analysis of Change in Incidence over Time

C. A. Bent[1], *J. Barbaro*[2] *and C. Dissanayake*[3], *(1)La Trobe University, Melbourne, VIC, Australia, (2)La Trobe University, Melbourne, Victoria, Australia, (3)Olga Tennison Autism Research Centre, La Trobe University, Melbourne, Australia*

Background: Changes made to the autism diagnostic criteria over time reflect our changing understanding of these conditions, as informed by research and clinical practice. The most recent iteration of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) was released in May 2013, amid much controversy. Foremost was the concern that a subgroup of individuals who previously met DSM-IV criteria for a Pervasive Developmental Disorder (PDD) may no longer meet the DSM-5 criteria for Autism Spectrum Disorder (ASD). This outcome could potentially have implications for ongoing service provision and funding eligibility. While previous research has provided important insights into the potential impact of the DSM-5 on prevalence estimates and the sensitivity of the revised diagnostic criteria, no studies have yet examined the population-level impact of the DSM-5 on the number of children receiving diagnoses in the community, and accessing autism support services.
Objectives: This study aimed to examine: (1) change over time in the estimated annual incidence of children diagnosed with ASD and registered to receive autism specific funding, and (2) trends in the number of diagnoses across PDD diagnostic groups, prior to and following the introduction of the DSM-5.
Methods: De-identified data for 32,199 children aged under 7 years who were registered with the Helping Children with Autism Package (HCWA) in Australia from January 2010 to June 2015 was utilised. Eligibility criteria for HCWA requires diagnoses to be consistent with the DSM-IV or DSM-5 and confirmed by a Paediatrician, Psychiatrist or a multidisciplinary team. The annual incidence of children diagnosed with ASD and registered with HCWA was calculated by dividing the total number of children registered each year, by the estimated population of children the same age.
Results: The estimated annual incidence of children diagnosed with ASD and registered to receive autism specific funding increased from 20 per 10,000 in 2010 to 34.2 per 10,000 in 2013. Following the introduction of the DSM-5 in 2013, the estimated annual incidence of ASD plateaued, with no significant difference in incidence evident from 2013 to 2015 (see Figure 1). Final results will also include an Interrupted Time Series Analysis to determine if this reflects a significant deviation from the overall trend of increasing diagnoses over time. A significant reduction in the proportion of Asperger's Disorder and PDD-Not Otherwise Specified was observed from 2013, in line with the removal of these subtypes from the DSM-5.
Conclusions: Diagnostic criteria comprise an important element of the service environment that influences clinical behaviour and ensuing diagnoses of ASD in the community. The findings suggest that the more stringent DSM-5 criteria may curb the trend of increasing diagnoses over time. However, further monitoring is required to assess the ongoing influence of the changes on diagnostic practice. Implications regarding access and availability of funding and support services will be discussed.

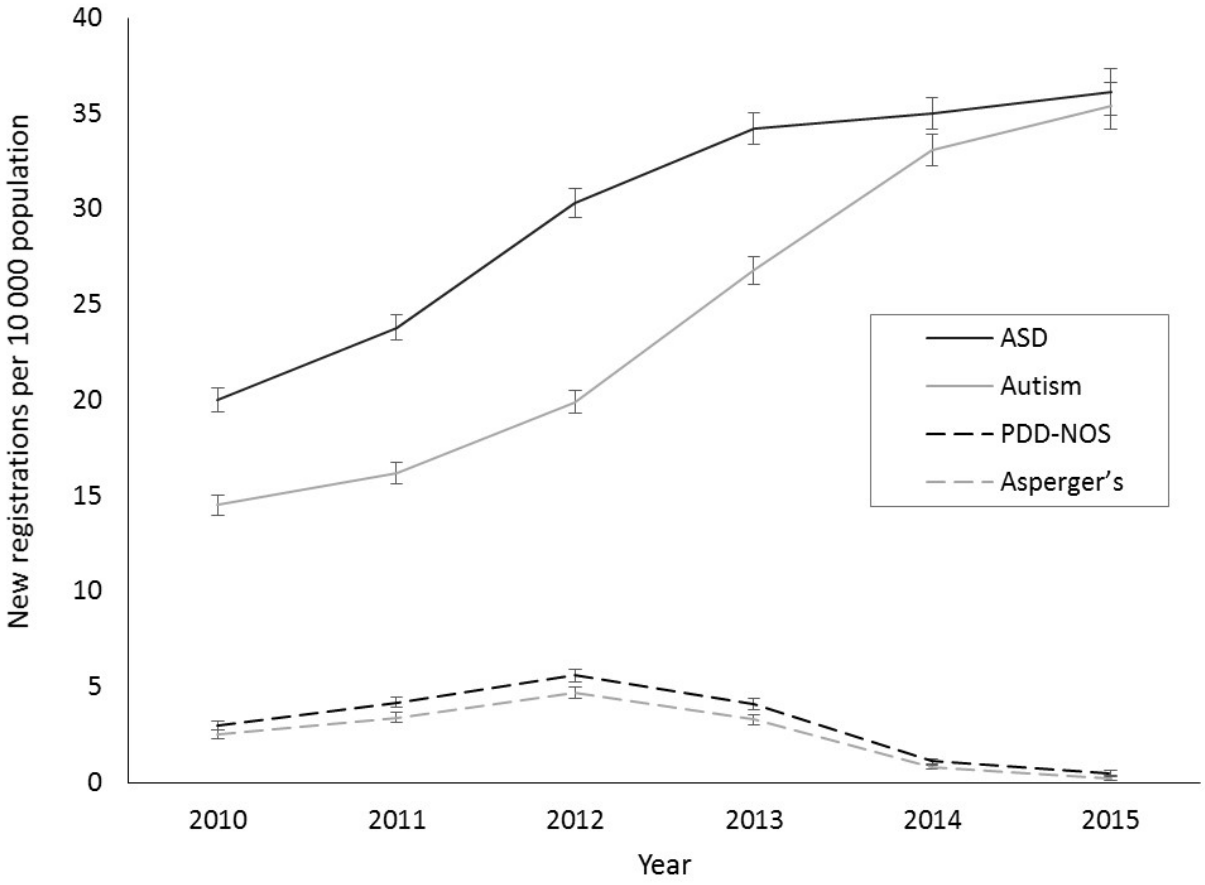


Figure 1. Change in the estimated annual incidence of Autism Spectrum Disorder diagnoses of children registered with the Helping Children with Autism Package in Australia from 2010 to 2015. Error bars represent 95% confidence intervals.

200 **125.200** Leisure Activity Enjoyment Among Children with ASD

C. L. Hilton[1], *D. M. Collins*[2] *and M. Eversole*[2], *(1)University of Texas Medical Branch, Galveston, TX, (2)Occupational Therapy, University of Texas Medical Branch, Galveston, TX*

Background:
Activity enjoyment is a fundamental component of participation in activities. The use of child-preferred activities has long been used to promote social participation among children with ASD (Koegel, Dyer & Bell, 1987; Taylor & Fisher, 2010).
Objectives:
Research questions addressed were:
What are the patterns of leisure activity enjoyment for children with autism spectrum disorders (ASD) compared to those of typically developing (TD) children?
How do patterns of leisure activity enjoyment compare across age groups between TD children and those with ASD?
What is the relationship between severity and leisure activity enjoyment in children with ASD?
Methods:
We used a case-control comparison research design to compare activity enjoyment between children with ASD and TD children. Participants consisted of 131 children (ASD = 67, TD = 64) between the ages 6 and 13 years recruited through parent and professional contacts known by the principal investigator and through parent support group meetings, group e-mail lists, newsletters for parents of children with ASD, and flyers about the study posted at sites of service providers for children with ASD. This study used the *Children's Assessment of Participation and Enjoyment* (King et al., 2004), a child interview, to compare levels of leisure activity enjoyment. The *Social Responsiveness Scale, 2nd Edition* (SRS-2; Constantino & Gruber, 2012), a parent questionnaire, is a quantitative measure of traits associated with autism, and was used to quantify autism severity.
A within-group comparison of activity enjoyment for children with ASD was completed using descriptive statistics to rank sum activity enjoyment for each of the 55 specific activities. A Pearson product moment correlation coefficient (Portney & Watkins, 2009) was used to identify enjoyment of any of the activity categories that were correlated with SRS-2 scores for the children with ASD. Differences in activity enjoyment were compared by age group using an ANOVA to compare age groups in the TD children and those with ASD.
Results:
The TD children enjoyed *formal activities* and *physical activities* significantly more than the children with ASD. Symptom severity was negatively related to enjoyment of *overall activities, formal activities, physical* and *social activities* in children with ASD. Older children with ASD enjoyed *overall, informal, recreational*, and *self-improvement* activities significantly less than younger children, but no differences were seen across age groups in TD children. Most notable among specific activities was that children with ASD enjoyed *swimming* significantly more than the TD children.
Conclusions:
Having a better understanding of preferred activities among children with ASD can help to better prepare professionals regarding potential motivators for participation in interventions and in less preferred activities. Using child preferred activities has been shown to be a valuable motivator for many activities that are less participated in and less preferred among children with ASD.

201 **125.201** Linking Clinic and Hospital Data with Patients and Families

ABSTRACT WITHDRAWN

Background: Patient powered research presents unique opportunities to blend patient-derived data with clinic and hospital data. States are currently developing health information exchanges that can link with such data to provide range of measurable health outcomes.
Objectives: Linkage of patient and clinical data for broad measurement of health outcome.
Methods: Current models of linkage of patient-report and clinical data will be reviewed, including active projects in the states, including Michigan.
Results: NA
Conclusions: Trusted health information exchange, as being developed in PCORnet, will provide new research opportunites for the health community, including autism

researchers.

202 **125.202** Meeting the Needs of Families Affected By Autism Spectrum Disorder through Delivery of a Best-Practice Model of Care Coordination

R. McNally Keehn[1], *R. Rodgers*[2] *and J. W. McAllister*[3], *(1)Pediatrics, Indiana University School of Medicine, Indianapolis, IN, (2)Pediatrics, Indiana School of Medicine, Indianapolis, IN, (3)Children's Health Services Research, Indiana University School of Medicine, Indianapolis, IN*

Background: Families of children with autism spectrum disorder (ASD) report significant problems accessing health care and support services. The care needs of children with neurodevelopmental disabilities are straining the capacity of the healthcare service system. Programs that offer accessible, evidence based care coordination services are critical for improving child, family, and system outcomes. Pediatric care coordination is defined as a patient and family-centered, assessment driven, continuous, team-based activity designed to meet the bio-psychosocial needs of children and youth, while enhancing person and family care-giving skills and capabilities.
Objectives: The objectives of this study are twofold: 1) to **c**haracterize the unmet needs of children with ASD and 2) to determine whether a best-practice model of care coordination can assist families and clinicians in addressing these needs.
Methods: This study was completed as a part of a broader ongoing pilot study which employs an implementation science approach to evaluate the effectiveness of a best practice model of care coordination with children with neurodevelopmental disabilities and their families. A service model of care coordination, as put forth by McAllister (2014), was delivered to a subset of 60 children ages 2-8 years (mean age: 5.1 years; 85% male) diagnosed with ASD and their families. The care coordination intervention is delivered by a dyad consisting of a clinician and care coordinator in a children's hospital outpatient setting. Prior to and during a planned care visit, a Shared Plan of Care (SPOC) is jointly completed with the family. The SPOC includes a comprehensive medical summary and a set of negotiated actions (i.e., goals and strategies to address unmet needs and enhance family advocacy skills) generated together between the family and team. Following the planned care visit, these unmet needs are addressed during a three-month period of care coordination.
Results: Categories of reported unmet needs among families include: developing an understanding of the child's diagnosis and developmental level, referrals for subspecialists to address co-morbid medical needs, navigating/advocacy related to special education, enrollment in behavioral and rehab services, increased communication with primary care/community care network, and accessing needed health care financing resources (mean total unmet needs = 7.6). Of the families who have completed the care coordination intervention to date, 74% of unmet needs have been addressed (i.e., goals completed or in progress) by the end of the three month period. Data collection is ongoing; data will be presented on relative frequencies of unmet needs across categories as well as whether categorical differences exist with regard to types of needs met though the care coordination intervention.
Conclusions: Unmet needs of families of children with ASD are reported across medical, psychosocial, educational, community, and financial domains. This best-practice model of care coordination provides a promising approach to family-centered service delivery to address the critical unmet needs of children with ASD and their families. Addressing these unmet needs holds the potential to improve child outcomes, reduce family burden, and lower system costs over the child's life course.

203 **125.203** Methods for Quantifying Medical and Financial Benefits of Acute Behavioral Response during Inpatient Hospitalizations for Children with ASD

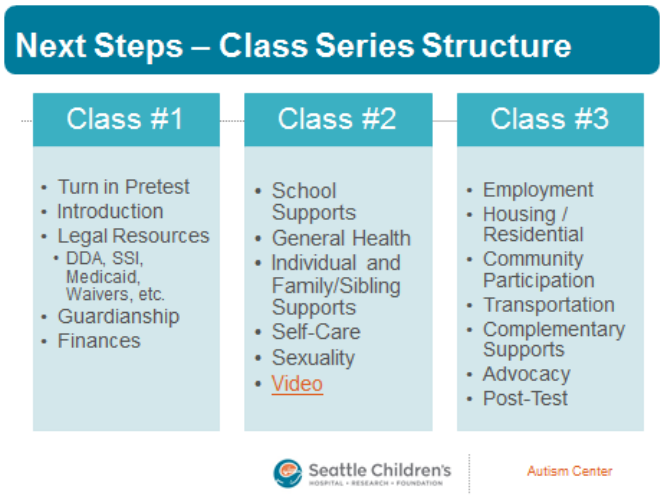
S. Marler[1], *J. E. Staubitz*[2], *P. Juarez*[3], *Z. Warren*[1], *L. L. Altstein*[4], *E. A. Macklin*[5] *and K. Sanders*[6], *(1)Vanderbilt University, Nashville, TN, (2)Pediatrics, Vanderbilt University Medical Center, Nashville, TN, (3)Vanderbilt University Medical Center, Nashville, TN, (4)Massachusetts General Hospital Biostatistics Center, Boston, MA, (5)Biostatistics Center, Massachusetts General Hospital, Boston, MA, (6)Vanderbilt, Nashville, TN*

Background: With an estimated prevalence of 1 in 68 (CDC, 2014), the inpatient care of children with Autism Spectrum Disorder (ASD) represents a critical public health issue. Although there have been advances in awareness and treatment of ASD in medical settings, children with ASD still have higher rates of acute healthcare utilization, an increased burden of unmet needs, and decreased satisfaction with care received (Lajonchere et al., 2012; Croen et al., 2006; Siegal et al., 2014). These patients frequently present with more severe behaviors (i.e. aggression, self-injury, etc.) than children without ASD and due to this, often remain hospitalized beyond medical clearance. While hospitalized, these children typically require increased levels of staffing and intensive interventions (e.g. physical/chemical restraint).
Hospitalization beyond medical clearance holds a negative financial return for hospitals. The cost of hospitalizing this population is much higher due to prolonged stay and increased staffing, with many charges remaining unreimbursed. There has been little study of inpatient care or interventions designed to improve hospitalizations in ASD. Innovative programs to reduce problematic behaviors of children with ASD in inpatient settings have the potential to improve outcomes on both child and system. While methods for quantifying change on the behavioral level are widely available, the availability of relevant financial data is far less common.
Objectives: As part of a larger study investigating the effect of brief Analogue Functional Analysis (AFA) on hospitalization for children with ASD, we studied the ability to draw relevant financial data from existing electronic medical records (EMR) to quantify care and potential cost of hospitalization.
Methods: This single site, pilot study involved a sample of 36 children with ASD and aggressive behaviors, ages 6-18, admitted to either a medical or psychiatric inpatient unit. Participants were randomized into a treatment group (receiving brief AFA and behavioral intervention) or a control group. We evaluated which primary data on medical, treatment, and financial factors were available from the EMR and administrative financial data to better understand additional methods/metrics necessary for quantifying impact of intervention.
Results: There were several relevant cost-related variables available via EMR. We were able to quantify length/total cost of hospitalization, use of physical/chemical restraint, and staffing ratios for all patients. However, it was not possible to extract reliable data with the EMR indexing the amount of time spent by ABA interventionists while implementing intervention. To assess this resource/cost we required specific datalogs from behavioral providers. Other challenges replicated known findings in previous work (e.g., quantifying "human" costs, staff costs; separating costs of behavior challenges from medical need). We were able to quantify re-hospitalization for all patients within our facility; however, determining the medical vs. behavioral necessity of hospitalization was not feasible.
Conclusions: It is becoming increasingly apparent that bolstering behavioral services for children with ASD in hospital settings will require demonstrating both clinical and cost efficacy. This pilot work documented that (1) novel metrics/methods are needed to ensure resources around behavioral interventions are captured and (2) separating medical and behavioral expenditures within financial data also require innovative methods.

204 **125.204** Next Steps – Improving Transition Outcomes through Caregiver Education

D. M. Eaton[1], *R. Oti*[1], *G. Stobbe*[1], *K. Davis*[1] *and A. Owens*[2], *(1)Seattle Children's Hospital, Seattle, WA, (2)University of Washington, Seattle, WA*

Background: Within the next 15 years, an estimated 500,000 children in the United States with autism spectrum disorder (ASD) will enter adulthood. Additionally, there has been limited research into adult services and outcomes. As a result, a challenge faces clinicians in providing families with evidenced-based transition tools in a manner that allows caregivers to build resiliency in becoming creative and flexible consumers for their young adult children. We have developed and implemented three consecutive 90 minute classes entitled "Next Steps," focused on educating caregivers about transition related topics in small group settings. The lecture material is tailored to two distinct trajectories: 1) "Steps To Independence" for caregivers of those likely to pursue post-secondary education, and 2) "Life Long Learning" for caregivers of those who will access programs through age 21 and require life-long supports.
Objectives: To assess caregiver satisfaction with the curriculum of the Next Steps classes. To measure caregiver concerns pre- and post-class participation.
Methods: Course evaluations were collected at the end of the third class regarding participant satisfaction related to class design and curriculum content. A survey questionnaire called *Transitions Daily Rewards and Worries Questionnaire* (Glidden & Jobe, 2007) was also used, which rates 28 statements such as "I am excited by the prospects for my child's future," on a Likert scale of 1 to 5 (Strongly Disagree to Strongly Agree). This was mailed at the time of scheduling and collected before the first class began. The questionnaire was re-administered after completing the third class.
Results: Course evaluation and quantitative pre- and post-questionnaire data collection is ongoing. Currently we have 25 participant course evaluations (N = 25). The average rating for the question "How would you rate the overall quality of content presented?" was a 4.72 out of 5 (3 = "good", 4 = "very good" and 5 = "excellent") with 19 participants (76%) indicating "excellent," 5 (20%) indicating "very good," and 1 (4%) indicating "good." To open-ended questions such as "Were the topics covered relevant? Meaningful? Did you learn something new?" 92% of participants indicated "yes" or an equivalent comment (e.g. "Topics were relevant, meaningful, helpful, resourceful," and "I learned a lot, thanks!"). Themes of responses have included "increase in hope for my child" and "I learned from other parents and the instructor." For the *Transitions Daily Rewards and Worries Questionnaire*, currently we have 18 participants (N=18) who completed both the pre- and post-test. There was limited change pre-test to post-test among respondents and any change present was bi-directional.
Conclusions: Transition to adulthood for ASD individuals poses unique challenges to caregivers. Administering transition-related curriculum in small group settings is not only feasible but is well received by participants. Differentiating the curriculum based on trajectories is necessary in order to tailor the course material appropriately. Feedback from caregivers has been overwhelmingly positive. Future direction includes improving our understanding of long-term impact of course participation and broadening delivery of the Next Steps course to additional demographics.



205 **125.205** Oral Health Care and Challenges Facing Dentists and Families of Children with Autism Spectrum Disorder (ASD) in Dental Clinics in the Kingdom of Saudi Arabia (KSA)

H. M. Al Dhalaan[1], *K. A. Alhammad*[2], *M. S. Zakaria*[3] *and H. A. Masadomi*[4], *(1)King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia, (2)Riyadh college of dentistry and pharmacy, Riyadh, Saudi Arabia, (3)centre for autism research, riyadh, Saudi Arabia, (4)Research Centre, Riyadh college of dentistry and pharmacy, Riyadh, Saudi Arabia*

Background:
Autism is a developmental disorder characterized by deficits in social interaction and communication skill.
ASD families are facing difficulties maintaining good oral health and dental care. Delivering Dental care to this population is also a challenge to the dentist. In this study we try to explore some of these challenges.
Objectives: The study aimed to identify the following
1. Challenges facing dentists during dental evaluation and procedures for ASD patients
2. Challenges facing families of ASD patients in finding suitable dental clinics
3. Explore the level of dentist knowledge about ASD
Methods:
A cross-sectional study. A self-administrated survey & questionnaires distributed in different regions of KSA. Targeting: ASD Families (17 questions) and Dentist. (26 questions).
Professional https://www.surveymonkey.com/r/S79X9LM
Family's https://www.surveymonkey.com/r/Y93FJPN
The questionnaires were formulated in Arabic and English languages and distributed. Up to date, 80 dentists and 97 families completed the survey
Results:
> 85 % of dentist respondents were from the Central and Eastern regions. Most of the participating dentists were general practitioners while 1/3 were specialists and consultants. While 72% of ASD Families respondents are living in the central region.
> 65% of the dentists had no or minimal knowledge about ASD and more than 80% of the dentists never participated in ASD continuing education courses. 25% of the dentists had behavior control protocols for ADS patients in their clinics.
86% of ASD families had difficulties finding suitable dental clinics. 65% of the ASD children visited dentists only for pain management. 41% of ASD children were denied treatment in the dental clinics. 97.5 % of dentist reported that they did not or rarely treat ASD patient. <3% of dentist regard them self as expert in handling and treating ASD patient .55% of ASD patients visited private dental clinics. 77% stated that no health insurance for dental care.
>50% of dentist used General anesthesia and comprehensive treatment plans modality to treat ASD patients.
81% of dentists reported that the hand piece and the syringe with needle, as tools are most common trigger for behavioral difficulties. 93% of the dentists believed that "sound" was the most common trigger of adverse reaction in ASD patients while 75% believed that it was "touch" as a sensory stimulation.
Results also showed the most common oral conditions were bruxism and attrition and the most common oral finding was dental caries with high prevalence of gingivitis.
Conclusions: sample size is small and the study still on going, preliminary results indicate the dental care for ASD population is poor with lack of dentist experience.
Oral health instructions should be given to ASD patients and their families. Dental management of ASD should be included in dental undergraduate education in KSA. There is a need for a "standard protocol" in the management of ASD patients in dental clinics in KSA
A specialized dental clinic must be developed to improve the dental treatment experience for ASD children.

206 **125.206** Parents' Beliefs about Autism: A Link to Intervention Services in English and Spanish Language Proficient Families

N. M. Reyes[1], *O. J. Lindly*[2], *A. E. Chavez*[3], *K. Macias*[4], *A. Folan*[5], *K. Smith*[6], *A. M. Reynolds*[5] *and K. Zuckerman*[7], *(1)Box C-234, University of Colorado - Denver, Aurora, CO, (2)Oregon State University, Portland, OR, (3)Oregon Health and Science University, Portland, OR, (4)UCEDD Children's Hospital Los Angeles, University of Southern California, Los Angeles, CA, (5)University of Colorado - Denver, Aurora, CO, (6)Children's Hospital Los Angeles, Pasadena, CA, (7)Oregon Health & Science University, Portland, OR*

Background: Previous research suggests that there are language disparities in service utilization among families of children with Autism Spectrum Disorder (ASD). Specifically, children in Limited English Proficient (LEP) families tend to use fewer intervention services than children from English Proficient (EP) families. In an effort to understand what might explain these differences, this study examined parents' beliefs about ASD and treatment use in both Spanish-speaking LEP families compared to EP families.
Objectives: This study had three aims: (1) to investigate differences in beliefs about ASD between families with limited English proficiency (LEP) and families with English proficiency (EP), (2) to examine links between these beliefs and treatment use, and (3) to investigate the predictive value of these beliefs on treatment use
Methods: This study included a probability sample of 262 mothers and their children with ASD, 168 with English Proficiency (EP), and 94 with limited English proficiency (LEP) from Oregon, California, and Colorado. One parent per family completed a telephone or self-administered survey in English or Spanish. Parents were asked questions about their beliefs about their child's ASD, including ASD severity, ASD as a lifelong condition, consequences of ASD on their child's life, whether ASD was a mystery to them, whether they had the power to change their child's ASD, and whether challenges related to ASD can be decreased with treatment. Parents also reported the number of hours of ASD-related intervention per week their child received, categorized as: none, <1 hour, 1-4 hours, 5-10 hours, 11-20 hours, and 20 hours or more.
Results: Regarding the beliefs about ASD, mothers with LEP reported more often than mothers with EP that ASD was a mystery to them. In the EP group, number hours of intervention were significantly associated with mothers' beliefs about the child's ASD severity, ASD consequences on the child, and whether ASD is a mystery. In the LEP group, number of hours of intervention were linked to ASD severity and the power to change their child's ASD. Finally, in a multivariate model assessing the association between beliefs and number of hours of intervention, the belief that ASD has consequences on a child's life predicted greater treatment hours in the EP group but not on the LEP group.
Conclusions: These analyses showed that LEP and EP families differed in their beliefs about ASD; however, maternal beliefs were more strongly associated with variation in treatment hours among families with EP. It is possible that factors, such as access to health and educational therapy services, may more strongly predict treatment hours in families with LEP. Overall, findings suggest that providers should take parent beliefs into account when caring for children with ASD from diverse backgrounds, since these beliefs may be associated with treatment use.

207 **125.207** Pathways to Early Autism Diagnosis and Intervention

M. Martinez[1], *K. Thomas*[2], *R. Christian*[3], *R. Edmondson Pretzel*[4] *and S. R. Hooper*[5], *(1)Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill, Chapel Hill, NC, (2)University of North Carolina at Chapel Hill, Cecil G. Sheps Center for Health Services Research, Chapel Hill, NC, (3)Carolina Institute for Developmental Disabilities, Chapel Hill, NC, (4)Carolina Institute for Developmental Disabilities, University of North Carolina at Chapel Hill, Chapel Hill, NC, (5)Allied Health*

Sciences, University of North Carolina at Chapel Hill, Chapel Hill, NC

Background:
Families of children with an ASD have more difficulty accessing and using services compared to families with children with other mental health care needs (Vohra, Madhavan, Sambamoorthi & St. Peter, 2014). The Autism CARES Act of 2014 introduced legislation to reduce barriers to screening, diagnosis and treatment however little is known about pathways that lead to earlier diagnosis and intervention. The Anderson model of health care utilization (Aday & Anderson, 1975) provides a framework to organize and examine factors associated with earlier access to autism services.
Objectives:
The purpose of this study is to identify pathways associated with early screening, assessment and intervention that can be utilized to develop a system of service that provides early intervention for autism spectrum disorders (ASD) and other developmental disabilities in order to facilitate children's ability to reach their maximum potential. The target audience includes researchers, stakeholders and policy makers.
Methods:
Data from the 2014-2015 North Carolina Needs of Young Children with Autism Survey are presented that represent over 450 families with a child diagnosed with an ASD. Descriptive statistics and logit modeling analyzed de-identified demographic, diagnostic and service use information using the Anderson health care utilization framework. Pathways to early intervention as well as models predicting early parent recognition of concerns, who first recognized concerns, time to diagnosis, and early intervention are presented.
Results:
Early parent recognition is associated with parents sharing concerns with more providers prior to a child's initial ASD diagnosis ($p < .005$), ASD presentations with lower levels of functioning ($p < .005$), parents (vs. providers) first recognizing a concern ($p < .005$), and type of providers conducting initial autism assessment ($p < .05$). Who first recognized developmental concerns was associated with parent completion of an autism screener at their doctor's office ($p < .01$) and minority child race/ethnicity ($p <.05$). Early diagnosis was associated with ASD presentations with lower functioning ($p < .001$), type of provider ($p < .05$) conducting ASD assessment, and autism screening ($p < .05$). Early intervention was associated with ASD presentations with lower functioning ($p < .05$) and type of providers conducting initial autism assessment ($p < .05$).
Conclusions:
Parents who recognized concerns early were more likely to enter a pathway to earlier child diagnosis and intervention, particularly in cases of prompt initial diagnosis. This appears to be associated with type of provider conducting initial autism assessment and severity of child functioning, reflecting quicker pathway entry for families who are swiftly connected with specialists as well as autism presentations with greater functional impairment that may be easier to identify. When providers initially recognized developmental concerns, families were more likely to enter a pathway to quicker diagnosis and earlier intervention.
It is important for policy makers to support and increase autism awareness among parents and providers, routine autism screening and follow-up, strategies to improve provider recognition for minority and higher functioning children, and availability of specialists trained to conduct early diagnostic assessments

208 **125.208** Pcornet- Creating a National Network of Patient-Powered Research Networks

***S. F. Terry**, Genetic Alliance, Washington, DC*

Background: The Patient-Centered Outcome Research Institute has developed a national clinical research network comprised of Patient Powered Research Networks and Clinical Data Research Networks, known as PCORnet. This network strives to conduct patient centered research that focuses on priorities most critical to individuals, families and communities. It creates opportunities for collaborative research on health conditions, connecting researchers and participants for research tied to the unique interests of those affected.
Objectives: Creation of a new and unique model of national clinical research aimed at addressing the needs and concerns of those affected by medical conditions.
Methods: PCORnet's structure and organization will be reviewed. Current and future planned initiatives will be discussed.
Results: NA
Conclusions: PCORnet creates a new national clinical research model to address the needs and interests of participants, clinicians, and researchers for rapid, large population investigation of criticial health conditions and concerns.

209 **125.209** People with Autism Spectrum Disorder in Criminal Justice and Mental Health Systems: Improving Recognition and Developing Preliminary Guidelines

***C. M. Murphy**[1], G. M. McAlonan[2], J. Harvey[3], E. L. Woodhouse[4], D. M. Robertson[5], S. Whitwell[6], A. Carrier[6], A. Forrester[6] and D. G. Murphy[7], (1)Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (2)Department of Forensic and Neurodevelopmental Science, IoPPN, KCL, London, United Kingdom, (3)Department of Forensic and Neurodevelopmental Sciences, IoPPN, KCL, London, United Kingdom, (4)Forensic & Neurodevelopmental Sciences, King's College London, Institute of Psychiatry, Psychology & Neuroscience, London, United Kingdom, (5)Adult Autism Service/Behavioural Genetics Clinic, Maudsley Hospital, London, United Kingdom, (6)Department of Forensic and Neurodevelopmental Sciience, IoPPN, KCL, London, United Kingdom, (7)Sackler Institute for Translational Neurodevelopment, Department of Forensic and Neurodevelopmental Sciences,, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom*

Background: People with autism spectrum disorder (ASD) are vulnerable to social and mental health difficulties that can result in contact with the criminal justice system (CJS) as victims of crime, offenders, or because of misunderstandings in communication and behaviour. Although ASD is common, the number of people with ASD who offend is unknown. However, it is thought likely that ASD is over-represented and under-recognised in the CJS. Moreover, despite increasing ASD awareness, in the UK there is no tailored ASD training for criminal justice mental health service (CJMHS) staff at a local (or national) level. Hence interactions between the CJS and people with ASD may be unnecessarily distressing, unsuccessful and costly.
Objectives: To improve recognition of ASD in South London amongst mental health and CJS teams and, with the ASD community, to draft the first guidelines for support of people with ASD within the CJS. Further, to produce a free-access film regarding ASD and the CJS for widespread dissemination.
Methods: To facilitate joint working, professionals working with people with ASD and in the CJS (including barristers, police, probation, prison and youth offending) were invited to an ASD CJS workshop. The workshop included invited speakers and small group sessions to gather expert opinions for inclusion in the guidelines. Additionally, views of people with ASD with experience of the CJS and their families were gathered via a focus group. The workshop and family focus group were filmed. Finally, training in ASD was provided to local CJMHS staff and their views on ASD and the CJS were compared in pre-and post-training focus groups.
Results: Recommendations and opinions gathered during the workshop and family focus group were included in local guidelines regarding best identification and management of people with ASD in the CJS. The free-access film will also be widely disseminated. Pre- and post training questionnaires completed by CJMHS staff indicated they felt significantly more able to identify people with ASD in the CJS, communicate with people with ASD in the CJS and to safely manage anxiety and agitation in people with ASD in the CJS. Further, CJMHS staff reported significant improvements in their understanding of the comorbid mental health difficulties of some people with ASD that may contribute to behavioural difficulties and misunderstandings in the CJS. They also were better informed on routes to access specialist clinical care and support groups for people with ASD.
Conclusions: Brief training can be effective in raising awareness and safe management of people with ASD in the CJS. This may lead to short-term (development of sustainable, on-line, free training materials) and long-term (reduced costs to the individual, judicial and health systems) cost savings. Guidelines including identification of barriers to awareness and care for people with ASD in the CJS, solutions to overcome barriers and increased awareness of ASD will enable people with ASD who become known to the CJS to be better understood and have their needs met. This, with better direction to appropriate care pathways, may result in significant cost savings to the individual and society.

210 **125.210** Pilot Test of a Model for Remote Provision of Evidence-Based Services for Rural Families of Children with Autism Spectrum Disorder

***K. M. Simcoe**[1], M. Martinez[2], A. Stainbrook[3], P. Juarez[1] and Z. Warren[4], (1)Vanderbilt University Medical Center, Nashville, TN, (2)Vanderbilt University Medical Center-Treatment and Research Institute for Autism Spectrum Disorder, Nashville, TN, (3)Vanderbilt Kennedy Center, Nashville, TN, (4)Vanderbilt University, Nashville, TN*

Background:
Early Intensive Behavioral Intervention (EIBI) is recommended as an intervention of choice for young children with Autism Spectrum Disorder (ASD), but services can be challenging for many families to access. Research suggests that Caregivers have the ability to acquire and implement intervention strategies with their children with ASD. Video-teleconferencing can be used to teach Caregivers to use a naturalistic language intervention and remote technology can also be used to train Early Interventionists (EIs) on Caregiver coaching strategies.
Objectives:
The objectives of this pilot study are to evaluate the feasibility and impact of using a remote consultation model to train Caregivers and EIs in non-rural and rural areas on evidence-based strategies.
Methods:
Approximately 90 families will be provided with services following participation in a psychological evaluation for ASD. Families of children under three who are referred by Tennessee Early Intervention System (TEIS) to Vanderbilt Kennedy Center's Treatment and Research Institute for Autism Spectrum Disorders (TRIAD) for a psychological evaluation and are living in any county within the Greater Nashville and South Central districts of Middle TN are eligible. All participating families receive two home-based

evaluation support sessions led by a professional in the field of applied behavior analysis which include focused consultation and training on evidence-based practices for children with ASD.
Families residing in select counties are eligible for expanded services, including two additional home visits. These families are already receiving services from an EI through TEIS. Participation of the EI in these two sessions is required to ensure the training of the EI in evidence based behavior analytic strategies is adequate. During these sessions, the Consultant will work with the Caregiver and EI to implement strategies recommended previously. The service will also include two bi-weekly clinic visits that will include the EI, Caregiver and remote attendance of the TRIAD Consultant. Remote clinic visits are held at a community clinic closer to participants' homes than the TRIAD clinic. During these two visits, the TRIAD Consultant will remotely observe interactions while providing feedback and recommendations in real-time for EI and Caregiver. The EI will continue to serve the family throughout the TRIAD service and consult with the TRIAD Consultant remotely. Following the completion of the service, remote consultation will be provided to the EI for up to two hours per month for six months or until the child turns three years old.
Behavioral and social validity data will be collected on skill acquisition by the child, skill acquisition by Caregivers and EI's, and Caregiver and EI satisfaction with services.
Results:
Preliminary results indicate that Caregivers and EIs are satisfied with the services that they receive. In addition, Caregivers are able to implement interventions to promote skill acquisition. Finally, EIs implement strategies learned with 75-100% of their other clients.
See attached preliminary data for additional information.
Conclusions:
Preliminary data is not complete enough to allow conclusions to be drawn. Data will continue to be collected through April 2016. We anticipate a total of twelve participants in this pilot study by that date.

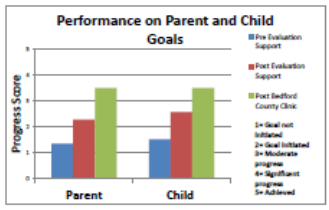


Figure 1 shows pre and post ratings on caregiver and child goals per Evaluation Support (N=6), Post Evaluation Support (N=3), and Post Bedford County Clinic Services (N=1).

Figure 2 provides mean Clinical Global Impression (CGI) ratings by both caregivers (N = 3) and interventionists (N=3) for families receiving Evaluation Support services.

Caregiver Survey	1 (poor) - 4 (excellent)
Caregiver Confidence	3.5
Child Improvement	3.9
Satisfaction with Service	3.2

Figure 3 provides the mean rating on a caregiver survey (N=3) regarding child progress, confidence implementing strategies discussed, and satisfaction with services during Evaluation Support service.

Early Interventionist Survey	1 (strongly disagree)-4 (strongly agree)
Satisfaction with Service	3.5
Effectiveness of recommendations	3.7
Generalization to other families	3.5

Figure 4 provides the mean ratings on a survey sent to EIs (N=2) who completed the Bedford County service with a family.

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211 **125.211** Pre-Professional Preparation of Speech-Language Pathologists to Serve Individuals with ASD Across the Lifespan

K. P. Wilson[1], *J. Preis*[2], *G. Chasson*[3], *A. C. Jozkowski*[4] *and C. Shotto*[1], *(1)Department of Audiology, Speech-Language Pathology, and Deaf Studies, Towson University, Towson, MD, (2)Department of Speech-Language-Hearing Sciences, Loyola University Maryland, Baltimore, MD, (3)Department of Psychology, Towson University, Towson, MD, (4)Department of Occuptional Therapy and Occupational Science, Towson University, Towson, MD*

Background: With the rising incidence of autism spectrum disorder (ASD; Baio, 2014) and the aging of the existing population of individuals on the spectrum, there is a pressing need for clinical professionals trained and experienced to work with individuals with ASD across the lifespan. Individuals on the spectrum interact with a variety of professionals and community members throughout their lives. Disconcertingly, studies show that pre-professional students in health care disciplines lack even a basic understanding of diagnostic criteria for ASD (e.g., Freedman, 2014; Price, 2013) and have very little experience with adults on the spectrum, in particular. Despite speech-language pathologists' training in typical and atypical development of language and social communication, research shows a lack of preparation and misconceptions about ASD among practicing professionals in the field.
Objectives: This study aims to (1) describe the preparation levels of graduate speech-language pathology (SLP) master's students across two regional universities, (2) examine the impact of a unique clinical teaching model at one university that includes hands-on experience with adults with ASD, and (3) suggest practices for optimal clinical education in the area of ASD across the lifespan.
Methods: This study utilized a longitudinal design with data collected at multiple time points across students' graduate education (baseline and following each semester). Dependent variables include the following, as self-reported by student participants (n=140) through survey completion: (1) feelings of preparedness related to treating clients with ASD across age ranges and settings, (2) knowledge of characteristics and diagnostic criteria of ASD, (3) additional contact with individuals on the spectrum sought

outside of assigned clinical experiences, and (4) openness/attitudes regarding adult peers on the spectrum. This presentation will focus on the change in student responses across time and following specific clinical experiences to offer implications and suggestions for clinical preparation strategies.
Results: Preliminary results indicate that SLP students lack significant experience with individuals with ASD prior to graduate school, and with adults with ASD in particular. The majority of participants reported more positive perceptions of their prior experience with children with ASD as compared to their experiences with adults with ASD. Analysis of longitudinal data indicates only minimal increase in feelings of preparation to treat clients with ASD over time, with the majority responding that they felt only moderately competent in their clinical preparedness in ASD after both their first and second semesters of graduate school. Gaps in preparedness and knowledge regarding adults with ASD were more marked. Analysis of the impact of a unique hands-on model of clinical education with adults with ASD is ongoing with preliminary results showing trends towards significant impact of the program. Results will be reported and discussed.
Conclusions: With 80% of participating students reporting interest in working with clients with ASD, it is clear that additional ASD experience and education is needed. Initial results elucidate this gap and point to specific areas of need and interest for SLP master's students. Implications and suggestions will be geared towards university educators in clinical fields that serve individuals with ASD across the lifespan.

212 **125.212** Priority Service Receipt of Individuals with ASD Across the Lifespan: Findings from a Canadian National Survey

J. K. Lai[1] *and J. A. Weiss*[2]*, (1)Psychology, York University, Toronto, ON, Canada, (2)York University, Toronto, ON, Canada*

Background: Across the lifespan, individuals with Autism Spectrum Disorder (ASD) have many health, community, and social service needs. These create age group-specific challenges in navigating service sectors. Further, individuals with ASD often have a high level of service need, which are often left unmet, compared to other individuals with disabilities of similar age. Knowing which services are currently considered priorities by caregivers, and identifying correlates and barriers to having those needs met, will shed light on the resource gaps in the care and support of individuals with ASD and inform policies to improve service access.
Objectives: The objective of this study was to identify differences in priority service receipt of individuals with ASD and the clinical, sociodemographic and systemic correlates of obtaining priority services across the lifespan.
Methods: An online survey was administered across Canada through the Canadian Autism Spectrum Disorders Alliance, completed by 3251 caregivers reporting on 3319 family members with ASD. Analysis was done in an age-stratified manner. Current service use was operationalized as any service used in the last 6 months, from a list of 23 community and health services and an "other" category that was recoded as needed. Participants also identified their current top 5 (priority) needs from the same list of services. We calculated the number of priority needs that were currently met as a proportion of priority receipt.
Results: Across the entire sample, 1048 of 3319 individuals (31.6%) had none of their priority needs met and 682 individuals (20.5%) had at least half of their priority needs met. The number of priority receipts decreased across the lifespan ($F(4,3318)=21.7$, $p<.001$); with preschool aged and elementary school age children receiving more priority services (respectively 1.9 ± 1.3 and 1.5 ± 1.3; mean ± SD) compared to adolescents and adults (1.2 ± 1.3). Priority receipt was correlated with various factors. In all age groups, the number of parent-directed service receipts was positively correlated with priority receipts. In preschool children, priority receipt was also related to ability to afford services ($p<.001$). In elementary school children, priority receipt was negatively correlated with child age ($p<.001$), the number of behavioural concerns ($p=.006$) and psychiatric diagnoses ($p=.003$) but positively correlated with the ability to afford services ($p<.001$), less barriers experienced ($p=.002$) and access to government funding ($p<.001$). In contrast, adolescent priority receipt was positively related to child age ($p<.001$), the number of chronic physical health conditions ($p=.025$), the presence of behavioural concerns ($p=.024$) and intellectual disability ($p<.001$), and access to government funding ($p<.001$). For adults, priority receipt was related to the presence of intellectual disability ($p<.001$) and the number of behavioural concerns ($p=.042$).
Conclusions: The results show the alignment of receipt with addressing priority needs in a large sample of individuals with ASD. Future analyses will identify how sociodemographic, clinical need, and systemic factors function together to predict priority service receipt in each age group.

213 **125.213** Right Kids, Right Time, Right Services: Developmental Surveillance in Early Childhood Education Settings

B. Mozolic-Staunton[1]*, J. Barbaro*[2]*, M. Donelly*[1] *and J. Yoxall*[1]*, (1)School of Health and Human Sciences, Southern Cross University, Bilinga, Australia, (2)La Trobe University, Melbourne, Victoria, Australia*

Background: Children who are at risk for autism spectrum disorder (ASD) would benefit from early identification and access to early intervention, as this takes advantage of children's early brain plasticity and improves outcomes for families and children. ASD can be reliably detected in children as young as 18 months of age, although developmental surveillance practices are inconsistent in community health settings and many developmentally vulnerable children are not identified until late preschool or school age. Childcare settings present an ideal yet underutilized opportunity for ongoing developmental surveillance and appropriate, timely referral of young children to allied health supports.
Objectives: This study aims to *implement* and *evaluate* a system for identifying young children who have early signs of Autism Spectrum Disorder (ASD) and other developmental challenges in early childhood education and care centers in regional Australia. Using the Social Attention and Communication Surveillance (SACS; Barbaro & Dissanayake, 2010), a highly reliable developmental monitoring system which has recently been developed and validated with maternal child health nurses in Australia, this study aims to improve the health and wellbeing of children who are showing early signs of ASD by increasing the capacity of those professionals working closely with young children and families on a daily basis to accurately and efficiently identify which children would most benefit from specialized early intervention services.
Methods: Early childhood educators were trained and supported to completed developmental surveillance using SACS-R in their centres every 6 months over an 18 month period. Any child identified as being at risk for developmental challenges received comprehensive developmental assessment including Autism Diagnostic Observation Schedule (ADOS-2). Specificity, sensitivity, positive and negative predictive values of SACS-R and common parent report measures was determined using regression and receiver operating characteristic (ROC) curve analysis. Qualitative survey and interview data collected from participating educators and families provides information related to the perspective of educators on their role in the process of developmental surveillance and a deeper understanding of the nature of any barriers preventing families from accessing evidence-based early intervention supports in a timely manner.
Results: The inter-rater reliability of early childhood educators compared with maternal child health nurses is high (98%). Specificity, sensitivity and positive predictive value of SACS-R administered prospectively in natural groups of young children by early childhood educators is significantly higher when compared with commonly used parent report measures in accurately detecting the early signs of ASD in children aged 12 months- 4 years.
Conclusions: Understanding the effectiveness of current and emerging screening and surveillance tools and processes available to early childhood educators is critical in supporting their involvement in early identification of young children with ASD and has implications for policy and practice across the health and early childhood education sectors for timely, efficient and widely available early detection.

214 **125.214** Satisfaction with Care Coordination Program for Families of Children with Autism Spectrum Disorders

M. H. Pinkett-Davis[1]*, V. Singh*[2]*, A. Schrembs*[3] *and R. Landa*[3]*, (1)Center for Autism and Related Disorders, Kennedy Krieger Institute, Baltimore, MD, (2)Kennedy Krieger Institute, Baltimore, MD, (3)The Kennedy Krieger Institute, Baltimore, MD*

Background:
Care Coordination (CC) services provided in the context of a medical home, emphasize an "accessible, continuous, comprehensive, family-centered, coordinated, compassionate and culturally effective" (American Academy of Pediatrics, 2002) approach to care. CC services can be important for families of children with autism spectrum disorder (ASD) (Carbone, Behl, Azor, & Murphy, 2010), especially in the presence of additional co-occurring medical or mental health conditions (Carbone, Behl, Azor & Murphy, 2010). This highlights the need for specialty clinics to provide these services to families.
To evaluate the benefit of implementing CC services in a clinical setting, its utility for helping families understand the child's diagnosis, connect to community resources, and benefit from coordination of care must be examined.
Objectives:
Assess participants' preliminary feedback about the CC program and define aspects of the program that they found most helpful.
Methods:
The sample for this analysis is part of an ongoing study that is currently enrolling families of children with ASD at Kennedy Krieger Institute's Center for Autism and Related Disorders (CARD). 92 of the 225 enrolled families have completed the study and, thus, have completed the post measures between September 2014 and September 2015. Assessment of the demographic profiles found the sample to be fairly representative of CARD's clinical population with respect to age, parent education, race and socioeconomic status.
Parents were given an opportunity to provide qualitative feedback via online survey on the aspects of the program that they found most helpful. These responses were coded by two independent coders and differences were resolved by discussion.
Results:
Approximately 99% of participants identified the CC program to as helpful. Based on their comments, seven independent themes (care coordination, overall and community resources, psycho-education, general support, availability and other) emerged.
There were differences in parent reporting of themes based on the whether the child had a previous ASD diagnosis. Parents in this group found psycho-education (chi square=5.25 p=0.02) and the general support (chi square=5.59 p=0.02) from the program most helpful. Also parents with less than Bachelor's level education found community resources (chi square=6.63 p=0.04) to be more helpful than those with bachelor's level education or higher. There were no differences in reporting based on age, race and SES.

Conclusions:
The analysis suggests that most families found the program to be helpful and would continue to benefit from these services throughout the child's lifetime. The themes that emerged in our analysis were expected given the primary targets of our program. However, an unexpected finding was that the general supportive nature of the care coordination alone was helpful for a large proportion of the families. These comments speak to the very basic need for families of children with ASD to feel connected to a network of support that can assist them in meeting their child's needs.
We recognize the inherent need to differentiate services based on individual families' needs. Further analysis of participant feedback and program utilization will assist us in determining how to best customize CC services in the future.

Table 1. Demographic Characteristics

Demographic Characteristic	N=92
Age of child (mean, SD)	7.06 (3.5)
Sex (%)	
Male	86
Female	14
Education (%)	
High School or Less	21
Trade school	22
Bachelor's	32
Master's	25
Race (%)	
Caucasian	60
African American	23
Other	17
Socioeconomic status (%)	
High	73
Low	27

Table 2. Themes emerging on qualitative coding: Whole sample and by ASD status.

Service	Reported (%) n=75	No previous ASD (n=25)	Previous ASD (n=50)	p val
Coordination of care	33.33	32	34	0.8
Overall helpful resources	41.33	28	48	0.1
Community resources	30.67	28	32	0.7
Psychoeducation	6.67	16	2	0.02*
General support	37.66	56	28	0.02*
Availability	6.67	8	6	0.7
Other	3	0	4	0.3

215 **125.215** School Placement Outcomes and Services at Preschool, Kindergarten, and School-Age for Children Diagnosed with ASD before Age Three Years

P. Towle[1] *and A. E. Ausikaitis*[2]*, (1)Westchester Insitute for Human Development, Valhalla, NY, (2)Cerebral Palsy of Westchester, Rye Brook, NY*

Background: Longitudinal studies of children with autism spectrum disorder (ASD) tend to focus on stability of diagnostic outcomes. Given the broad spectrum of functioning with ASD, there is a need to know more about functional outcomes such as school placements as well as distribution of different disability levels.
Objectives: To examine the school placement of children diagnosed early at three points in time: preschool, kindergarten, and school age. In addition, educational placements were compared among those with moderate to severe disability, milder disability, and who no longer met criteria for ASD at school age.
Methods: Participants were 56 children identified through an early intervention chart review as being diagnosed with ASD under age 3 years (Time 1 M=25.15, range 13 – 35 mos). 82% were male. Parents were recruited to fill out a set of questionnaires when their children were 7 – 16 years old (Time 2 M=10 yrs 7 mos). Measurements included (1) an extensive parent questionnaire including items about school placement history, current learning problems and school services received; (2) GARS-3; (3) Autism Spectrum Rating Scales (4) Vineland Adaptive Behavior Scales-II. A subset of children also were evaluated directly using the ADOS-2 and brief forms of the WISC-IV or the Leiter-2. Each participant was placed in a school-aged severity outcome category based on all available information. Agreement between judgments based on questionnaire material was kappa (w)=.83. A reliability substudy was conducted to validate the judgment-based ratings with in-person Best Estimate Diagnosis. Agreement between judgments and Best Estimate Diagnosis was 91%.
Results: Time 2 diagnostic distribution was 48% falling in the ASD with Moderate/Severe Disability category, 32% in the ASD with Mild Disability category, and 20% in the No ASD/Social Communication/Learning Disability category. For preschool settings, all children in the two ASD groups were in special education settings with many services. For the eventual No ASD group, all but one were also receiving services, but a smaller proportion were in self-contained classes. In kindergarten, the majority of the two ASD groups received from some to extensive services, but fewer were exclusively in self-contained settings. However, members of the eventual No ASD group were in less restrictive settings than the two ASD groups in kindergarten, and over half had no to only some services. About one-third still received a significant amount of services, however. By school age, all of the Moderate/Severe group were in special education settings, with 75% in highly restricted settings. For the Mild group, half were in regular public school settings with services, whereas the other half were in more restricted settings. The No ASD group had half the children in regular classes, and the rest in a variety of low-restriction settings.
Conclusions: This is the first study to describe school placements at three points in time, according to different severity levels of outcome, for a community sample of children diagnosed early with ASD. It gives insight into the time it takes for the children with the most favorable disability outcome to function with fewer educational supports.

216 **125.216** Service System and Cognitive Outcomes for Young Children with Autism Spectrum Disorder in a Rural Area of Taiwan

C. H. Chiang[1]*, C. L. Chu*[2]*, C. C. Wu*[3] *and Y. M. Hou*[4]*, (1)National Chengchi University, Taipei, Taiwan, (2)Psychiatry, National Cheng Kung Universitity and Hospital, Tainan, Taiwan, (3)Department of Psychology, Kaohsiung Medical University, Kaohsiung City, Taiwan, (4)Chia-Yi Christian Hospital, Chiayi City ,Taiwan, Taiwan*

Background: Chiayi is a rural county located in southwestern Taiwan, the early intervention (EI) service system for autism spectrum disorder (ASD) was possible underserved. Thereby, the effectiveness of its early intervention (EI) service system for autism spectrum disorder (ASD) should be studied in detail.

Objectives: The first aim of the present study was to survey the unitization of EI sources for families in the Chiayi area. The current survey was conducted via a monthly telephone call to avoid parental recall bias. The types and amount of EI received over 1.5 years in children who had ASD and developmental delays (DD) within a narrow age range of 24 to 36 months initially would be assessed. The second purpose of the study was to investigate an association between EI and subgroups of high and low/moderate learners in both ASD and DD groups, and to elucidate how the factors of initial cognitive function and EI impact on the consequent outcomes.
Methods: Seventy-one children of ASD (n = 35) and developmental delay (DD, n = 36) aged 2.5 (time 1, T1) were referred from the only one EI Reporting and Referral Center in Chiayi and followed at ages 4 years old. Cognitive abilities were evaluated using the Mullen Scales of Early Learning (Mullen, 1995) Diagnosis was verified with ADI-R, ADOS, and clinical diagnoses for ASD with DSM-5.

Results: The results showed that, regarding EI services utilization, the total hours per week which these children received were relatively low and varied. Second, while separating the high or low/moderate learner subgroups in the ASD and DD groups, it was found that, after controlling the baseline scores, the children in the higher learner group improved significantly in all of the domains and ELS in MSEL in both the ASD and DD groups. However, only in the DD group, the regular preschool experience and the parental SES could contribute to the improvement of scores.
Conclusions: The current study demonstrated that young children with ASD and DD living in a rural area of Taiwan receive limited and lower quality services. Although the initial data showed that both children with ASD and DD could improve on all of the domains of cognitive function, the children with ASD seem to require more autism-specific services to improve their development in a rural area. Some suggestions are provided to the government, medical, educational and social welfare systems in the future.

217 **125.217** Service Usage, Needs, and Obstacles for Adults Living and Not Living with Family: A Message Regarding Public Policy

K. M. Dudley[1], *L. G. Klinger*[2], *J. L. Mussey*[3] *and M. R. Klinger*[4], *(1)TEACCH Autism Program, University of North Carolina at Chapel Hill, Carrboro, NC, (2)Psychiatry, University of North Carolina TEACCH Autism Program, Chapel Hill, NC, (3)TEACCH Autism Program, University of North Carolina at Chapel Hill, Greensboro, NC, (4)University of North Carolina at Chapel Hill, Chapel Hill, NC*

Background: Individuals with autism spectrum disorder (ASD) have substantial difficulty accessing services (Kraus et al., 2003; Kogan et al., 2008), and many of their service needs go unmet (Chiri & Warfield, 2012). However, the majority of studies have focused on children with ASD, and studies with adults have generally only included individuals in their twenties (Shattuck et al., 2012). Thus, there is very little research on service needs of adults with ASD. Even less is known about how service needs for those in middle adulthood may differ depending on their living situation, which is important due to the high number of adults with ASD living with family caregivers (Krauss et al., 2005).
Objectives: The current study investigated the service use in a large sample of adults diagnosed with ASD as children between 1970 and 1999 at the UNC TEACCH Autism Program. Specifically, this study compared services received, unmet needs, and obstacles that impacted service usage for adults living with family caregivers compared to those not living with family caregivers.
Methods: Caregiver surveys were completed for 189 adults with ASD (21-64 years of age; *M* age=35.5). All participants were diagnosed with ASD during childhood (initial evaluation *M* age=7.22). Caregivers of adults with ASD completed a survey that included 34 questions about service usage. Analyses examined differences in service usage, unmet needs, and obstacles attaining services for those living with family members and those not living with family (including those living independently, in supervised housing, a group home, or institution).
Results: As adults, 47% of individuals with ASD lived with family members. Analyses indicated that those living with family members received significantly fewer services than those not living with family members. Specifically, they received less support with independent living skills (24% family, 62% non-family; X^2=14.97, p<.001), psychological care (23% family, 57% non-family; X^2=17.41, p<.001), social work (23% family, 49% non-family; X^2=7.40, p=.007), and transportation (26% family, 70% non-family; X^2=19.89, p<.001). Furthermore, adults living with family members were reported to have significantly more unmet needs than those not living with family members (65% family, 43% non-family; X^2=9.96, p=.007). Families with adults living at home reported more struggles in knowing where to find services (36% family, 11% non-family; X^2=13.68, p<.001). These findings hold when comparing individuals living at home to different types of residential categories for those living outside the home (e.g., those living with family members received fewer services than those living independently).
Conclusions: These data indicate that adults living with family members receive approximately half the amount of services as adults who are living outside the family home. Further, adults living with family are reported to have a greater unmet need for services and difficulty knowing where to access services. With approximately half of this adult sample living with family, these results have clear implications for public policy; we need to work to increase services for middle-age adults with ASD living with family and knowledge regarding where to find these fundamental services.

218 **125.218** South Carolina's Use of Presumptive Eligibility to Improve Early Identification and Intervention for Young Children with ASD

D. A. Rotholz[1], *A. M. Kinsman*[2], *J. M. Charles*[3], *K. Musick*[4] *and K. K. Lacy*[5], *(1)Center for Disability Resources (UCEDD), Columbia, SC, (2)Greenville Health System, Greenville, SC, (3)Pediatrics, Medical University of South Carolina, Charleston, SC, (4)South Carolina BabyNet (Part C), Columbia, SC, (5)South Carolina Department of Disabilities and Special Needs, Columbia, SC*

Background: Implementing practices through which young children at risk for ASD receive early intervention as young as possible poses significant challenges for pediatricians, service providers and the systems responsible for early intervention. AAP efforts have addressed the rationale for and recommended practices through which children can be identified, screened and referred for diagnostic evaluation for ASD. However, these recommendations for screening in pediatric practices are significantly more difficult to implement than would be considered ideal. Concern has also been raised that use of brief assessment models would result in increased errors in definitive classification (Swanson et al 2013) and that it may not be realistic for service systems to revise eligibility and service models to accommodate the use of a briefer assessment model.
Objectives: While these concerns are well founded, this poster provides an example of the successful implementation of a statewide two-tiered screening model with accompanying training and policy efforts that provided for “presumptive eligibility” for early intensive behavioral intervention (EIBI) for young children at risk for ASD via the Part-C program in South Carolina (BabyNet).
Methods: Under the South Carolina BabyNet and presumptive eligibility procedures, the Modified Checklist for Autism (M-CHAT, Robins, Fein, Barton & Green, 2001) is administered to children based upon recommended guidelines adopted by BabyNet .If the M-CHAT is failed, the child is immediately referred for the M-CHAT follow up questions and the Screening Tool for Autism in Toddlers and Young Children (STAT, Stone, Coonrod & Ousley, 2000). The STAT is then administered by professionals who have completed STAT training and are determined eligible to administer by the SC Department of Disabilities and Special Needs (DDSN). Children determined to be at risk for ASD based on the STAT are presumed eligible for EIBI services funded through BabyNet. EIBI services are then initiated in conjunction with a referral for a full ASD diagnostic evaluation. If the evaluation results in a formal diagnosis of ASD or determination of eligibility through South Carolina’s DDSN, the child continues to receive EIBI through BabyNet and continue then with DDSN after age 3.
Results: Implementation of this process has increased the number of children determined eligible for and receiving EIBI services through BabyNet from 61 children in 2011 prior to implementation of presumptive eligibility to 267 children determined eligible through presumptive eligibility and 294 children total receiving EIBI services at the current time. The false positive rate of children identified through presumptive eligibility but not subsequently diagnosed with ASD via comprehensive evaluation is approximately 1%.
Conclusions: Presumptive eligibility for EIBI has proved to be dramatically effective in South Carolina for serving young children at risk for ASD. While this contradicts the “conventional wisdom” that use of a screening process would produce high false positive rates, the results in South Carolina are likely due to the two-tiered screening system that includes quality control measures for the STAT training and STAT provider eligibility.

219 **125.219** Stakeholder Perspective on Transition Planning for Youth with ASD

L. A. Ruble[1], *C. Snell-Rood*[2], *M. W. Jackson*[3], *W. H. Wong*[1], *Y. Yu*[4], *A. D. Rodgers*[1], *J. ". A. Odom*[1] *and J. H. McGrew*[5], *(1)University of Kentucky, Lexington, KY, (2)Behavioral Sciences, University of Kentucky, Lexington, KY, (3)Educational, School, and Counseling Psychology, University of Kentucky, Lexington, KY, (4)Indiana University-Purdue University, Indianapolis, IN, (5)Indiana University - Purdue University Indianapolis, Indianapolis, IN*

Background:
Although federal law mandates that all youth with disabilities in special education have transition plans to facilitate the “hand-off” to adult services, research on transition planning and implementation indicates we are falling short for students with autism spectrum disorder (ASD). Specifically, transition planning for youth with ASD is poorly understood, and little is known about how transition is actually perceived and experienced directly from the perspective of stakeholders.
Objectives:
To describe stakeholder perspectives on (i) the strengths and weaknesses of existing state/local policies, procedures, services, and resources and the changes needed to support effective transition, and (ii) concerns associated with adult services such as housing, social security, health insurance, transportation.
Methods:
Participants (n=42) were individuals with ASD, parents, teachers, school administrators, adult service providers, and state policy makers from the offices of Vocational Rehabilitation (OVR), Special Education, Medicaid, and Developmental Disabilities. A total of 10 focus groups were conducted. Each 1-hr session was recorded and transcribed for coding and analysis. Qualitative content analysis was oriented around identifying deductive themes in the data. Agreement for themes was assured with a minimum of two research analysts collaborating on the transcript-based analysis. After reading the transcripts, the team composed an initial codebook and revised the codes

through a consensus-based iterative process. Once each coding pair reached inter-rater reliability of at least 80%, codes were applied to the rest of the interview independently. Coders worked in pairs to apply codes line by line to the text. A total of 15 content codes were identified.
Results:
*(i) Strengths and weaknesses of state policies, procedures, services, and resources that exist or are needed: S*everal criticisms of state policies and procedures emerged from the interviews, especially for the OVR which is not very involved with transition planning. Participants criticized OVR for limited support for adult education and vocational training, and lack of knowledge about ASD. Participants critiqued schools' inadequate funding for appropriate transition assessment tools and community based instruction. Some felt educators and administrators were resistant to adjusting curricula for applied skill development for students withi a regular diploma. Stakeholders were concerned that students pursuing the alternative assessment/diploma track would have difficulty obtaining a job; yet the use of the word "diploma" might misrepresent the student's skill set. Finally, participants advocated for the need for an experienced navigator to guide the student and his/her family throughout the transition process.
(ii) Concerns about adult services: Participants reported a lack of knowledge about the role of OVR in transition, services available after transition, and how to access services. Participants emphasized the need for parents to apply for Medicaid waiver services early. Many commented that adult service providers lacked understanding of ASD and consequently had difficulty providing appropriate services. Finally, transportation was a challenge for participants seeking services in rural areas.
Conclusions:
Stakeholder perspectives on transition planning emphasized better involvement of OVR, curricular changes based on individual student needs, support for parent navigation, better trained service providers, and access to services- important factors necessary to consider in intervention research.

220 **125.220** Supporting Children with Autism Spectrum Disorder (ASD) on the Day of Surgery: A Balancing Act

S. L. Snow[1,2], *J. Chorney*[2], *M. Latimer*[2] *and I. M. Smith*[3], *(1)Dalhousie University, Halifax, NS, Canada, (2)IWK Health Centre, Halifax, NS, Canada, (3)Dalhousie University / IWK Health Centre, Halifax, NS, Canada*

Background: Children with autism spectrum disorder (ASD) appear to be especially vulnerable to distress around the time of surgery and managing distress can be particularly challenging for both parents and healthcare providers to manage (e.g., Bultas et al., 2012). More research is needed to better understand the surgery-related experiences of children with ASD, and to identify practices for ensuring that services are responsive to the unique needs of this growing population of healthcare service users.
Objectives: To gather the perspectives of parents and healthcare providers who have been directly involved with children with ASD undergoing surgery, and gain deeper insight into the surgery-related experiences of children with ASD, their families, and healthcare providers.
Methods: Purposive sampling was used to recruit 7 nurses and 8 physicians (surgeons & anesthetists) with Day Surgery experience with children with ASD, as well as 8 parents of children with ASD who had undergone Day Surgery. Participants engaged in semi-structured interviews that focused on (1) how perioperative distress presents in ASD, and consequences of such distress, (2) management approaches to preparing or supporting children with ASD, (3) how surgical services could be altered to better serve children with ASD and their families, and (4) barriers and facilitators to improving Interpretive description (Thorne, 2008) was the qualitative framework; themes were identified in the transcripts. Strategies such as constant comparison, peer debriefing, stakeholder meetings, and consulting expert readers were used to establish the trustworthiness and credibility of the findings.
Results: Three main themes were identified, in addition to an overarching metaphor of the child, family and health providers experience during the surgical course as a "delicate balancing act". The first theme: "Finding your footing" described how child, parent, and healthcare provider factors (e.g., anxiety, tolerance of uncertainty, and self-efficacy) set the foundation for surgery-related experiences; "Keeping each other steady" highlighted how interpersonal dynamics among children with ASD, their parents, and healthcare providers (e.g., working alliance) further shape the surgical experience; "Seeing straight ahead" captured how systemic factors (e.g., hospital environment and policies) complicate, as well as provide opportunities for the delivery of surgical care to children with ASD and their families.. A six-minute video animation was built to provide a visual representation and facilitate dissemination of these findings.
Conclusions: Parents and HCPs provided a nuanced and multi-faceted understanding of how individual, interpersonal, and systematic factors interact and shape the surgery-related experiences of children with ASD, their families, and healthcare providers. Findings underscored the complexities associated with trying to keep children with ASD, their parents, and healthcare providers balanced throughout the surgical course, while also shedding light on opportunities for interventions and clinically feasible practices that may help families and parents to successfully navigate this delicate balancing act.

221 **125.221** Systematic Review of Clinical Guidance Documents for Autism Spectrum Disorder Diagnostic Assessment

E. Anagnostou[1], ***M. Penner***[2] *and W. Ungar*[3], *(1)University of Toronto, Toronto, ON, Canada, (2)Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada, (3)Hospital for Sick Chidlren, Toronto, ON, Canada*

Background: The reported increase in prevalence of autism spectrum disorder (ASD) has also increased the demand for ASD diagnostic assessments. Clinical guidance documents play an important role in shaping these diagnostic assessment practices.
Objectives: The objective of this study was to perform a systematic review of clinical guidance documents for ASD diagnostic assessment, comparing and contrasting their quality and content.
Methods: The systematic review of guidance documents included documents published from 2000 to present by Canadian, American and UK health and educational professional associations, as well as documents published by governments in Canada or the UK. Professional association statements, practice parameters, and practice guidelines were included as clinical guidance documents. Documents pertaining only to management of ASD, as well as literature reviews and commentaries were excluded. MEDLINE, EMBASE, PsychINFO, CINAHL and ERIC were searched. Search terms included Child Development Disorders, Pervasive; Asperger Syndrome; and Autistic Disorder; these were combined with Diagnosis. Titles and abstracts were screened for eligibility based on their applicability to ASD diagnostic assessment. All documents with titles and/or abstracts that were relevant underwent full text review with application of the inclusion and exclusion criteria. One reviewer extracted relevant information from each document and assessed for quality using the Appraisal of Guidelines Research and Evaluation, 2nd edition (AGREE-II) tool.
Results: A total of 837 unique documents were retrieved, of which 24 were considered relevant and underwent full-text review. Of these, nine documents met the inclusion criteria and were included in the analysis. Two of these documents were no longer endorsed by their professional associations. The mean total score on the AGREE-II for all included documents was 68.6 (s.d. = 11.9, range 45, 89). Domain scores from the AGREE-II showed relatively high quality in Scope and Purpose (mean 90.6, s.d. 10.2) and Clarity of Presentation (mean 89.9, s.d. 10.6). Scores were lowest in Applicability (mean 42.7, s.d. 23.4) and Rigor of Development (mean 51.6, s.d. 25.8). Six of the nine documents strongly recommend a multidisciplinary team (MDT) for diagnostic assessment, while the remaining three state that MDT assessment is ideal. The guidelines varied substantially in their recommended personnel for diagnostic assessment, from no stated recommendations to a list of recommended MDT members. There was little supporting evidence for MDT and personnel recommendations. Recommended tools varied from no recommended tools to recommendations that multiple specified tools be completed. Only three of the documents included recommended wait times for assessment, all of which were from governments or non-profit associations.
Conclusions: Multiple guidance documents have been published for ASD diagnostic assessments, with varying quality and recommendations. The substantial variation in quality and content likely stems from insufficient evidence supporting diagnostic assessment practices. Further empiric evidence is needed to support diagnostic decision making in ASD and should include analysis of systems impacts, such as wait times.

223 **125.223** The Feasibility of Implementing and Assessing Acute Behavioral Interventions in an Inpatient Setting for Children and Adolescents with ASD: Challenges and Lessons

S. Marler[1], *J. E. Staubitz*[2], *P. Juarez*[3], *Z. Warren*[1], *L. L. Altstein*[4], *E. A. Macklin*[5] *and K. Sanders*[6], *(1)Vanderbilt University, Nashville, TN, (2)Pediatrics, Vanderbilt University Medical Center, Nashville, TN, (3)Vanderbilt University Medical Center, Nashville, TN, (4)Massachusetts General Hospital Biostatistics Center, Boston, MA, (5)Biostatistics Center, Massachusetts General Hospital, Boston, MA, (6)Vanderbilt, Nashville, TN*

Background: Children with Autism Spectrum Disorder (ASD), while hospitalized, frequently present with severe behaviors (i.e. aggression, self-injury) and due to this, often remain hospitalized beyond medical clearance. These behavioral challenges associated with ASD have resulted in perceived suboptimal treatment in inpatient settings by children, families, and providers (Scarpino et al., 2010; Kopecky et al., 2013). The inability of current systems to adequately respond to behaviors often limits the ability of children to be safely discharged. Though steps have been made toward improving treatment of ASD in medical settings, these children still have higher rates of hospitalization and an increased burden of unmet needs (Lajonchere et al., 2012; Croen et al., 2006; Siegal et al., 2014). There have been few studies of interventions designed to improve hospitalization for this population, leaving questions regarding the ideal organization of care unanswered. Although utilizing the principles of Applied Behavior Analysis (ABA) for assessing and treating challenging behavior can significantly impact functioning of individuals with ASD (Weitlauf et al., 2014), behavioral professionals with ABA-specific training are rarely incorporated into inpatient treatment plans. The development and implementation of innovative care programs to reduce problematic behaviors of children with ASD in inpatient settings has the potential to improve outcomes for all involved.
Objectives: Our aim was to investigate the feasibility of implementing and assessing the efficacy of brief Analogue Functional Analysis (AFA) in an inpatient setting for children with ASD to guide care during, and hopefully improve, hospitalization. We sought to evaluate if the proposed level of support and specialized care is possible during hospitalizations, or if additional components must be added and analyzed in future studies.
Methods: This single site, pilot study attempted to enroll and randomize 40 children with ASD , ages 6-18, admitted to either a medical or psychiatric inpatient unit, with severe challenging behavior(s). Participants were randomized on a 1:1 basis into a treatment group (receiving brief AFA and behavioral intervention) or a control group

(receiving “treatment as usual”). Feasibility was assessed by enrollment/completion data as well as staff, parent, and clinician ratings of challenges and successes during hospitalization.
Results: We recruited 36 children over a brief enrollment period (approximately six months) in both medical (41.7%) and psychiatric facilities (58.3%), with 19 completed, 12 lost to follow-up, and 5 pending 3-month follow-up. Major challenges endorsed by clinicians involved in the protocol included: communication challenges with staff, availability of appropriate/safe space for AFA on medical floors, challenges conducting randomization for services, and availability of behavioral services increasing parental desires to stay in hospital.
Conclusions: Although several challenges to implementing behavioral intervention in an inpatient setting were identified, we were successful in conducting a randomized intervention in these inpatient settings. The most significant challenges related to integrating behavioral staff/procedures into an already-established treatment flow and obtaining efficacy data from parents. The latter is not surprising given the pervasive disruption of having a hospitalized child, but highlights the need for novel methods, procedures, and tools that will yield higher levels of efficacy data capture over time.

224 **125.224** The Impact of Demographics on Service Utilization Among Youth with Autism Spectrum Disorder

*R. Gott[1], **C. R. Shoff**[2] and P. Xaverius[3], (1)Saint Louis University, Clayton, MO, (2)Pediatrics, Saint Louis University, Saint Louis, MO, (3)Epidemiology, Saint Louis University, Saint Louis, MO*

The Impact of Demographics on Service Utilization among Youth with Autism Spectrum Disorder
Background: Early intervention improves the behavior and the developmental outcomes of individuals with autism spectrum disorder (ASD) but there is currently no standard for the type, amount and duration of treatment. Previous research has documented disparities in access to care for youth with ASD, but it is unclear how service utilization may vary by race/ethnicity, parental income and education.
Objectives: To identify how disparities in race/ethnicity, parent socioeconomic status and insurance type affect medical and therapy services for individuals with ASD.
Methods: Between 2008-20015 the Autism Treatment Network (ATN) collected data on almost 7000 youth with ASD, ages 2-17 from United States and Canada. Using data collected through the ATN Registry, we described the sample and performed bivariate analysis to determine relationships between race, ethnicity, SES variables and use of medication, as well as complementary or alternative therapies, behavioral, speech/language, occupational, and physical therapy services.
Results: Race and ethnicity were significantly associated with receipt of speech/language services (ST), occupational therapy (OT) and physical therapy (PT) at baseline ($p<0.05$). Hispanics were less likely to use all services (53.1% vs. 60.4% ST, 40.3% vs. 47.1% OT, 11.6% vs. 15.6% PT). Service utilization also was associated with insurance type. For all categories, those with no insurance were less likely to use services (34.2% vs. 61.3% ST, 28.1% vs. 48.3% OT, 10.0% vs. 15.9% PT). Household income was significantly associated with all service categories ($p<0.05$), with behavioral, speech/language and occupational services increasing as income increased. Race and ethnicity, household income, caregiver education, any private insurance status and household income were also associated with using complementary/alternative medications ($p<0.05$).
Conclusions: Patterns of service utilization vary with race/ethnicity and socioeconomic status. In many instances Caucasians, those with a higher income, and those with any type of insurance were more likely to receive services. The same trend exists for complementary/alternative medication usage. This suggests that youth with ASD from low-income households are at a greater disadvantage. Future research studies should explore how disparities in service utilization affect outcomes of individuals with ASD.

225 **125.225** The Role of Professional Responses to Parental Concern in Predicting the Timeliness of Autism Spectrum Disorder Diagnosis

***C. A. Bent**[1], J. Barbaro[2] and C. Dissanayake[3], (1)La Trobe University, Melbourne, VIC, Australia, (2)La Trobe University, Melbourne, Victoria, Australia, (3)Olga Tennison Autism Research Centre, La Trobe University, Melbourne, Australia*

Background: A substantial gap exists between the age that a reliable and accurate diagnosis of Autism Spectrum Disorder (ASD) is possible, and the age that the majority of children currently receive a diagnosis. Previous research has identified factors associated with the age at diagnosis of ASD; including clinical features, parental concerns as well as community level characteristics such as socioeconomic status and service availability. Families’ interactions with health services may also act as a barrier or enabler to early diagnosis; with later diagnoses found to be associated with a greater number of professional consultations. However, less is known about the role of professionals’ behaviour and responses to parental concerns in predicting the timeliness of ASD diagnosis.
Objectives: This study aimed to examine the role of families’ interactions with health services and professional responses to parental concerns in the prediction of the timeliness of ASD diagnosis.
Methods: 185 parents/caregivers with a child with ASD completed a purpose-developed online survey which included questions on child characteristics, severity of ASD symptoms (measured using the Social Communication Questionnaire), family demographics, parental concerns, type and number of professionals consulted and professional responses. Correlations were initially conducted to examine relationships between variables and hierarchical regression analyses were conducted to predict the timeliness of ASD diagnosis. The final paper will include data collected up until the end of December 2015.
Results: On average, parents’ reported becoming concerned about their child’s development at 25 months, first seeking professional advice at 35 months, and receiving an ASD diagnosis at 63 months. Shorter delays in the time between seeking professional advice and obtaining a diagnosis were associated with more active professional responses (e.g., raising concerns about child development, making a referral, administering a screening tool or developmental assessment). While more passive professional responses (e.g., advising the child was too young to diagnoses, not to worry or to wait and see) were associated with greater delays in ASD diagnosis. Controlling for child age at the time of the survey, active responses to parental concerns and the overall number of professional consultations were significant unique predictors of timeliness of ASD diagnosis, with the overall model accounting for 52% of variance. Severity of ASD symptoms, family socio-economic characteristics and family history of ASD were not meaningfully associated with timeliness of diagnosis.
Conclusions: Substantial delays were reported between parents first seeking professional advice regarding their child’s development, and child age at ASD diagnosis. Active professional responses to parental concerns may reduce delays in diagnosis. These findings reiterate the importance of developmental surveillance, which provides a structure within which parents and primary health care professionals can raise concerns regarding a child’s development.

226 **125.226** The Role of Self-Efficacy When Preparing Teachers in Autism Spectrum Disorders

***J. Salt** and K. Johnsen, Have Dreams, Park Ridge, IL*

Background:
Research has begun to look at self-efficacy effects during teacher training. Recently, we added a *autism specific* self-efficacy measures to our training evaluation protocol. Our program is an intensive training based on structured teaching principles. The 5-day, interactive training provides opportunities to receive in-vivo supervision and feedback from experienced trainers. Through hands-on construction of visual supports, participants create a classroom, work with children with ASD and teach the autism curriculum.
Objectives:
This study investigated the effectiveness of the training model to increase teachers competence in delivering the autism curriculum. The study addressed:
(i) teacher change in self-competence to teach the autism curriculum
(ii) the relationship of teachers initial self-efficacy to outcome
(iii) the relationship of teachers self-efficacy to skills gained during training and professional experiences prior to training.
Methods:
Participating teachers (n= 46) completed two questionnaires pre and post training:
(i) The ‘structured teaching competence’ questionnaire contains three sections: concrete level (early learner); intermediate level; abstract level (advanced learner.) Participants answered questions regarding their ability to provide interventions for that child. The final questionnaire had 15 questions; maximum score 90.
(ii) The Autism Self-Efficacy Scale for Teachers (ASSET; Ruble et al., 2013) is a 30-item self-report measure designed to assess ASD specific knowledge and skills. Each question is rated on a 1-100 scale.
Teachers provided information on their educational qualifications and experience with ASD.
Results:
(i) T-test revealed that there was a significant ($p<.01$) increase in competence scores pre and post training at each level of development (concrete, intermediate, abstract).
(ii) Baseline ASSET scores were divided by the mean to create high and low self-efficacy groups. To compare group performance on the structured teaching measure, scores were entered into a repeated measures multivariate analysis of variance, with time (pre, post) as the within subjects repeated measure and group (high, low SE) as the between factor. There was no significant group by time interaction effects at any level of development.
(iii) Final ASSET scores were divided by the mean score to create high and low self-efficacy groups. To determine the relationship of prior experience and competence gained on teacher self-efficacy, data was entered in a logistic regression model with group membership (high and low self-efficacy) as the dependent variable, and lifetime number of ASD students, educational level, years teaching and final competence score as covariates. Both total score (OR= 1.2, $p<.05$) and educational level (OR = 9.6, $p<.05$) significantly predicted self-efficacy group membership.
Conclusions:
These results provide support for the effectiveness of our training. Teachers increased their confidence in their ability to teach the autism curriculum, at any level of ability, to individuals with ASD. Teachers in both the low and high self-efficacy groups increased their scores on both measures over the training period. Results indicate that

experiences prior to training do not significantly impact outcome. Therefore even experienced teachers can increase their autism intervention self-efficacy by attending an intensive training. Further research will explore if educational level or self-efficacy predicts *implementation* of specific strategies in the classroom following training.

227 **125.227** Therapy and Medication Use in Young Children with Autism: A Secondary Data Analysis from the Autism Speaks-Autism Treatment Network

D. Ziskind[1], *A. Bennett*[1], *A. F. Jawad*[2] *and N. Blum*[1], *(1)Developmental & Behavioral Pediatrics, The Children's Hospital of Philadelphia, Philadelphia, PA, (2)Pediatrics, The Children's Hospital of Philadelphia, Philadelphia, PA*

Background: Guidelines suggest that young children with Autism Spectrum Disorder (ASD) should receive intensive psychosocial interventions. Additionally, associated symptoms may be treated with psychotropic medications. However, actual intervention use by young children with ASD has not been well characterized.
Objectives: The aim of this study was to describe interventions received by young children with ASD ≥6 months after diagnosis. The association with socio-demographic factors was also explored.
Methods: Data were used from the Autism Speaks- Autism Treatment Network (AS-ATN), a research registry of children with ASD which includes 17 sites in the U.S. and Canada. AS-ATN participants undergo a standardized diagnostic evaluation and receive treatment recommendations from Autism specialists. Parents report services and medications being used at follow-up visits. This study used data from 12/2007 to 12/2013 and included 1354 subjects aged 36-72 months.
Results: Most young children (91%) received psychosocial interventions but only 36% received behavioral-based therapy. The median total hours per week of therapy was only 5.0 hours (range 0-65; interquartile range 1.5-14) and of those who received behavioral-based therapies, the median hours per week received was only 4.6 hours (range 0.1-50, interquartile range: 2-12). 50% of subjects received <5 hours per week of therapy and only 18% reported receiving >20 hours per week of therapy. Demographic factors found to be associated with increased total therapy intensity included younger age, non-Hispanic/ Latino ethnicity, higher parental educational level and geographic location in the Northeast or Southern U.S. Additionally, 22.4% of subjects were on ≥1 psychotropic medication and the most commonly prescribed medications were α-agonists Demographic factors found to be associated with increased psychotropic medication use included older age, Black/ African American race, lower parental education and living in Canada.
Conclusions: Relatively few young children with ASD diagnosed at high quality academic centers are receiving evidence-based behavioral therapies and few are receiving psychosocial interventions at the recommended intensity. There is significant regional and socio-demographic variability in psychosocial intervention and psychotropic medication use. Additionally, the class of medications most commonly prescribed has not been extensively studied in this population. Further research is needed to support current prescribing practices and to improve access to evidence-based treatments for young children with ASD.

228 **125.228** Training Needs of Health Professionals Working with Adults on the Autism Spectrum

K. van Dooren[1,2], *T. Parkin*[3], ***S. J. Girdler***[4,5], *A. Urbanowicz*[6,7], *M. Ciccarelli*[3,6] *and N. Lennox*[6,8], *(1)Queensland University, Queensland Centre for Intellectual and Developmental Disability, South Brisbane, Australia, (2)Cooperative Research Centre for Living with Autism Spectrum Disorders, long Pocket, Brisbane, Australia, (3)School of Occupational Therapy and Social Work, Curtin University, Bentley, Australia, (4)School of Occupational Therapy and Social Work, Curtin University, Perth, WA, Australia, (5)Cooperative Research Centre for Living with Autism Spectrum Disorders (Autism CRC), Brisbane, Australia, (6)Cooperative Research Centre for Living with Autism Spectrum Disorders, Long Pocket, Brisbane, Australia, (7)University of Queensland, Queensland Centre for Intellectual and Developmental Disability, South Brisbane, Australia, (8)The University of Queensland, Queensland Centre for Intellectual and Developmental Disability, South Brisbane, Australia*

Background: Approximately 1 in 134 Australians are living on the Autism spectrum, yet only 1% of research in Autism focuses on adults. The limited research available suggests that adults on the Autism spectrum have unique health needs and may exhibit poorer physical and mental health outcomes in comparison to the general population. Additionally, health professionals working in the area often experience challenges at systems, education and training levels when working with these adults on the spectrum.
Objectives: To undertake an assessment of the needs of Australian health professionals in relation to their provision of care to adults on the Autism spectrum.
Methods: We recruited 78 health professionals from across Australia, using purposive and snowballing approaches, to complete an online survey about providing health care to adults on the Autism spectrum. The survey consisted of 39 open-ended and closed questions and was open for completion from December 2014 to February 2015. Questions sought information on health professional and patient demographics, self-assessment of health professional competence and training needs. Descriptive data analysis was performed on closed questions. Open-ended data were analysed using content analysis.
Results: The 78 health professionals came from a broad range of health professions. Most commonly the professionals worked as a nurse (18%), other including psychiatrists (18%), occupational therapist (14%), psychologist (13%) or medical practitioner (13%). The vast majority 79% (62/78) were female, with most aged 45-64 years (63%), 28% aged 25-44 years, 6% aged 18-24 years and 3% aged 65 years or older.
On average, health professionals (n=68) saw 22 (SD 27) adults on the Autism spectrum every year, who had a mean age of 32 (SD 19) years. More than half of the adults on the Autism spectrum (60%, 41/68) also had intellectual disability and only 14% (10/69) attended appointments on their own. Health professionals were asked to rank up to three of the most common medical conditions of the adults they cared for and these included mental health, general health including check-ups, gastrointestinal, neurological and metabolic.
Two thirds (62%, 48/78) of the health professionals agreed or strongly agreed with the statement “I feel competent providing care to adults with ASD”. Most frequently, professionals stated an interest or knowledge of Autism helped them provide services to the adults they cared for but that a lack of training, knowledge, time, experience and resources made it difficult for them to provide this care. The majority (83%, 54/65) strongly agreed or agreed that they would like more training specific to caring for adults on the spectrum and the most preferred modes of receiving training were workshops, webinars, electronic and hard copy reading material, and online courses. Areas identified for training included behaviour management, mental health, communication and teaching.
Conclusions: This study found that even amongst a group of health professionals who often provided services to adults on the Autism spectrum, while they felt competent in providing care, they still wanted more training specific to caring for adults on the Autism spectrum, particularly in the areas of behaviour management and mental health.

229 **125.229** Using Community Partnerships to Better Understand the Barriers to Using an Evidence-Based, Parent Mediated Intervention for ASD in a Medicaid System

K. Pickard *and B. Ingersoll, Michigan State University, East Lansing, MI*

Background: Within the autism spectrum disorder (ASD) field, service use disparities have been noted to impede under-resourced, ethnic minority families’ ability to access high quality services for their child with ASD. Service access barriers and rates of attrition in ASD services are particularly relevant for parent-mediated interventions, and may suggest a lack of fit between evidence-based, parent-mediated interventions as they are presently being implemented in underserved community settings. However, no research to date has explicitly examined this fit.
Objectives: The present study used Roger’s Diffusion of Innovations theory to guide the understanding of the variables that might influence parent and provider use of an evidence-based, parent-mediated program (Project ImPACT) in a Medicaid system. The longterm goals are to use this understanding to enhance the fit of Project ImPACT for Medicaid systems.
Methods: Community-based partnerships were formed with 3 Medicaid systems to better understand the perceived compatibility, complexity, and relative advantage of using Project ImPACT within a Medicaid eligible population. As part of the community partnerships, 3 focus groups were conducted with 16 Medicaid eligible parents, and 3 focus groups were conducted with 16 ASD providers operating within a Medicaid system (i.e. see Tables 1 and 2). Groups were designed to elicit participants’ perceptions of Project ImPACT and feedback on adaptations that would enhance the fit of the Project ImPACT program within the Medicaid system.
Results: Across all groups, parents’ and providers’ reported general interest in using the Project ImPACT program. However barriers and suggestions consistently emerged regarding the need to: 1) reduce the complexity of all written materials; 2) include more visuals and metaphors in teaching; 3) ensure a strong alliance between the therapist and parent; 4) involve the extended family; and 5) have specific strategies to help families practice the intervention within their chaotic environments and within their pre-existing resources.
Conclusions: Results from the present study suggest that Project ImPACT is generally viewed as an important intervention by Medicaid parents and providers. However, parents and providers specify a number of perceived barriers centering on Project ImPACT’s compatibility, acceptability and relative advantage that would likely impede its use within this setting. Future directions are thoroughly discussed regarding next steps in designing and testing an adapted Project ImPACT program geared for the Medicaid system.

Table 1. Parent Demographics

Characteristic	Percent	Mean (*SD*)
Parent		
Gender (% female)	87.50%	
Age in years		34.81 (7.07)
Marital status		
Married/Living with Partner	43.80%	
Single, Widowed, Divorced	56.20%	
Ethnicity		
White/Caucasian	12.50%	
Black/African American	62.50%	
Hispanic/Latino	0%	
Middle Eastern	6.30%	
Asian/Pacific Islander	0%	
Biracial/Other	18.80%	
Parent Education		
Less than High School	12.50%	
High School Degree	56.30%	
Some College/Specialized Training	18.80%	
Bachelor's Degree	12.50%	
Annual Household Income		
<$10,000	37.50%	
$10,001-$15,000	6.30%	
$15,001-$20,000	31.30%	
$20,001-$30,000	25.00%	
Child with ASD		
Age		4.50 (0.73)
Gender (% male)	77.80%	

Table 2. Provider Demographics

Characteristic	Percent	Mean (*SD*)
Parent		
Gender (% female)	92.50%	
Age in years		34.81 (7.07)
Ethnicity		
White/Caucasian	43.75%	
Black/African American	43.75%	
Hispanic/Latino	0%	
Middle Eastern	6.25%	
Asian/Pacific Islander	0%	
Biracial/Other	6.25%	
Education		
High School Degree	18.75%	
Some College/Specialized Training	25.00%	
Bachelor's Degree	0%	
Graduate Degree	56.25%	
Occupation		
Behavior Technician	25.00%	
Family Supports Coordinator	12.50%	
Social Worker	6.25%	
BCBA	12.50%	
Early Childhood Therapist	37.50%	
Psychologist	6.25%	

230 **125.230** Using Quality Improvement Collaboratives to Improve Early Identification of Autism By Primary Care Providers Serving Low Resource Urban Communities

M. Siller[1], *E. R. Hotez*[2] *and M. R. Swanson*[3], *(1)Hunter College of the City University of New York, New York, NY, (2)The Graduate Center of the City University of New York, New York, NY, (3)University of North Carolina at Chapel Hill, Chapel Hill, NC*

Background:
Almost a decade ago, the AAP (2006, 2007) published a groundbreaking policy statement on surveillance and screening of autism spectrum disorder (ASD). These guidelines recommended that all children be screened for ASD using formal screeners during pediatric well-child visits at 18 and 24 months. Although limited, available data suggest that only a minority of primary care providers (PCPs) has successfully implemented the AAP's recommendations (Volkmar & Reichow, 2014).
Objectives:
To investigate the preliminary efficacy of quality improvement collaboratives (QICs) for improving (1) ASD-specific screening rates during well-child visits at 18 and 24 months, and (2) self-reported knowledge/attitudes about early identification of ASD among primary care physicians.
Methods:
This research was conducted in collaboration with two urban PCPs in the Eastern US: a network of five clinics (PCP#1), and a clinic affiliated with a hospital center (PCP#2). The communities served by these PCPs were primarily African American (28% and 41%, respectively) and Hispanic (31% and 49%, respectively). The QICs were implemented over a 4-month period. Activities were guided by a multi-disciplinary leadership team comprised of the researchers and three individuals from within the clinic. The team met monthly to develop, evaluate, and refine an office-wide implementation system that addresses clinic-specific barriers. In addition, the leadership team determined the content of monthly training workshops offered to the clinic staff. Both PCPs chose to implement the M-CHAT (Robins et al., 2001).
To evaluate increases in screening practices and physician knowledge/attitudes, two kinds of outcome measures were collected: 1) Monthly chart reviews were completed for a period of about 6 months, starting one month prior to the QIC. Using a random sampling approach, medical charts of children from 17-25 months at the time of well-child visit were reviewed for documentation about ASD-specific screening and referrals. For PCP#1 and PCP#2, we abstracted data from 250 and 140 charts, respectively. 2) Before and after the QIC period, physicians completed a questionnaire evaluating knowledge/attitudes about screening, communicating with families, and referral practices.
Results:
A total of 15 physicians completed the pre- and post-questionnaire measures (female: 72%; racial/ethnic minority: 80%; years in practice: M=26, SD=12.5). Results revealed significant increases in physicians' knowledge/attitudes about screening measures, $t(14)=2.7$, $p < .05$. No significant increases were found with regard to physicians' knowledge/attitudes about early diagnosis, strategies for communicating with families, and effective referral practices. In addition, chart review results indicated that ASD-specific screening rates increased from 16% to 76% at PCP#1, and from 24% to 39% at PCP#2. Across both PCPs, ASD-specific screening measures identified a total of 10 children at high risk for ASD. Four of these were referred by the treating physician to the local early intervention program to determine eligibility for services.
Conclusions:
Despite advances in early identification of ASD, significant challenges persist in moving screeners from academic centers to the "real world". The current research demonstrates the preliminary efficacy of QICs for implementing ASD-specific screening measures by PCPs in ethnically diverse and low resource communities. Future directions for optimizing this learning system will be discussed.

231 **125.231** Using Technology to Create Sustainable Systems of Support for Toddlers at Risk for Autism Spectrum Disorder

S. K. Fuhrmeister[1], *E. Brooker Lozott*[2], *K. Resua*[1], *T. Ryan*[1], *M. Costo*[1] *and J. L. Stapel-Wax*[3], *(1)Marcus Autism Center, Atlanta, GA, (2)EIs for Autism Foundation, Jensen Beach, FL, (3)Emory University School of Medicine, Atl, GA*

Background:
The National Research Council (2001) found that early detection and 25 hours per week of active engagement promoted optimal success for young children with autism spectrum disorder (ASD) in kindergarten. Although intervention has the greatest impact on ASD if it begins before age three, 80% of children who need early intervention are missed (CDC, 2009; Filipek et al., 1999; NRC, 2001; USDOE, 2011). NRC (2001) along with Wong et al. (2014) of the Autism Evidence-Based Practice Review Group and the National Standards Project (2015), emphasize that evidence-based practices, such as naturalistic and parent-implemented interventions meet the criteria of "established treatments" for individuals with ASD. However, families with access to early intervention often find that the available systems are ill prepared in the specific skills and methods needed to effectively collaborate and coach parents/caregivers (Friedman & Woods, 2012). Therefore, more innovative methods for providing support and coaching to early intervention providers (EIPs) is necessary to ensure development of knowledge and skills and translation into practice (Bransford et al., 2000). However, there is a paucity of research on the effectiveness of coach-the-coach models supporting EIPs with the use of technology.
Objectives:
This ongoing project aims to improve collaborative coaching proficiencies of EIPs across Georgia via implementation of a novel, coach-the-coach model utilizing innovative and community-viable mobile coaching technology focused on increasing knowledge of adult-learning strategies, early red flags for ASD, and supports to promote active engagement for toddlers at risk for ASD.
Methods:
This study is tracking the progress of 25 EIPs across Georgia, coached to coach caregivers on increasing active engagement in toddlers at risk for ASD. Coaching of EIPs is

conducted in-person quarterly, with all other weekly coaching sessions occurring via technology. Effectiveness of the coach-the-coach model is assessed using SEE-KS™ (Rubin, E. et al., 2014) three-point rating scales to determine supports coached to caregivers by the EIPs to foster engagement and support understanding and expression in toddlers at risk for ASD. SEE-KS™ is a coaching framework based on Universal Design for Learning encompassing the principals of SCERTS® (Prizant et al., 2005).

Results:

Friedman's Tests were used to examine differences in support ratings over time due to the small sample size. Results from the current five EIPs indicate a significant increase from baseline in supports coached to caregivers to foster engagement (p<0.0001) and to support understanding (p=0.0060) and expression (p=0.0034) during the first three months of the project (see Table 1 and Figure 1). Mean changes represent approximately 30% increase in supports coached to caregivers from Time 1 to Time 2. Baseline scores of supports represent "treatment as usual" from the EIPs.

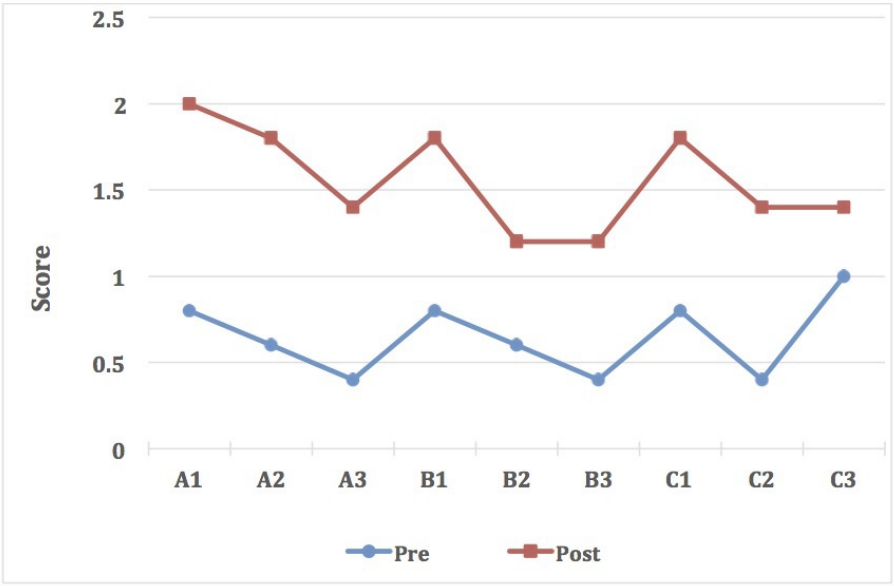
Conclusions:

These data indicate that the current coach-the-coach model resulted in caregivers providing increased supports to promote engagement, understanding, and expression in toddlers at risk for ASD. Through the use of innovative technology within the coach-the-coach model, EIPs learned to effectively coach an increase in caregiver-implemented supports within three months, empowering caregivers to utilize evidence-based supports in a short amount of time.

Table 1. Descriptive Statistics on Pre/Post Scores (Per Activity/Segment)

Activity/Segment	Pre Score*	Post Score*	p-values
A. Fostering Engagement	0.6 (0.51)	1.7 (0.46)	<0.0001
B. Presenting information in multiple ways	0.6 (0.51)	1.4 (0.74)	0.0060
C. Allowing students to act and express themselves in multiple ways	0.7 (0.46)	1.5 (0.83)	0.0034

Figure 1. Mean Score Comparison Per Question - Pre vs. Post



Practice

***C. M. Harker**, L. V. Ibanez, S. R. Edmunds, E. A. Karp and W. L. Stone, Department of Psychology, University of Washington, Seattle, WA*

Background: State-implemented early intervention (EI) programs are a first line of treatment for many children with, or at risk for ASD, making them an ideal setting for implementing ASD-specialized evidence-based interventions (EBIs) such as Reciprocal Imitation Training (RIT). However, sustained use of EBIs requires that the setting supports their delivery (Chambers et al., 2013). *Implementation climate,* the extent to which users perceive an intervention as supported and rewarded in their work setting (Klein & Sorra, 1996), is associated with intervention use (e.g., Dingfelder, 2012), as are the intervention's *acceptability* and *feasibility* (Proctor et al., 2011). Little is known about how these factors change over time, and how these changes influence providers' use of EBIs. One-day professional development workshops are the norm in training community-based providers; however, few studies track provider use of interventions after trainings are delivered. Even fewer track providers' sustained use of interventions over time.

Objectives: The specific objectives were to examine changes in ratings of RIT acceptability, feasibility, and implementation climate over three time points (post-training, 3-month follow-up, and 6-month follow-up) between providers who are and are not using RIT at follow-up.

Methods: EI providers attended one-day RIT workshops. Providers (n=116) rated the acceptability and feasibility of RIT and the implementation climate of their work setting (Usage Rating Profile-Intervention, selected items; Chafouleas, 2009) at three time points: immediately post-training and at 3- and 6-month follow-ups. Providers also reported at the 6-month follow-up whether they had used RIT (Use Group=79). Report of RIT use at 3-months was used when 6-month data were missing.

Results: Three hierarchical linear models were conducted to examine changes in provider ratings of RIT acceptability, feasibility, and implementation climate over time (see Table 1 for raw means) and handle missing data using Maximum Likelihood estimation. RIT use at follow-up was a predictor of the intercept for acceptability, B_{01} =. 29, p <. 01, feasibility, B_{01} = .22, p = .03, and implementation climate, B_{01} = .31, p <. 01. RIT use was also a predictor of linear change for acceptability, B_{11} = .13, p < .01, feasibility, B_{11} = .12, p < .01, and implementation climate, B_{11} = .11, p < .01. Ratings declined for all providers between post-training and follow-up, but declined *more* steeply for providers *not* using RIT at follow-up.

Conclusions: These findings suggest that though providers find RIT to be acceptable and feasible and rate their work climate as supportive immediately after the workshop, real world application of the intervention may present challenges that temper these ratings and providers' subsequent use of RIT. Community providers may require additional support within their work settings (e.g., supervisor encouragement, resources, incentives) in order to facilitate their use of EBIs with children in their caseload.

Table 1
Descriptives for feasibility, acceptability, and implementation climate

Variable	All Providers *M (SD)/n*	Use Group** *M (SD)/n*	No-Use Group** *M (SD)/n*
Acceptability*			
Post-training	3.45 (.48)/99	3.53 (.45)/71	3.26 (.50)/28
3-month follow-up	3.09 (.63)/87	3.29 (.49)/64	2.52 (.61)/23
6-month follow-up	3.02 (.73)/53	3.28. (.61)/40	2.23 (.44)/13
Feasibility*			
Post-training	3.37 (.45)/97	3.43 (.47)/70	3.23 (.38)/27
3-month follow-up	3.25 (.62)/80	3.42 (.49)/59	2.75 (.66)/21
6-month follow-up	3.04 (.81)/54	3.28 (.69)/41	2.28 (.71)/13
Implementation Climate*			
Post-training	3.43 (.43)/98	3.51 (.40)/70	3.23 (.42)/28
3-month follow-up	3.27 (.62)/82	3.46 (.47)/61	2.70 (.67)/21
6-month follow-up	3.15 (.69)/54	3.41 (.57)/40	2.43(.46)/14

Notes. * Scores range from 1-4, with 4 indicating more optimal ratings. Data reported are raw means. **Use Group = providers who reported using RIT with their caseload at 6-month follow-up; No-Use Group = providers who reported not using RIT with their caseload at follow-up (3-month data were used when 6-month data were not available).

233 **125.233** When Should Next Generation Sequencing be Used in Children at High-Risk for Autism Spectrum Disorder?

T. Yuen[1,2], *W. Ungar*[3], *P. Szatmari*[4] *and M. T. Carter*[5], *(1)Technology Assessment at Sick Kids, Hospital for Sick Chidlren, Toronto, ON, Canada, (2)Institute of Health Policy, Management and Evaluation, University of Toronto, Toronto, ON, Canada, (3)Hospital for Sick Chidlren, Toronto, ON, Canada, (4)Centre for Addiction and Mental Health, Toronto, ON, Canada, (5)Hospital for Sick Children, Toronto, ON, Canada*

Background: Next generation sequencing (NGS) is a novel but costly genetic testing technology that is currently reserved for syndromic children with autism spectrum disorder (ASD) who failed to receive a genetic diagnosis from traditional genetic testing. Using NGS earlier in the diagnostic pathway could generate information to aid diagnosis and lead to earlier treatment, but its optimal position in the diagnostic pathway remains unknown.
Objectives: The objective of this study was to construct a model of the diagnostic pathway from birth to age 6 in children at high risk for ASD to predict the health consequences of introducing NGS at different time points.
Methods: The diagnostic pathway for children at high-risk for ASD was modeled using discrete event simulation to predict age at diagnosis, wait time for treatment, and total costs. Clinical progression was structured in consultation with clinicians and current Canadian guidelines. The model incorporates ASD risk factors, recognized phenotypes of genetic mutations and developmental trajectories based on two prospective cohort studies (the Infant Sibling Study and Pathways to ASD Study) and published literature.
Results: The model accounts for heterogeneity in clinical pathway associated with individual characteristics such as gender, family history, congenital anomalies, ASD

symptom severity and developmental milestones. Moreover, the model can simulate queues for health services and predict wait times for clincial assessment and treatment. In turn, the average age at diagnosis and age at treatment initiation can be estimated when NGS was introduced at different time points along the diagnostic pathway. Conclusions: The simulation model from this study can generate much needed information for clinicians and decision-makers on how to integrate NGS in clinical settings. This model will be used in economic evaluations to help decide whether NGS can replace cheaper but less effective genetic tests. Reduction in unnecessary testing could also reduce delays in diagnosis and wait times for ASD services, which are critical issues in improving long term outcomes in ASD.

Oral Session -
127 - INSAR Awards Ceremony
4:00 PM - 5:00 PM - Hall B

4:00 INSAR Awards Ceremony

Oral Session -
128 - Advocate Award Address
5:00 PM - 5:10 PM - Hall B

5:00 Advocate Award Address

Oral Session -
129 - Keynote - Lifetime Achievement Award
5:10 PM - 5:30 PM - Hall B

5:10 Keynote - Lifetime Achievement Award

Oral Session -
134 - Welcome Address
8:45 AM - 8:50 AM - Hall B

8:45 Welcome Address 2

Oral Session -
135 - Autism Speaks Update
8:50 AM - 9:00 AM - Hall B

Autism Speaks Update

8:50 Autism Speaks Update

Keynote Address
136 - Dissecting Synaptic and Circuitry Mechanisms of Autism
9:00 AM - 10:00 AM - Hall B

Speaker: G. Feng, MIT McGovern Insitute for Brain Research, Boston, MA

Recent genetic studies have identified a large number of candidate genes for autism spectrum disorder (ASD), many of which encode synaptic proteins, suggesting that synaptic dysfunction might be a key pathology in ASD. In addition, recently, genetic studies have revealed a significant overlap of risk genes for ASD and schizophrenia. However, it is not clear how different mutations of the same gene could contribute to the manifestation of different diseases. One such example is the Shank3 gene. The Shank3 gene encodes a postsynaptic scaffolding protein critical for the development and function of glutamatergic excitatory synapses. Disruption of the Shank3 gene is thought to be the cause of the core neurodevelopmental and neurobehavioral deficits in Phelan-McDermid Syndrome, an autism spectrum disorder. Using various Shank3 mutant mice as a model system, I will discuss (1) recent findings on synaptic and circuit mechanisms underlying autistic-like behaviors in Shank3 mutant mice; (2) the reversibility of synaptic, circuit and behavioral abnormalities in adult mutant mice; and (3) molecular and synaptic mechanisms that may explain how different alleles of the same gene lead to distinct synaptic and behavioral phenotypes in mice. Together, these findings may inform exploration of neurobiological mechanisms of ASD in human patients.

9:00 Dissecting Synaptic and Circuitry Mechanisms of Autism
***G. Feng**, MIT McGovern Insitute for Brain Research, Boston, MA*

Recent genetic studies have identified a large number of candidate genes for autism spectrum disorder (ASD), many of which encode synaptic proteins, suggesting that synaptic dysfunction might be a key pathology in ASD. In addition, recently, genetic studies have revealed a significant overlap of risk genes for ASD and schizophrenia. However, it is not clear how different mutations of the same gene could contribute to the manifestation of different diseases. One such example is the Shank3 gene. The Shank3 gene encodes a postsynaptic scaffolding protein critical for the development and function of glutamatergic excitatory synapses. Disruption of the Shank3 gene is thought to be the cause of the core neurodevelopmental and neurobehavioral deficits in Phelan-McDermid Syndrome, an autism spectrum disorder. Using various Shank3 mutant mice as a model system, I will discuss (1) recent findings on synaptic and circuit mechanisms underlying autistic-like behaviors in Shank3 mutant mice; (2) the reversibility of synaptic, circuit and behavioral abnormalities in adult mutant mice; and (3) molecular and synaptic mechanisms that may explain how different alleles of the same gene lead to distinct synaptic and behavioral phenotypes in mice. Together, these findings may inform exploration of neurobiological mechanisms of ASD in human patients.

Panel Session
137 - Recent Advances in Genetics and Neurobiology of Autism
10:30 AM - 12:30 PM - Hall B

Panel Chair: Guoping Feng, *MIT McGovern Insitute for Brain Research, Boston, MA*

Both genetic and environmental factors play important roles in the pathogenesis of autism spectrum disorder. The four panel members, each at the forefront of their respective fields, will discuss recent advances in large-scale genetic studies, neuro-immunology crossroad, and iPS cell technologies in the effort to unravel the etiology and neurobiology of autism spectrum disorder.

10:30 **137.001** Emerging Genetic Analyses of Autism Spectrum Disorders: Insights from Common and Rare Variation
***B. Neale**, Broad Institute, Cambridge, MA*

Background: The genetic analysis of autism spectrum disorders (ASDs) is accelerating. Increasing sample sizes are revealing risk factors across the allele frequency spectrum.
Objectives: Review genetic influences on ASD across the allele frequency spectrum from common variation through to spontaneously arising variation.

Methods: Genome-wide association analysis has been performed on over 10,000 cases of ASDs. Whole exome sequencing has been performed on ~5,000 cases of ASDs. We also incorporated frequency information from Exome Aggregation Consortium to refine and strengthen the evidence for association.
Results: For common variation, substantial increases in sample size have led to the identification of genome-wide significant loci. For rare variation, aggregation efforts to exome sequencing have sharpened our ability to identify significant genetic risk factors.
Conclusions: These studies highlight the importance of taking a comprehensive view of genetic risk and the need to continue increasing sample sizes to build the foundation for understanding the biological mechanisms that drive ASD in the population.

11:00 **137.002** A Multi-Omics Analysis of the Autism Brain

***D. Arking**, Johns Hopkins University School of Medicine, Baltimore, MD*

Background: Despite recent advances in identifying a number of genes involved in autism spectrum disorder (ASD) through identification of large effect de novo mutations, the vast majority of ASD risk remains unexplained. Moreover, while common genetic variation is expected to explain >50% of the variance in liability for ASD, no large/moderate genetic effects have been identified, and current studies are underpowered to identify common variants of small effect.
Objectives: Understanding the etiology of ASD is critical to identifying potential therapeutic targets. Given the limited success relying solely on genetic studies, we focus on a multi-omics approach, incorporating genome-wide association study (GWAS) results along with transcriptomic and methylation data from the primary affected tissue in ASD, human brain. The goal is to combine these different layers of genome-wide data to identify key pathways in the development of ASD.
Methods: GWAS results are available through the Psychiatric GWAS Consortium Autism Working Group on ~6,500 parent-affected child trios. Gene expression and methylation data were generated in up to 47 (32 unique individuals) ASD samples and 57 (40 unique individuals) controls, including multiple brain areas for gene expression studies.
Results: Gene expression studies identify microglial genes robustly dysregulated in ASD cortical brain, pointing to M2-activation as a common feature of ASD brains. Notably, these genes are not enriched for genetic variants associated with ASD (common or rare). Instead, a set of neuronal genes that are not differentially expressed are enriched for the genetic signal. Thus, combining GWAS with transcriptomics suggests a model in which the gene expression changes are secondary to the primary genetic defects, raising the question of whether M2-activation is a common causal pathway for ASD symptoms, or instead, a response to changes occurring during neurodevelopment. The incorporation of genome-wide methylation data is ongoing.
Conclusions: Combining multiple genome-wide level datasets (GWAS, transcriptomics, methylation) provides key insights into the etiology of ASD that cannot be gleaned from any of the datasets in isolation, and is likely to prove critical in identifying potential therapeutic targets.

11:30 **137.003** The Maternal Interleukin-17a Pathway in Mice Promotes Autism-like Phenotypes in Offspring

***G. Choi**, MIT McGovern Insitute for Brain Research, Cambridge, MA*

Background: Accumulating evidence points to a central role for immune dysregulation *in utero*as as a risk factor in Autism Spectrum Disorder (ASD). Human studies suggest that maternal viral infections early in pregnancy correlate with an increased frequency of ASD in the offspring. This observation, coined maternal immune activation (MIA), has been modeled in rodents by inducing inflammation in pregnant dams. However, The immune cell populations critical in the MIA model have not been identified.
Objectives: Based on previous observations suggesting their involvement in ASD, we tested whether TH17 cell population and its cytokine are necessary for MIA phenotypes.
Methods: N/A
Results: Using both genetic mutants and blocking antibodies targeting their activities, we have recently found that Th17 cells are critical mediators working in pregnant mice to induce behavioral abnormalities in MIA-affected offspring. T cell-specific inactivation of RORgt in mothers (thus selectively removing Th17 cells in pregnant mothers) protected from induction of MIA-dependent behavioral phenotypes in offspring. In addition, we found that maternal inflammation leads to abnormal cortical phenotypes in offspring and this malformation is fully rescued by inhibiting the maternal IL-17a pathway. We also found that the receptor for IL-17 (IL-17R) is expressed in the developing fetal brain and its expression is increased in the cortex upon MIA.
Conclusions: These observations suggest a hypothesis that uncontrolled activation of IL-17R expressed in fetal brain induces abnormal cortical development and these structural abnormalities may be an underlying cause of the MIA-dependent behavioral phenotypes.

12:00 **137.004** From Cortical Development to Cortex in the Dish: Modeling Human Neurodevelopmental Disease

***P. Arlotta**, Harvard, Cambridge, MA*

Background:
Brain imaging approaches have allowed for a low-resolution understanding of network abnormalities in living human brains of patients with neurodevelopmental and neuropsychiatric disorders, however a deeper understanding of pathologies affecting neural network behavior are only possible when abnormalities in cell connectivity, network activity and transcriptomes can be directly interrogated and correlated in an experimental system amenable to manipulation, phenotyping and high-throughput analysis.
Objectives:
We aim to generate a high-throughput in vitro model of the human developing brain to investigate the effect of disease-linked mutations on brain development and circuit function.
Methods:
I will present recent work on the development and long-term culture of 3D cerebral organoids derived from human pluripotent stem cells. This will include analysis of the developmental trajectory, cellular diversity and neuronal network features that mature within this human brain organoid model.
Results:
I will show that phenotypic abnormalities observed in patients carrying genetic mutations linked to neurodevelopmental disease can be reproduced within cerebral organoids.
Conclusions:
The work provides initial proof-of-principle demonstration that selected aspects of human neurodevelopmental disease can be modeled in high-throughput using 3D cerebral organoids.

Panel Session
138 - Growing Older with Autism; Cognition, Comorbidity and Quality of Life.
10:30 AM - 12:30 PM - Room 307

Panel Chair: Dermot M. Bowler, *City University London, London, United Kingdom*

Discussant: Laura Klinger, *Psychiatry, University of North Carolina TEACCH Autism Program, Chapel Hill, NC*

Although it has been known for several decades that autistic individuals grow older, it is not until the last few years that there has been any research into the effects of ageing in this population. This is surprising given that ageing in typical as well as other atypical populations carries with it a considerable burden for the individual in terms of cognitive and adaptive changes, and for society in terms of increased demands on systems of care provision. The four presentations in this panel report on age-related, later lifespan differences in cognition, quality of life and psychiatric comorbidities. These studies, although cross-sectional in nature, will lay the groundwork for future longitudnal follow-up investigations.

10:30 **138.001** The Association Between Cognitive Ability and Psychiatric Problems in Adults with ASD

***P. Howlin**[1] and P. Moss[2], (1)King's College London, Institute of Psychiatry, London, England, United Kingdom of Great Britain and Northern Ireland, (2)Kings College London, London, England, United Kingdom of Great Britain and Northern Ireland*

Background: Data on rates of mental health problems in adults with autism vary widely, from 20%-25% in some studies to over 70% in others. The relationship with cognitive level is also uncertain, with some studies suggesting mental health problems are more likely to occur in individuals of higher IQ who are more exposed to social pressures and/or are more aware of their social and other difficulties than individuals with intellectual impairments.
Objectives: The aim of the present study was to explore the association between mental health and cognitive functioning in a cohort of adults with autism who have been systematically followed up over several decades
Methods: Participants were 58 individuals who were first diagnosed with autism as children (mean age 6 years); current age mean age is 45 years. All were of average non-verbal IQ when seen as children. Adult measures included IQ assessments and self and informant measures of psychiatric difficulties
Results: Most individuals were able to complete formal cognitive tests as adults and in this group cognitive ability had remained very stable since they were first seen in childhood (mean child IQ 85,5, sd 14.2; mean adult IQ 87.3, sd.20.1). However, ability levels in 15 individuals could be assessed only indirectly; in this group cognitive levels

(based on Vineland proxy estimates) had declined significantly (mean 20.5; sd 2.1). Among the total cohort, 44% of adults were rated as having no mental health problems but 28% had mild to moderate difficulties and a further 28% had severe psychiatric problems. Overall there was a small but statistically significant correlation between IQ and ratings of adult mental health (r=-.32, p=.015). Significantly more individuals in the group showing a decline in cognitive ability were rated as showing moderate to high levels of psychiatric morbidity than those whose IQ remained within the average range (Fisher exact test .03). Thus, two thirds of individuals in the "cognitive decline" group had moderate to high levels of psychiatric disturbance compared with 28% of those with an IQ in the average range.
Conclusions: In this cohort of individuals seen over many years, there was no evidence that higher IQ was associated with a higher risk of psychiatric morbidity; in contrast individuals who had shown an apparent decline in cognitive functioning over the years seemed more likely to experience psychiatric disturbance. However, whether the findings reflect a true decline in cognitive ability, or whether poor test performance was due mainly to psychiatric and behavioural problems remains unclear. Other issues related to the assessment of IQ and mental health changes in long-term follow-up studies will also be discussed

10:55 **138.002** ASD-Related and Psychiatric Symptomatology Across the Adult Lifespan

A. G. Lever[1] *and H. M. Geurts*[2,3]*, (1)Dutch Autism & ADHD research center (d'Arc) Dept of Psychology, Brain and Cognition, University of Amsterdam, Amsterdam, Netherlands, (2)Dutch Autism & ADHD research center (d'Arc) Dept of Psychology, Brain and Cognition, University of Amsterdam; Dr. Leo Kannerhuis, Amsterdam, Netherlands, (3)Dept. of Research, Development & Innovation, Dr. Leo Kannerhuis, Doorwerth, Netherlands*

Background:
Although autism spectrum disorder (ASD) is considered a lifelong neurodevelopmental disorder, knowledge on the condition in middle and late adulthood is still limited. A steadily increasing number of studies suggest that some behavioral symptoms might abate over time, even though outcome is rather poor and the diagnosis is rarely waived. Psychopathology frequently co-occurs with ASD, but whether psychiatric symptoms and disorders, representing an important target for treatment, also diminish across the adult lifespan remains largely unknown.
Objectives:
The aim of this cross-sectional study is to investigate the relationship between age and ASD symptomatology (including social-emotional reciprocity and sensory sensitivity), and psychiatric symptoms and disorders.
Methods:
We administered self- and proxy-reported questionnaires (Autism-spectrum Quotient, Interpersonal Reactivity Index, Sensory Sensitivity Questionnaire, Symptom Checklist-90) and a neuropsychiatric interview (Mini International Neuropsychiatric Interview) to 435 adults with and without ASD (age range 19-79 years, IQ>80).
Results:
Self-report was poorly concordant to proxy-report, suggesting that both measures reveal different aspects of ASD symptomatology. Moreover, although age-related differences in social-emotional reciprocity were not observed, general and sensory symptoms increased in middle adulthood and decreased in late adulthood. High levels of depression, anxiety, and psychological distress characterized individuals with ASD across adulthood. More specifically, 79% experienced a psychiatric disorder at least once in their lives, and depression and anxiety disorders were most common. Nevertheless, older adults with ASD less often met criteria for any psychiatric diagnosis and, specifically, for social phobia.
Conclusions:
The high number of self-reported ASD symptoms and the persistence of these symptoms across the adult lifespan, underline the lifelong nature of this neuropsychiatric condition. However, despite consistently high levels of psychological distress, lifetime diagnoses for any psychiatric disorder occurred less often in older adults than in younger adults, suggesting reduced psychopathology in late adulthood.

11:20 **138.003** Ageing and Autism Spectrum Disorder: Symptom Severity, Life Outcome and Additional Mental Health Conditions in Adults Coming for First Diagnosis

E. Zivrali[1]*, F. Happé*[1] *and P. Howlin*[2]*, (1)Social Genetic and Developmental Psychiatry, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (2)King's College London, Institute of Psychiatry, London, England, United Kingdom of Great Britain and Northern Ireland*

Background: Recent studies suggest the prevalence of Autism Spectrum Disorder (ASD) in adults equals that found in children, approximating 1% in the last UK ONS Household survey (Brugha et al., 2011). Although ASD is assumed to be a lifelong condition, the majority of research studies focus on children or young adults (Mukaetova-Ladinska et al., 2011), and very little is known about changes in old age in ASD (Happe & Charlton, 2010; Perkins & Berkman, 2012).
Objectives: To gather more information about the pattern of autism symptom severity, life outcome and additional mental health conditions in older versus younger adults with ASD receiving first-diagnosis in adulthood.
Methods: Clinical case records were analysed from adults (N=100; aged 18 to 70, mean= 40 years) referred to an adult ASD diagnostic clinic to be assessed for a possible ASD diagnosis. Group comparisons between younger (aged 18 to 38, mean= 24 years) and older adults (aged 50 to 70, mean= 56 years) were made, for those individuals who did and those who did not receive an ASD diagnosis. ASD symptoms, life outcome (i.e. education, employment, independence, close relationships, and friendship), and additional psychiatric disorders were compared for younger and older adults, and in relation to age across the group.
Results: A third of adults with ASD had fair or poor life outcome, despite all having at least average intellectual functioning.Old adults with ASD had better close relationships, employment, and independence compared to the younger group, whereas ASD symptom severity, friendship, and educational outcome did not differ by age. The same pattern of age differences was seen in the non-ASD group except for employment. Additional psychiatric problems were common in both age groups with ASD, while there was a higher incidence of anxiety (56%) and depression (42%) in the old group compared to young adults. Other additional psychiatric conditions seen in old adults with ASD were OCD, ADHD, personality disorders, bipolar disorder, and harmful use of alcohol. Among the young individuals with ASD those who had OCD as an additional diagnosis had more severe rigid and repetitive behaviours and interests than those without additional mental health conditions.
Conclusions: This study represents an exploratory and preliminary step to fill the huge gap in the ASD literature concerning ageing. Limitations, implications and future research will be considered.

11:45 **138.004** Ageing with Autism: Memory and Quality of Life

A. Roestorf[1]*, P. Howlin*[2] *and D. M. Bowler*[3]*, (1)City University London, London, United Kingdom of Great Britain and Northern Ireland, (2)King's College London, Institute of Psychiatry, London, England, United Kingdom of Great Britain and Northern Ireland, (3)Psychology, City University London, London, United Kingdom*

Background: Longitudinal studies of ageing in autism spectrum disorder (ASD) report poorer outcomes for the majority of individuals, and that intellectual disability predicts later life outcomes (Howlin et al., 2013; Howlin & Moss, 2012). Cross-sectional studies paint a slightly different picture, reporting fewer age-related differences in relational processing (Ring et al., 2015), executive function and memory (Geurts & Vissers, 2012, Lever & Geurts, 2015). Whilst more longitudinal work is necessary, the time needed to complete such studies means that cross-sectional evaluations of age-related differences will continue to be important, albeit needing cautious interpretation. It remains largely unknown how the severity of autistic traits such as repetitive behaviours, and cognitive skills such as language and everyday memory, which are crucial in maintaining independence and quality of life in healthy ageing (Maylor, 1996; Henry et al., 2004), are affected by growing older with autism.
Objectives: (i) To identify cross-sectional age-related differences in language, intellectual functioning, repetitive behaviours and memory, between younger and older adults with ASD; (ii) Identify how these factors affect quality of life in older ASDs.
Methods: Our study includes 48 younger (YA) and older (OA) adults diagnosed with ASD and 44 non-autistic (non-ASD) adults, matched on age (18-80) and IQ (>70). Participants completed a series of tasks assessing IQ (WAIS), language ability (CREVT), autistic traits and repetitive behaviours (AQ; SRS;OCI-R), memory (CVLT) and Quality of Life (PWI; WHOQOL-BREF).
Results: Our preliminary data on (i) memory and (ii) Quality of Life show the following age-related differences in ASD (max n analysed to date = 21) and comparison participants (max n analysed to date = 11):
(i) Memory – no differences in recall were observed between younger and older ASDs (all $p > .1$), whereas older non-ASD comparison participants had significantly poorer recall than younger participants across short and long-delays (all $p < .05$).
(ii) Quality of Life was significantly worse overall for all ASDs compared to non-ASDs (all p's $<.02$). Older ASD participants reported significantly more satisfaction than younger ASDs with *personal relationships* ($p = .02$) and *future* ($p = .005$) Quality of Life domains, but the comparison participants showed no age-related differences in any domain.
In comparison participants, long-delay recall significantly correlated with receptive language ($p < .05$), negatively correlated with overall Quality of Life ($p < .05$), and all recall negatively correlated with age ($p < .05$). However, in ASD participants, recall and learning across trials was significantly associated with Quality of Life in *physical*, *standard of living*, *safety* and *future* domains (all $p < .05$), whilst recall across short delays was associated with receptive language and comprehension ($p < .05$) and the *community* Quality of Life domain.
Conclusions: Our preliminary findings on memory and Quality of Life both confirm and extend existing cross-sectional comparisons of older and younger adults with ASD (Lever & Geurts, 2015; Ring et al., 2015). However, these findings need to be complemented by robust longitudinal investigations, which will emerge from on-going follow-up of the sample studied here.

Panel Session

139 - What Is Different about Females with Autism: Where Are We and Where Do We Need to Go?

10:30 AM - 12:30 PM - Room 308

Panel Chair: Allison Ratto, *Children's National Medical Center, Silver Spring, MD*

Discussant: Julia Bascom, *Autistic Self Advocacy Network, Washington, DC*

Autism spectrum disorder (ASD) occurs significantly less often in females than in males, particularly among those without comorbid intellectual disability. Consistent with these discrepant prevalence rates, ASD research has often focused primarily on males, limiting our knowledge of the ASD profile in females. Increasingly, research examining gender differences in ASD has found that females may be affected differently than males by this disorder. Prior research has indicated that there are differences in symptom profiles, delays in diagnosis, and differential impacts on daily functioning, but the direction of effects differs notably across studies. The presentations in this panel will focus on the unique presentation of ASD symptoms in females, particularly those without intellectual disability. A meta-analysis of existing research will review findings over the past several decades regarding gender differences in symptom profiles across the range of intellectual disability. Other presentations will discuss gender differences in adaptive behavior, executive functioning, and core ASD symptoms, with a focus on females without intellectual disability. Implications of these findings for better understanding the diagnosis of ASD among females, as well as long-term impacts on daily functioning, will be discussed.

10:30 **139.001** A Systematic Review and Meta-Analysis Reveals Sex Differences in Rrbis in School Age Children with ASD without ID

K. Register-Brown[1], *A. B. Ratto*[2], *C. E. Pugliese*[3], *A. Verbalis*[3], *C. Rothwell*[4,5], *J. L. Martucci*[6], *E. I. White*[7], *G. Wallace*[8] *and L. Kenworthy*[9], *(1)Child and Adolescent Psychiatry, University of Maryland, Baltimore, MD, (2)Children's National Medical Center, Silver Spring, MD, (3)Children's National Medical Center, Rockville, MD, (4)Center for Autism Spectrum Disorders, Children's National Medical Center, Rockville, MD, (5)Catholic University of America, Washington, DC, (6)Neuropsychology, Children's National Health System, Rockville, MD, (7)NIMH, Bethesda, MD, (8)The George Washington University, Washington, DC, (9)Children's Research Institute, Children's National Medical Center, Rockville, MD*

Background: The consensus that autism spectrum disorders (ASDs) are found four times as often in males as females has remained strikingly consistent despite evolving diagnostic criteria. The possible reasons for this sex difference in prevalence of ASDs are a topic of vigorous debate. First, although typical social, communication, and play behavior develops differently in boys and girls, the ASD diagnostic criteria are not sex-specific, and may systematically underdiagnose girls. Second, the higher prevalence of externalizing behaviors in boys may lead to an ascertainment bias, with boys more frequently taken for diagnostic evaluation due to their disruptive behavior. Finally, biological and environmental factors including genetics, hormones, and neuro-immune processes may act differentially in boys and girls, leading to true phenotypic differences by sex.
Objectives: Quantify sex differences in social, communication, and repetitive behavior and restricted interests (RRBI) symptom severity in individuals diagnosed with ASDs, and the potential mediating impacts of age and IQ.
Methods: PubMed was searched for relevant peer-reviewed articles published before September 29, 2015. Included studies reported core (social, communication, and/or RRBI) ASD symptom severity by sex in subjects diagnosed with ASDs. Meta-analyses were performed using random effects models. To account for measurement heterogeneity, separate meta-analyses were run by symptom domain for studies using the ADOS vs. the ADI vs. any other instrument. The effects of age and IQ were examined by rerunning meta-analyses stratified by subject age (in 5 year increments) and IQ (≤70 and >70).
Results: A total of 39 studies providing data on 9,005 subjects were included (Table 1). Males had significantly higher RRBI on all instruments, including the ADI and ADOS (OR 1.92, 95% CI 1.32-2.87, p=0.001; Table 2). Neither the ADI nor the ADOS, which were used in approximately two-thirds of the studies of social symptoms, revealed sex differences for social problems, although other instruments (eg. AQ, RBQ II, BISCUIT, and DASH-II) did indicate more social symptoms in males than females (OR 1.30, 95% CI 1.01-1.67, p=0.044). The ADI, but not the ADOS or other instruments, revealed more severe communication problems in males (OR 1.40, 95% CI 1.07-1.83, p=0.014). As only RRBI analyses were stable by measurement instrument, and as numbers of studies were inadequate to stratify by both age/IQ and instrument, only RRBI results were stratified by age and IQ. Boys aged 11-15 had significantly worse RRBI symptoms (OR 2.82, 95% CI 1.45-5.48, p=0.002), as did males with IQ>70 (OR 1.83, 95% CI 1.26-2.37, p=0.001).
Conclusions: This meta-analysis did not find any consistent sex differences in social deficit severity. Males had significantly worse communication deficits on parent report measures, and RRBI intensity on all measures. Early adolescent boys, and boys without intellectual disability (ID), showed higher RRBI severity than corresponding girls. These findings indicate that in non-ID school-aged children with ASD, current measurement tools are capturing more severe RRBI difficulties in boys. Whether this reflects inadequacy of the tools to comprehensively capture RRBI in girls, or relatively lower RRBI severity in girls, is a question for future research.

Table 1. Studies included in the meta-analyses.

Study Name	Total N	Instruments	Mean Age (years)	IQ (Mean or cutoff)
Ame et al. 2011	60	ISAA	8.2	61
Andersson et al. 2013	38	VABS	3.1	67.5
Auyeung et al. 2009	265	EQ	8.1	NA
Banach et al. 2009	194	ADI, VABS	9.3	69.5
Baron-Cohen et al. 2001	58	AQ	31.6	100
Baron-Cohen et al. 2003	68	FQ	34.3	106
Baron-Cohen et al. 2006	79	AQ	12.5	72.6
Baron-Cohen et al. 2014	726	EQ	NA	"average"
Bolte et al. 2011	56	ADOS, ADI	14	99
Carter et al. 2007	90	ADOS, ADI	2.3	NA
Cholemkery et al. 2014	55	SRS	12.5	100.6
Coffman et al. 2015	24	ADI, ADOS	10.3	98.82
Dawson et al. 2007	352	BPASS	NA	75.2
Dean et al. 2014	50	ADOS	7.6	91
Frazier et al. 2014	2418	ADOS, ADI	9.0	81.3
Harrop et al. 2015	80	ESCS	3.35	65
Hartley et al. 2009	199	ADOS	2.98	NA
Hattier et al. 2011	140	DASH-II	49.3	40
Head et al. 2014	50	FQ	13.8	above 70
Hiller et al. 2014	140	DSM interview	8.4	99
Holtmann et al. 2007	46	ADI, ADOS	12	88.8
Lai et al. 2011	62	ADOS, ADI	27	112.7
Lugnegard et al. 2013	52	eyes test	28.8	NA
Mandy et al. 2012	325	ADOS	9.8	92.6
May et al. 2012	64	SRS	9.9	96.79
McLennan et al. 1993	42	ADI	NA	NA
Nicholas et al. 2008	295	DSM Coding Guide	8	60% <70
Park et al. 2012	111	ADI, ASDS, SCQ	8.3	93
Pilowsky et al. 1998	36	ADI, CARS	10.5	NA
Postorino et al. 2015	60	VABS	3.6	64
Reinhardt et al. 2015	288	ADOS	2.9	76.5
Sipes et al. 2011 – high functioning	99	BISCUIT	2.2	92.5
Sipes et al. 2011 – low functioning	291	BISCUIT	2.2	69
Solomon et al. 2012	40	ADOS, SCQ	12	104
Spiker et al. 2001	288	ADI	9	64
Szatmari et al. 2011	1407	ADI	8.5	66% >70
Tsai et al. 1983	75	Developmental Profile	6.2	52.4
Volkmar et al. 1993	199	VABS	13.3	42
Zwaigenbaum et al. 2012	85	ADI	3.3	92

ADI, Autism Diagnostic Inventory. ADOS, Autism Diagnostic Observation Schedule. AQ, Autism Spectrum Quotient. ASDS, Asperger Syndrome Diagnostic Scale. BISCUIT, Baby and Children Screen for Children with Autism Traits, Part I. BPASS, Broader Phenotype Autism Symptom Scale. CARS, Childhood Autism Rating Scale. DASH, Diagnostic Assessment for the Severely Handicapped. DSM, Diagnostic and Statistical Manual. EQ, Empathy Quotient. ESCS, Early Social Communication Scales. FQ, Friendship Questionnaire. ISAA, Indian Scale for Assessment of Autism. NA, not available. RBQ-II, Repetitive Behaviors Questionnaire, Second Edition. SICD, Sequenced Inventory for Communication Development. SRS, Social Responsiveness Scale. VABS, Vineland Adaptive Behavior Scale.

Table 2. Meta-analysis results for stratification by instrument.

Triad Domain	Instruments	Number of Studies	Number of Subjects (Male/Female)	OR (95% CI)	p	I^2
Social	ADOS	7	2712/499	1.08 (0.752-1.54)	0.69	56.1
Social	ADI	13	4174/719	0.842 (0.569-1.24)	0.38	77.6
Social	All except ADI and ADOS	20	1736/1016	1.30 (1.01-1.67)	0.044*	59.0
Social	All (13 instruments)	38	6372/1858	1.10 (0.884-1.36)	0.40	74.4
Communication	ADOS	7	2712/499	1.11 (0.673-1.83)	0.68	77.8
Communication	ADI	12	2865/613	1.40 (1.07-1.83)	0.014*	36.2
Communication	All except ADI and ADOS	7	476/214	1.25 (0.920-1.70)	0.15	8.65
Communication	All (6 instruments)	22	3803/950	1.34 (1.04-1.73)	0.024*	62.7
RRBI	ADOS	9	2971/578	1.77 (1.13-2.77)	0.012*	78.3
RRBI	ADI	13	4122/701	2.13 (1.12-4.04)	0.022*	92.4
RRBI	All except ADI and ADOS	9	777/368	1.66 (1.06-2.60)	0.026*	74.5
RRBI	All (9 instruments)	27	5620/1271	1.92 (1.32-2.87)	0.001**	89.2

* p<0.05. ** p<0.001. ADI, Autism Diagnostic Inventory. ADOS, Autism Diagnostic Observation Schedule. Note that some studies provided both ADI and ADOS data, so totals in "All Instruments" cells are lower than the sums of preceding cells.

10:55 **139.002** Sex Differences in Real-World Executive Functioning and Adaptive Behavior in Children and Young Adults with Autism Spectrum Disorder

E. I. White[1], *A. B. Ratto*[2], *A. C. Armour*[3], *K. Register-Brown*[4], *H. S. Popal*[1], *G. Wallace*[5], *A. Martin*[1] *and L. Kenworthy*[6], *(1)NIMH, Bethesda, MD, (2)Children's National Medical Center, Silver Spring, MD, (3)Children's National Medical Center, Arlington, VA, (4)University of Maryland, Gaithersburg, MD, (5)The George Washington University, Washington, DC, (6)Children's Research Institute, Children's National Medical Center, Rockville, MD*

Background: Females with Autism Spectrum Disorder (ASD) are diagnosed less frequently (Rivet & Matson, 2011) and later (Begeer et. al., 2012), on average, than males. Questions surround whether these differences could be due to a distinctive profile of behavioral deficits for females with ASD as compared to males.
Objectives: The present study is the largest to date examining executive function and adaptive ability in females with ASD. The aim was to utilize parent ratings of real-world

executive functioning and adaptive behavior to better understand whether females present differently from males in areas of everyday functioning.
Methods: This analysis included a group of 81 females (mean age = 12.21, *SD* = 2.74; mean IQ = 106.88, *SD* = 20.15) and 162 males (mean age = 12.70, *SD* = 2.43; mean IQ = 106.88, *SD* = 18.84), ranging in age from 7-18 years, who met criteria for ASD on the Autism Diagnostic Interview-Revised (ADI-R) and/or Autism Diagnostic Observation Schedule (ADOS). Two male participants were matched to each female to within 4 years of age and 11 IQ points. Groups were equivalent on ADOS, ADOS-2, and ADHD symptom ratings for the subset of the group that had each. All participants were assessed using the Behavior Rating Inventory of Executive Function (BRIEF) and a subset of 57 females and 133 males were assessed using the Vineland Adaptive Behavior Scales-II (VABS-II). Two repeated measures ANOVAs were conducted to compare sex differences across scales on the BRIEF and VABS-II and, when appropriate, post-hoc independent *t*-tests were used to assess differences on specific domain scores.
Results: A mixed-model ANOVA with Sex (male, female) as the between subjects factor and BRIEF scale (8 scales) as the within subjects factor revealed a main effect of sex (F=5.035; p=.026, η_p^2=.020) with females rated as exhibiting greater executive function problems. The Sex (male, female) x VABS-II Domain (3 domains) ANOVA yielded no main effect of sex, but an interaction between VABS-II domain and sex (F=5.834; p=0.003, η_p^2=.030). Post-hoc *t*-tests revealed significantly greater impairments (i.e., lower standard scores) for females with ASD in the domain of Daily Living Skills (p=0.003).
Conclusions: Our results indicate relative weaknesses for females compared to males diagnosed with ASD on non-social executive function and daily living skills. These differences occur in the context of equivalent: clinician ratings of core autism symptomatology, parent ratings of ADHD symptoms and parent-reported social and communication adaptive skills. If these findings are confirmed, they have important implications for treatment targets in females with ASD.

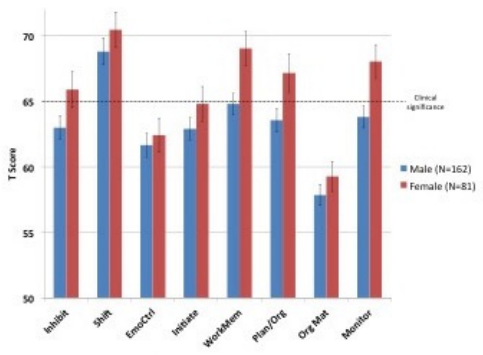


Figure 1. BRIEF profile T scores by sex

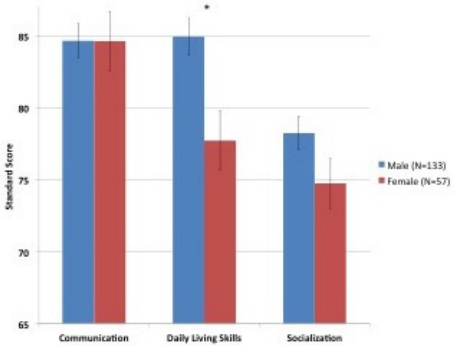


Figure 2. VABS-II domain standard scores by sex

11:20 **139.003** Gender Differences in Parent-Reported and Clinician-Rated Autism Symptoms

A. B. Ratto[1], *G. Wallace*[2], *C. E. Pugliese*[3], *J. L. Martucci*[4], *K. Register-Brown*[5], *E. I. White*[6], *H. S. Popal*[6], *C. Rothwell*[7,8], *A. Martin*[6] *and L. Kenworthy*[9], *(1)Children's National Medical Center, Silver Spring, MD, (2)The George Washington University, Washington, DC, (3)Children's National Medical Center, Rockville, MD, (4)Neuropsychology, Children's National Health System, Rockville, MD, (5)Child and Adolescent Psychiatry, University of Maryland, Baltimore, MD, (6)NIMH, Bethesda, MD, (7)Catholic University of America, Washington, DC, (8)Center for Autism Spectrum Disorders, Children's National Medical Center, Rockville, MD, (9)Children's Research Institute, Children's National Medical Center, Rockville, MD*

Background: Females are diagnosed with autism spectrum disorder (ASD) at significantly lower rates than males, with particularly discrepant rates among those without intellectual disability (Kirkovski, Enticott, & Fitzgerald, 2013). Prior research has found indications of differences in core ASD symptoms, including peer relationships, play, communication, and restricted/repetitive behaviors and interests (Kirkovski et al., 2013). Some have questioned whether high-functioning females may actually be under-diagnosed with ASD, due to differences in symptom presentation (Halladay et al., 2015). However, specific symptom profiles and patterns of impairment differ significantly across studies and by the particular measure used.
Objectives: The aim of the present study was to investigate differences in core symptoms of ASD by gender on gold standard measures using both clinician observation and parent report.
Methods: Participants included 129 children (n=43 females, n=86 males) with a confirmed ASD diagnosis, ages 4-14 years, with IQ>70 recruited from research and specialty clinic samples. Female participants were double-matched (i.e., two males to every one female) on IQ within 10 points. There were no significant differences in age (t= -.42, *ns*) or full-scale IQ (t=.25, *ns*) by gender. All participants were assessed using Module 3 of the Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, DiLavore, & Risi, 2002) or its recent revision the ADOS-2 (Lord et al., 2012), the Autism Diagnostic Interview-Revised (ADI-R; Rutter, Le Couteur, & Lord, 2003), and the Social Responsiveness Scale (SRS; Constantino & Gruber, 2004) or its recent revision, the SRS-2 (Constantino & Gruber, 2012).
Results: Chi-square analyses were used to examine differences on individual items on the ADOS. Overall, males and females performed similarly on ADOS items. However, females received significantly more severe scores for “Compulsions/Rituals” (χ^2=8.29, p<.02), and males performed worse on “Offers Information” at the trend level (χ^2=5.08, p<.07). Gender differences in parent-reported ASD symptoms were compared on subscales and total scores of the SRS and the ADI-R using t-tests (Table 1). Parents reported statistically significant differences on the SRS in Social Cognition (t= -1.99, p<.05), Social Communication (t= -2.71, p<.008), and Restricted/Repetitive Behavior (t= -2.67, p<.009) and approaching significant differences in Social Awareness (t= -1.87, p<.07), with females rated as more impaired than males on all subscales. In contrast, ADI-R scores showed males as more impaired in Social Interaction (t=1.98, p<.05) and Communication (t=2.25, p<.02).
Conclusions: Parent report measures showed greater impairment in current functioning for females, while greater impairment was reported for males during the crucial historical period for diagnosis (preschool years). This pattern of findings suggests that females with high-functioning ASD are at risk for delays in diagnosis and consequently are more impaired than their male peers during school-age years, perhaps due to related delays in access to services. Importantly, males and females performed similarly on clinician observation, with no significant differences on ADOS algorithm items, suggesting those who meet criteria for a diagnosis present similarly to expert clinicians during middle childhood and early adolescence. This may indicate a need for sex-normed early screening measures to increase access to early diagnosis for females with high-functioning ASD.

Table 1. Demographics and ASD Symptoms by Gender.

	Females (n=43)	Males (n=86)	Significance
Age	9.66 (1.83)	9.48 (2.40)	t =-.42 (*ns*)
Full-Scale IQ (Standard Score)	103.42 (19.08)	104.34 (19.75)	t =.25 (*ns*)
SRS (T-Score)			
Social Awareness	72.61 (12.83)	67.53 (11.38)	t= -1.87 (p<.07)
Social Cognition	79.29 (13.52)	73.37 (12.64)	t= -1.99 (p<.05)
Social Communication	81.43 (14.33)	72.71 (13.88)	t= -2.71 (p<.008)
Social Motivation	69.86 (14.85)	70.29 (13.55)	t= .14 (*ns*)
Restricted/Repetitive Behaviors	88.07 (16.69)	78.88 (16.69)	t= -2.67 (p<.009)
Total	78.82 (14.08)	75.15 (13.46)	t= -.74 (*ns*)
ADI-R (Raw Score)			
Reciprocal Social Interaction	14.54 (6.00)	17.03 (5.10)	t= 1.98 (p<.05)
Communication	12.62 (4.66)	14.89 (4.14)	t= 2.25 (p<.02)
Restricted/Repetitive Behaviors	4.65 (2.43)	5.43 (2.38)	t= 1.38 (*ns*)
Abnormal Development	2.88 (1.42)	3.05 (1.28)	t= .54 (*ns*)
ADOS (Raw Score) (n= 29 female, n= 54 male)			
Social-Communication	11.59 (4.82)	11.06 (4.58)	t= -.49 (*ns*)
Restricted/Repetitive Behavior	2.69 (1.61)	2.63 (1.69)	t= -.16 (*ns*)
ADOS-2 (Raw Score) (n= 14 female, n= 32 male)			
Social Affect	10.79 (3.42)	10.88 (3.35)	t= .93 (*ns*)
Restricted/Repetitive Behavior	3.57 (1.95)	3.84 (1.94)	t= .66 (*ns*)

11:45 **139.004** Gender Differences on the Newly Proposed ADOS-2, Module 4 Algorithm in ASD without ID: A Multi-Site Study

*L. G. Anthony[1], L. Kenworthy[2], G. Wallace[3], B. E. Yerys[4], B. B. Maddox[5], S. W. White[6], A. C. Armour[7], J. Miller[8], J. Herrington[9], R. T. Schultz[10], A. Martin[11] and **C. E. Pugliese**[1], (1)Children's National Medical Center, Rockville, MD, (2)Children's Research Institute, Children's National Medical Center, Rockville, MD, (3)The George Washington University, Washington, DC, (4)The Center for Autism Research, Philadelphia, PA, (5)Children's Hospital of Philadelphia, Philadelphia, PA, (6)Virginia Polytechnic Institute and State University, Blacksburg, VA, (7)Children's National Medical Center, Arlington, VA, (8)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (9)The Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (10)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (11)NIMH, Bethesda, MD*

Background: There has been increased interest in possible differences in symptomatology in females with ASD without ID as compared to males (Van Wijngaarden-Cremers et al., 2014). Traditionally, females with ID were thought to be more severely affected than males. Current research questions whether this is a true discrepancy or a methodological manifestation of mis- or under-diagnosis in females with ASD without ID (Halladay et al., 2015). The algorithm for the ADOS Module 4, appropriate for verbally fluent adolescents and adults, has been recently updated (Hus & Lord, 2014), though gender differences in the algorithm and items have not yet been explored.
Objectives: The purpose of this study was to investigate gender differences in core symptoms of ASD on gold-standard diagnostic measures via parent interview, parent report, and clinician observation.
Methods:
Participants included 255 individuals (n=53 females) across four research-reliable sites with a confirmed ASD diagnosis, ages 11-61 years, with either a full-scale (M=107.23, SD=17.71) or verbal (M=109.14, SD=17.93) IQ>70. There were no significant gender differences in age or full-scale or verbal IQ. All participants were assessed using Module 4 the Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, DiLavore, & Risi, 2002) or its recent revision the ADOS-2 (Lord et al., 2012). A subsample received the Autism Diagnostic Interview-Revised (ADI-R; Rutter, Le Couteur, & Lord, 2003) (n=33 females, n=157 males) and the Social Responsiveness Scale (SRS/SRS-2; Constantino & Gruber, 2004; Constantino & Gruber, 2012) (n=33 females, n=144 males).
Results:
There were no significant gender differences on any ADI-R subscales, but females scored significantly higher than males on the SRS total score (t= -2. 39, p<.01). On the ADOS, there was a trend towards males being rated as more impaired on the updated algorithm (t= 1.92, p=.06). Chi-square analyses were used to examine differences on individual items on the ADOS. Ratings of "3" were converted to "2" and ratings of "7/8" were converted to "0." Males were rated as significantly more impaired on the following items: "Stereotyped/Idiosyncratic Use of Words of Phrases" (χ^2=9.37, p<.01), "Descriptive, Conventional, Instrumental or Informational Gestures" (χ^2=7.12, p<.05), "Communication of Own Affect" (χ^2=8.51, p<.01), and "Empathy" (χ^2=9.40, p<.01).
Conclusions:
Historical parent report of ASD symptoms via the ADI-R did not reveal gender differences in the present sample. However, parents rated concurrent ASD symptoms on the SRS as more impaired in females than males. Males and females performed similarly on the majority of ADOS items though males were rated as having more severe ASD symptoms in several social communication skills, including two items on the newly proposed ADOS algorithm. Findings from this study indicate that although females look the same as (or better than) males on a few key symptoms on gold standard diagnostic measures, parents observe more social problems in the real world. This may be due to our societal expectations of greater social skills from cognitively able females or because our diagnostic tools are built for and standardized on a majority male population

and may not adequately capture ASD in females.

Panel Session
140 - Perspectives on Pain in ASD: Perception, Physiology, and Behavior
10:30 AM - 12:30 PM - Room 309

Panel Chair: Michelle Failla, *Vanderbilt University, Nashville, TN*

Discussant: Carissa Cascio, *Vanderbilt University School of Medicine, Nashville, TN*

Despite the common assumption that individuals with ASD are less sensitive to pain, empirical evidence is scarce and inconsistent. This panel will explore the available evidence, beginning with a systematic review of clinical behavioral studies suggesting that measurement approaches (e.g., facial affect, pain ratings, parent/self-report) heavily influence the presence and direction of reported differences in pain perception in individuals with ASD. This will be followed by three presentations that represent a range of these approaches, including clinical/caregiver report, psychophysics, functional neuroimaging, peripheral biopsy, and facial affect coding. The relation between pain and self-injurious behavior in ASD will be considered, and a summary discussion will synthesize the work presented with animal model and pharmacological perspectives. The goal of this panel is to provide an overview of available evidence for a severely under-studied aspect of sensory atypicality in ASD, and to encourage collaborative efforts integrating several of these approaches within the same population to clarify the emerging story of differences in pain perception in ASD. Given the potential for communication deficits to mask altered pain perception in verbal or nonverbal measures, creative approaches to understanding pain perception and processing are highly important for improving quality of life for individuals with ASD.

10:30 **140.001** An Overview of Pain in Autism: Investigating Differences in Sensation, Feeling and Behaviours

***D. J. Moore**, Natural Sciences and Psychology, Liverpool John Moores University, Liverpool, United Kingdom*

Background: In contrast to the well-known and extensively studied social communication challenges that characterize ASD, sensory atypicalities, which are also included in the core diagnostic criteria, are not well understood. In DSM-V criteria insensitivity to pain is cited as an example of these sensory atypicalities, however there is limited research evidence or consideration of what aspects of pain perception are measurable in this population.
Objectives: In a systematic review, a comprehensive search was utilized to identify research articles addressing the topic of pain in ASD.
Methods: Studies were identified using a range of relevant search terms including '(pain OR noxious OR nociception OR nociceptive OR C-fibers) & (Autism OR Asperger syndrome OR ASD OR Autistic)', in addition, hand searches from relevant journals, screening the reference sections of articles considered, and consultation from other experts in the field. Articles were eligible for inclusion if they included a well-defined sample of individuals with ASD, were written in English, and included a quantifiable measure of pain response or perception. Included articles used a variety of methods to assess pain sensitivity, including self-report, observations of behavioural changes in response to pain, and response to experimental pain models.
Results: The findings of the review show that both self/parent report and clinical observations appeared to report hyposensitivity to pain, whereas observations of medical procedures and experimental manipulation suggested normal or hypersensitive responses to pain.
Conclusions: The current state of the research leaves a large number of questions unanswered and fails to consider the reasons for or implications of altered pain perception in ASD. This introductory talk and the symposium at large will begin to address these core concerns. Further, in consideration of these limitations, we will also report preliminary data from our lab, which systematically considers response to a range of experimental pain models and motivational aspects of pain in individuals with ASD.

10:55 **140.002** Decreased Thermal Sensitivity in Adolescents with Autism Spectrum Disorder

***E. G. Duerden**[1], M. J. Taylor[2], M. Lee[3], P. A. McGrath[4], K. D. Davis[5] and W. Roberts[6], (1)The Hospital for Sick Children, Toronto, ON, Canada, (2)Diagnostic Imaging, The Hospital for Sick Children, Toronto, ON, Canada, (3)Hospital for Sick Children, Toronto, ON, Canada, (4)Pain Innovations Inc., London, ON, Canada, (5)Toronto Western Research Institute, University Health Network, Toronto, ON, Canada, (6)University of Toronto, toronto, ON, Canada*

Background: Autism spectrum disorder (ASD) is characterised by a range of behavioural, communication and social difficulties, as well as sensory abnormalities. While much research and clinical attention has focused on communication and socialization deficits, relatively less research has focused on sensory abnormalities, particularly altered pain reactivity, which may contribute to children's withdrawal behaviours and corresponding psychosocial difficulties.
Objectives: To assess sensitivity to thermal (cool, warm, heat pain, cold pain) stimuli in adolescents with ASD.
Methods: 20 adolescents with ASD (15 boys, mean age=14.6, SD=1.9, IQ > 70) and 55 typically-developing adolescents (27 boys, mean age=15.7, SD=1.1) were recruited for the study. Warm and cool detection thresholds (WDT and CDT) and heat and cold pain threshold (HPT and CPT) levels were assessed using a method-of-limits quantitative sensory testing protocol.
Results: Adolescents with ASD demonstrated reduced sensory function for thermal detection ($p<0.001$, both WDT and CDT), but not pain thresholds ($p<0.05$, both HPT and CPT) in comparison to controls, with no evidence for significant age or sex effects ($p>0.05$). Loss of warm and cool detection and heat pain threshold was significantly associated with impaired cognitive ability and autism symptom severity ($p<0.05$).
Conclusions: The association between thermal sensitivity and cognitive impairments and may reflect alterations in central processing of somatosensation, cognition and salience detection in adolescents with ASD. Further research using neuroimaging methods is needed to assess the neural underpinnings of thermal perceptual deficits in adolescents with ASD.

11:20 **140.003** Temporally Distinct Neural Responses to Pain in ASD: Evidence for Altered Cognitive Pain Modulation and Relationships to Self-Injurious Behaviors

***M. D. Failla**[1], E. J. Moana-Filho[2], G. K. Essick[3], G. T. Baranek[4], B. P. Rogers[1] and C. J. Cascio[5], (1)Vanderbilt University, Nashville, TN, (2)School of Dentistry, University of Minnesota, Minneapolis, MN, (3)School of Dentistry, University of North Carolina, Chapel Hill, NC, (4)UNC Chapel Hill, Chapel Hill, NC, (5)Vanderbilt University School of Medicine, Nashville, TN*

Background: There is a prevalent assumption that individuals with autism spectrum disorders (ASD) are less sensitive to pain. Yet, this assertion is not well supported by empirical evidence. Importantly, communication deficits make assessing pain through verbal reports particularly challenging in ASD. Objective markers of pain, such as neural responses obtained with neuroimaging, have been suggested as a means of clarifying the pain experience in vulnerable populations. Previous work has identified a neural pain signature (somatosensory cortices, insula, anterior cingulate) using functional magnetic resonance imaging (fMRI) that differentiates pain from innocuous stimulation.
Objectives: The goal of this study was to determine whether the temporal or spatial properties of the neural pain signature differ in individuals with ASD, and if so, what possible modulators outside the identified neural pain signature contribute to these differences. We also sought to explore whether differences in the signature relate to self-injurious behaviors that are thought to arise from aberrant pain processing in ASD.
Methods: Participants included 16 adults with ASD and 16 adults without ASD in a typical comparison group. Self-injurious behaviors were assessed with the Repetitive Behavior Scale-Revised; participants with ASD were categorized by presence or absence of self-injurious behaviors. Neural response to sustained heat pain was assessed with fMRI using a block design. For each trial, heat was applied to the right lateral calf for 21 seconds (15 seconds at target temperature, 3 second ramp up/down) followed by 39 seconds rest period.
Results: The two groups had similar pain ratings and pain thresholds, in addition to similar neural pain signature responses during acute pain. Yet, there was a highly exaggerated suppression of the neural pain signature in ASD during intermediate and late phases of sustained pain ($Z>2.3$, $p<0.001$, corrected). Direct group contrasts revealed greater response in the typical comparison group compared to ASD in dorsolateral prefrontal cortex and posterior cingulate regions during intermediate and late phases. Additionally, this widespread, late suppression of the neural pain signature in ASD was more prominent in the subgroup of individuals with self-injurious behaviors.
Conclusions: Late suppression of the neural pain signature may indicate aberrant pain processing in ASD associated with self-injurious behavior. Altered activity in areas thought to modulate the pain experience (dorsolateral prefrontal cortex and posterior cingulate) suggests a wider potential selection of coping strategies available to the typical comparison group than the ASD group during sustained pain. The contrast between equivalent pain ratings and striking differences in the neural pain response suggests individuals with ASD may have an altered experience of pain that is not reflected in their subjective pain ratings. Future studies will need examine functional connectivity within the neural pain signature in ASD and in connection with modulating regions in order to understand the mechanism of this altered processing.

11:45 **140.004** Severe Self-Injury in Persons with Autism and Related Neurodevelopmental Disorders: Differences in Sensory, Autonomic, and Immune Markers Suggest Hyperalgesia

***J. W. Bodfish**[1], M. Garrett[2], G. Wendelschafer-Crabb[3], W. Kennedy[3] and F. J. Symons[3], (1)Vanderbilt University School of Medicine, Nashville, TN, (2)Vanderbilt University Medical Center, Nashville, TN, (3)University of Minnesota, Minneapolis, MN*

Background: Self-injurious behavior (SIB) is a costly and treatment resistant form of repetitive behavior seen in the context of neurodevelopmental disorders such as autism. Physiological mechanisms regulating SIB have been understudied. Conventional wisdom surrounding self-injurious behavior is that persons who engage in SIB are

insensitive to pain; however, studies directly examining sensory function and relevant biomarkers are needed.
Objectives: We provide a survey of a series of studies that we have conducted designed to test this pain insensitivity hypothesis of SIB.
Methods: 81 consecutively recruited cases with a clinical diagnosis of ASD were evaluated using research diagnostic criteria for ASD (ADOS, ADIR, & expert clinical opinion), and were then subgrouped based on nonverbal IQ (> 90; < 70) resulting in samples of n = 30 cases with ASD + cognitive impairment (ASD+ID), n = 41 cases with ASD and no cognitive impairment (ASD-only), and 10 excluded cases. Cases were evaluated for the presence and severity of SIB using a mulitmethod phenotypic battery that included a set of SIB measures (RBSR, Clinical Interview for Repetitive Behaviors, YBOCS, observational coding of repetitive behaviors). In a sample of 34 cases with severe SIB (occurred at least daily, persisted at least 12 months, was the focus of active intervention) and 17 non-SIB cases matched on age and IQ, measures from quantitative sensory testing (heat, cold, pin prick, deep pressure), saliva samples (cortisol, alpha amylase), and 3mm epidermal punch biopsies taken from non-SIB sites (ENF density/morphology, neuropeptide content, mast cell degranulation) were analyzed.
Results: SIB occurred in ASD+ID (63%) and ASD-only (24%) subgroups, but severity was significantly greater in the ASD+ID subgroup ($p = .002$), and only occurred frequently during sampled direct observations in the ASD+ID subgroup. Analysis of a separate severe SIB subsample compared to matched ID controls indicated: (1) that cases with chronic SIB were characterized by increased behavioral markers of sensory reactivity during quantitative sensory testing (facial action coding of pain signs - sham trials < sensation trials [$p < .05$] SIB > non SIB [$p < .03$], (2) that sensory reactivity (magnitude of facial action units in response to sensation trials) was correlated with ENF innervation [$r = 0.47$, $P < .001$], (3) that substance P (SP) positive fiber counts tended to be greater in SIB cases, and (4) that peripheral innervation of epidermal nerve fibers in SIB cases was marked by differences in nerve morphology (density, distribution) and increased evidence of altered immune system activity in the form of degranulated mast cells [$p < .01$].
Conclusions: Taken together, our work suggests that at least a subgroup of individuals with chronic repetitive SIB may be in a physiological state similar to neuropathic pain / hyperalgesia associated with alterations in inflammatory, immune, and nociceptive systems. If so, this may provide a set of accessible, objective biomarkers of altered sensory function that may help identify the need for treatment and perhaps also mark the course of treatment response in this vulnerable but under-researched subgroup.

Panel Session
141 - But It Worked so Well in the Lab! Measuring Implementation of Evidence-Based Practices for Children with Autism in Community Settings

10:30 AM - 12:30 PM - Room 310

Panel Chair: Jill Locke, *University of Washington Autism Center, Seattle, WA*

Discussant: David Mandell, *University of Pennsylvania School of Medicine, Philadelphia, PA*

Implementation science comprises the study of methods to understand factors associated with successful integration of evidence-based interventions into community practice. There is evidence suggesting that it takes an average of 17 years for autism evidence-based interventions (EBI) to enter community practice settings. EBIs for children with autism often include complex and resource-intensive strategies that address different clinical outcomes that must fit with the resources and mission of the organizations in which they are implemented, and with the training and abilities of the practitioners using them. Research on use of EBIs in community settings must focus on implementation outcomes. These include the extent to which EBIs are: 1) implemented in the way they were designed (fidelity); 2) integrated within a service system (penetration); and 3) sustained once initial implementation efforts end (sustainment). We will present data from a: 1) randomized school-based implementation trial of a social engagement EBI for children with autism; 2) randomized school-based effectiveness trial of autism behavioral EBIs in public schools; 3) large-scale effectiveness trial of an autism behavioral EBI in publicly-funded mental health agencies; and 4) prospective, observational study of multiple EBIs implemented in a large-scale mental health system reform in which children with autism were served.

10:30 **141.001** A Little Goes a Long Way: A Randomized Controlled Implementation Trial of a Social Engagement Intervention for Children with Autism Spectrum Disorder in Public Schools

J. J. Locke[1], *W. I. Shih*[2], *J. Caramanico*[3], *C. Oh*[3] *and D. S. Mandell*[4], *(1)University of Washington Autism Center, Seattle, WA, (2)UCLA, Monrovia, CA, (3)University of Pennsylvania, Philadelphia, PA, (4)University of Pennsylvania School of Medicine, Philadelphia, PA*

Background: Children with autism have poorer social inclusion than do their classmates throughout elementary school. While several interventions have been developed and tested to address this challenge, few evidence-based social engagement interventions for children with autism are successfully implemented in schools. This disconnect may occur because these interventions are not feasible to implement in many public schools. To address this challenge, we partnered with public school personnel to adapt existing social inclusion interventions to increase their feasibility and acceptability, and to develop a set of implementation strategies that can support school personnel in using the intervention.
Objectives: To examine the implementation, child outcomes and sustainment of an evidence-based social engagement intervention for children with autism in public schools.
Methods: Thirty-one elementary-aged children with autism (87% male; mean age=8.8 (SD=2.0) years; 48% white) and 28 school personnel (86% female, mean age=39.5 years; 61% white) from 12 public schools in five districts participated. A stepped-wedge randomized controlled design was used in which data were taken at baseline, second baseline, exit and follow-up. Schools were randomized to: 1) training in Remaking Recess, a social engagement intervention for children with autism; or 2) training in Remaking Recess plus implementation support. Intervention implementation occurred during recess (30-45 minutes) for 12 sessions over six weeks. Implementation support was provided to school administrators three times over 12 weeks and entailed consultation in implementation strategies. School personnel rated their attitudes about evidence-based practices, acceptability, and implementation climate at exit. Children completed sociometric ratings while blind observers recorded playground peer engagement and implementation fidelity at each time point.
Results: There were no significant differences in attitudes about evidence-based practices, acceptability, or implementation climate between school personnel in either condition. Fidelity of implementation was low in both conditions. On average, school personnel in both conditions improved in some components of Remaking Recess (assessment ($p=.02$), set up ($p=.045$), accuracy ($p<.001$), and understanding ($p<.001$)) but not others (transition, participation and feasibility). There were no significant differences in the rate of improvement between the two groups of school personnel from entry to exit. Multilevel models where time was nested within children and children were nested within schools were used to test differences in social outcomes between schools that were randomized to Remaking Recess or Remaking Recess plus implementation support. There was a significant main effect of time for solitary ($p<.001$) and joint engagement ($p<.001$), where children in both conditions spent significantly less time in solitary engagement and more time in joint engagement after the intervention and at follow-up. There was a significant time by condition interaction ($p=.01$) where children with autism in the Remaking Recess plus implementation support condition had significantly more improvement in social network salience than in the Remaking Recess alone condition after the intervention ($p=.002$) and at follow-up ($p=.05$).
Conclusions: These data suggest that implementing some components of an evidence-based intervention with fidelity may lead to improved child outcomes; however, organizational-level implementation support may be necessary to improve child outcomes in public school settings.

10:55 **141.002** Scaling up Fidelity Measurement of Autism Interventions in Schools

M. Pellecchia[1], *M. Seidman*[1] *and D. S. Mandell*[2], *(1)University of Pennsylvania, Philadelphia, PA, (2)University of Pennsylvania School of Medicine, Philadelphia, PA*

Background: Most evidence-based interventions for children with autism were developed in highly controlled laboratory settings, as were the fidelity measures that accompany them. A growing body of research describes the importance of determining the best ways to scale up evidence-based practices in communities so that they are effective and sustain; less attention has been paid to the challenges and opportunities in measuring intervention fidelity on a large scale. Inexpensive, regular fidelity measurement is an important component of any effort to test intervention effectiveness or to engage in quality improvement and assurance efforts
Objectives: To present scalable strategies to measure common components of behavioral interventions for children with autism; describe direct observation fidelity measures used to assess implementation fidelity on a large scale, and; discuss methods to improve fidelity measurement and barriers to measuring implementation fidelity in real-world settings.
Methods: Direct observation fidelity measures were developed to assess the implementation fidelity to common components of comprehensive behavioral treatment packages for children with autism (discrete trial training, pivotal response training, visual schedules, positive reinforcement, and data collection) within a large community-based randomized trial. Implementation fidelity of each behavioral component was measured by direct observation bimonthly in 73 classrooms for an academic year by trained research assistants. Observers were trained to 90% reliability with a master coder, with continued field-based reliability checks throughout the year. Inter-rater reliability data also was collected at least 3 times throughout the year for each observer as an additional validity check.
Results: Data collection and analyses are ongoing. Research assistants achieved and maintained reliability estimates of at least 90%, following a brief half-day training and practice with coding videos. Qualitative comparisons with more intensive fidelity measures indicate that reliability was achieved faster using these measures. Field-based direct observation fidelity measurement for each component was conducted quickly, using a brief 10-minute sample of the targeted intervention, with high rates of validity.
Conclusions: Preliminary data indicate that implementation fidelity for complex behavioral interventions can be measured accurately in natural settings using inexpensive and brief measures, and that it is relatively easy to train novice staff on these data collection procedures. Accurate field-based fidelity measurement is a critical step for measuring the effectiveness and sustainability of evidence-based interventions delivered within community-based settings. The procedures described offer a model for accurately measuring intervention fidelity in large scale that can be replicated for use in other large-scale community-based implementation trials.

11:20 **141.003** Training Mental Health Providers to Deliver Evidence Based Interventions for Autism Spectrum Disorders (ASD): Training Predictors and Outcomes

C. Chlebowski *and L. Brookman-Frazee, Autism Discovery Institute at Rady Children's Hospital – San Diego, San Diego, CA*

Background: Publicly-funded mental health (MH) services play an important role in caring for school-age children with ASD. Previous research indicates that therapists providing routine MH service have limited ASD training and do not deliver strategies consistent with evidence-based (EB) interventions. To address this gap, the AIM HI ("An Individualized Mental Health Intervention for ASD") clinical intervention and corresponding therapist-training model were developed. AIM HI is a package of EB behavioral strategies targeting challenging behaviors in children with ASD designed specifically for the mental health services context for delivery by providers who do not specialize in ASD. The training model consists of an introductory workshop, 6 months of structured consultation with an expert trainer with performance feedback. It is currently being tested in a large-scale effectiveness/implementation trial in publicly funded community and school-based MH programs in two large counties in Southern California. Examining the process and outcomes of training community providers is a key aim of this large-scale study. Understanding factors associated with successful training is essential to inform community implementation efforts.
Objectives: This presentation will report preliminary data on therapist training outcomes and factors associated with these outcomes from community providers participating in the AIM HI training condition of the ongoing community effectiveness/implementation study.
Methods: Participants include the first 122 therapists enrolled in the training condition of the AIM HI trial. Multiple methods, measures and informants were used to assess training outcomes: *Training Completion* measures included consultation attendance and whether the therapist met eligibility for AIM HI certification. *Protocol Adherence* was measured by a Trainer-Rated Treatment Planning rating. *Session Fidelity* was measured by Observed In-Session Fidelity (rated by observers blind to the training condition). The Evidence-Based Practice Attitudes Scale (EBPAS) was used to measure therapist attitudes towards EB practices.
Results: *Training Completion* was high with 100% of therapists attending the introductory workshop. Therapists attended an average of 9.55 of the 11 consultations (*SD* = 2.98; Range: 0-11). Seventy-four percent of enrolled therapists received AIM HI certification after the 6 month training period. *Protocol Adherence* was high with the average Treatment Planning Fidelity score of 25.99 (*SD*=4.77; Range: 0-29). Sixty percent of therapists with complete observational coding data had *Session Fidelity* scores (averaged across the training period) in the acceptable range. Therapist baseline attitudes towards EBPs were associated with consultation attendance, Treatment Planning Fidelity, and Session Fidelity scores. The impact of previous training in different types of manualized intervention strategies on AIM HI training outcomes will be reported.
Conclusions: Preliminary data indicate that training MH providers to implement an ASD intervention is feasible; however, provider attitudes and previous experiences with EB approaches impact training success. These findings are especially relevant for an ASD population due to their complex and heterogeneous needs and the limited ASD experience of community MH providers. Future work is needed to refine training and implementation interventions to further increase the impact of implementing EB interventions in community settings.

11:45 **141.004** Service Use Patterns of Youth with Autism Spectrum Disorder within a Large-Scale Implementation of Evidence-Based Practices Fiscally Mandated in Children's Mental Health Services

N. Stadnick[1,2]*, A. Lau*[3] *and L. Brookman-Frazee*[2,4]*, (1)Psychiatry, University of California, San Diego, San Diego, CA, (2)Child and Adolescent Services Research Center, San Diego, CA, (3)Psychology, University of California, Los Angeles, Los Angeles, CA, (4)Autism Discovery Institute at Rady Children's Hospital – San Diego, San Diego, CA*

Background: Children with autism spectrum disorder (ASD) receive care in multiple public service systems (Brookman-Frazee et al., 2009). The mental health (MH) service system plays an important role in caring for children with ASD (Mandell et al., 2005) given that the estimated rates of psychiatric comorbidity for youth with ASD are greater than 70% (Leyfer et al., 2006; Simonoff et al., 2008). There are a growing number of large-scale, system-driven implementations of evidence-based practices (EBPs) in publicly-funded MH systems for children but little is known about the specific types of services and intervention practices delivered to youth with ASD receiving MH care within these implementation efforts.
Objectives: To address this gap, this study examined MH service penetration and sustainment patterns of children and transition-aged youth with ASD receiving care in the largest public MH system in the United States within the context of a fiscally-mandated implementation effort of multiple EBPs.
Methods: In 2009, the Los Angeles County Department of MH (LACDMH) launched the Prevention and Early Intervention Transformation. Within this system reform, multiple EBPs were mandated through reimbursement reorganization, with initial implementation support (e.g., costs for therapist training) provided for six practices (Child Parent Psychotherapy [CPP], Cognitive Behavioral Intervention for Trauma in Schools [CBITS], Managing and Adapting Practice [MAP], Seeking Safety [SS], Trauma Focused Cognitive Behavioral Therapy [TFCBT], and Triple P) that address a range of child MH problems. Administrative claims data from LACDMH for these six practices from fiscal years 2009/2010 – 2014/2015 were extracted. Data from over three million claims for 87,100 clients from 94 agencies were used to characterize service utilization patterns for a subset of youth with ASD receiving specific practices.
Results: Preliminary analyses indicate that the total number of MH claims billed for youth with a primary ASD diagnosis was 12,690 from initial implementation to the current time of early sustainment. These claims represent 680 unique providers who delivered services to 499 unique children (76% male; *M* = 8.25 years, *SD* = 4.38). The majority of claims (75%) were for psychotherapy, followed by evaluation and assessment (13%), medication management (6%), and case management (6%). At the child-level, 40% of total claims were for Triple P followed by MAP (31%), CPP (11%), TFCBT (11%), SS (6%), and CBITS (<1%). Children with ASD in this sample were ethnically and culturally diverse (65% reported as Latino and 34% whose primary language was Spanish). A matched case-control design will be used to compare penetration and sustainment patterns between youth with ASD and those with non-ASD diagnoses to inform potentially unique implementation considerations for children with ASD. Children will be matched on sociodemographic and service context (e.g., provider type, setting type) characteristics.
Conclusions: This study is one of the first to use administrative claims data to characterize penetration and sustainment patterns of MH services for youth with ASD served within a large-scale system driven EBP implementation. Study findings provide direction on targeted implementation efforts to evaluate MH services delivered to children with ASD within a public MH system care reform.

Poster Session
142 - Innovative Technology Demonstrations
10:00 AM - 1:30 PM - Hall A

225 **142.225** Using Tablet-Based Gameplay for the Identification of Autism-Related Movement Patterns

A. Anzulewicz[1]*, D. Czajak*[2]*, J. T. Delafield-Butt*[3]*, P. Jarmolkowicz*[2]*, M. Mnich*[2]*, A. W. Paciorek*[4]*, K. Sobota*[2] *and D. A. Zaremba*[2,3,5]*, (1)Psychology, Jagiellonian University, Krakow, Poland, (2)Harimata, Krakow, Poland, (3)University of Strathclyde, Glasgow, United Kingdom, (4)Institute of Modern Languages, Pedagogical University of Krakow, Krakow, Poland, (5)Jagiellonian University, Krakow, Poland*

Background:
We would like to demonstrate a solution which automatically assesses the risk that a child might have ASD, by analyzing movements using smart gameplay. Disruption of normal movement patterns is a cardinal feature of ASD, however, it has recently been proposed that abnormalities in the development of intentional movements, including prospective planning and execution of movements, can be considered as one of the early markers of ASD. Crucially, such deficiencies can be observed before manifestations of syndromes typically associated with autism, *i.e.,* deficiencies in social interaction or reading emotions (Trevarthen and Delafield-Butt, 2013). Modern technology provides unprecedented access to motor information about the user. Inertial motion sensors coupled with gyroscopes and magnetometers have been miniaturised and integrated into consumer microelectronics such as smart phones, tablets, and wearable devices, opening new possibilities for their application in autism research and diagnosis.
Objectives:
To assess whether children with ASD can be distinguished from typically developing ones, and those with other developmental disorders on the basis of movement analysis conducted during a smart device gameplay
Methods:
Participants: 46 children with ASD, 20 with other developmental disorders (*i.e.*,. Down Syndrome, intellectual impairment, aphasia) and 369 typically developing children. The sample size of the control group was significantly larger than the experimental group to reflect the population structure, thus allowing precise calibration of the computer learning algorithms used for the data analysis.
Two mobile game-like applications for children aged 2-5 were used. In the first, a child's goal was to share a piece of food and distribute it evenly among four children depicted on the screen. In the second game, a child's task was to outline a shape (*e.g.* a squirrel or a snail) and fill it with colour. The materials were designed in collaboration with developmental psychologists. There was a 2-minute training and a 5-minute test session for each application. During the gameplay, touch data and data from tablet's sensors (gyroscope and accelerometer) were collected.
Results:
Data were analyzed by means of computer learning algorithms. 10-fold cross validation technique was used to ensure the models would not be prone to overfitting. Movement patterns of children with ASD and typically developing children were investigated by means of Random Greedy Forest (RGF) algorithm. Area under the receiver operating characteristic curve (AUC) was selected to be the metric, as it does not require a fixed classification threshold. The results demonstrated that AUC was relatively

high in case of both applications. The algorithms performed with 72% sensitivity and 88% specificity for differentiation of ASD from typically developing children. To assess whether the models successfully differentiate children with ASD from those with other developmental disorders simple models, namely, SVM and logistic regression were used because the latter group was relatively small (N=20). The models achieved 65% specificity and 79% sensitivity, suggesting that it is possible to differentiate ASD from other disorders.
Conclusions:
We provide evidence that ASD has a prominent motor component that can be identified by smart device gameplay, which should be taken into account in early assessment.

226 **142.226** The Effects of Video-Modeling on the Oral Hygiene of Children with Autism: A Promising Paradigm

M. Mademtzi[1], *B. Popple*[2], *C. A. Wall*[1], *L. Flink*[3], *J. Dikansky*[4], *D. Do*[4] *and F. Shic*[1], *(1)Yale Child Study Center, Yale University School of Medicine, New Haven, CT, (2)White Oak Pediatric Dentistry, Newnan, GA, (3)Sidney Kimmel Medical College, Thomas Jefferson University, Philadelphia, PA, (4)Yale New Haven Hospital, New Haven, CT*

Background: Oral health is important for a person's general health as well as psychological wellbeing. However, individuals with autism often face difficulties with their self-care skills and therefore there is a need for improved dental hygiene routines for these individuals (Pilebro & Backman, 2005). One promising method to achieve this is through the use of video-modeling. Video-modeling is an evidence-based intervention that has various areas of application including self-care skills (e.g. Charlop-Christy, Le & Freedman, 2000; McLay, Carnett, van der Meer & Lang, 2015).

Objectives: The objective of this study was to investigate whether video-modeling can be an effective method for children with autism to learn how to brush their teeth.

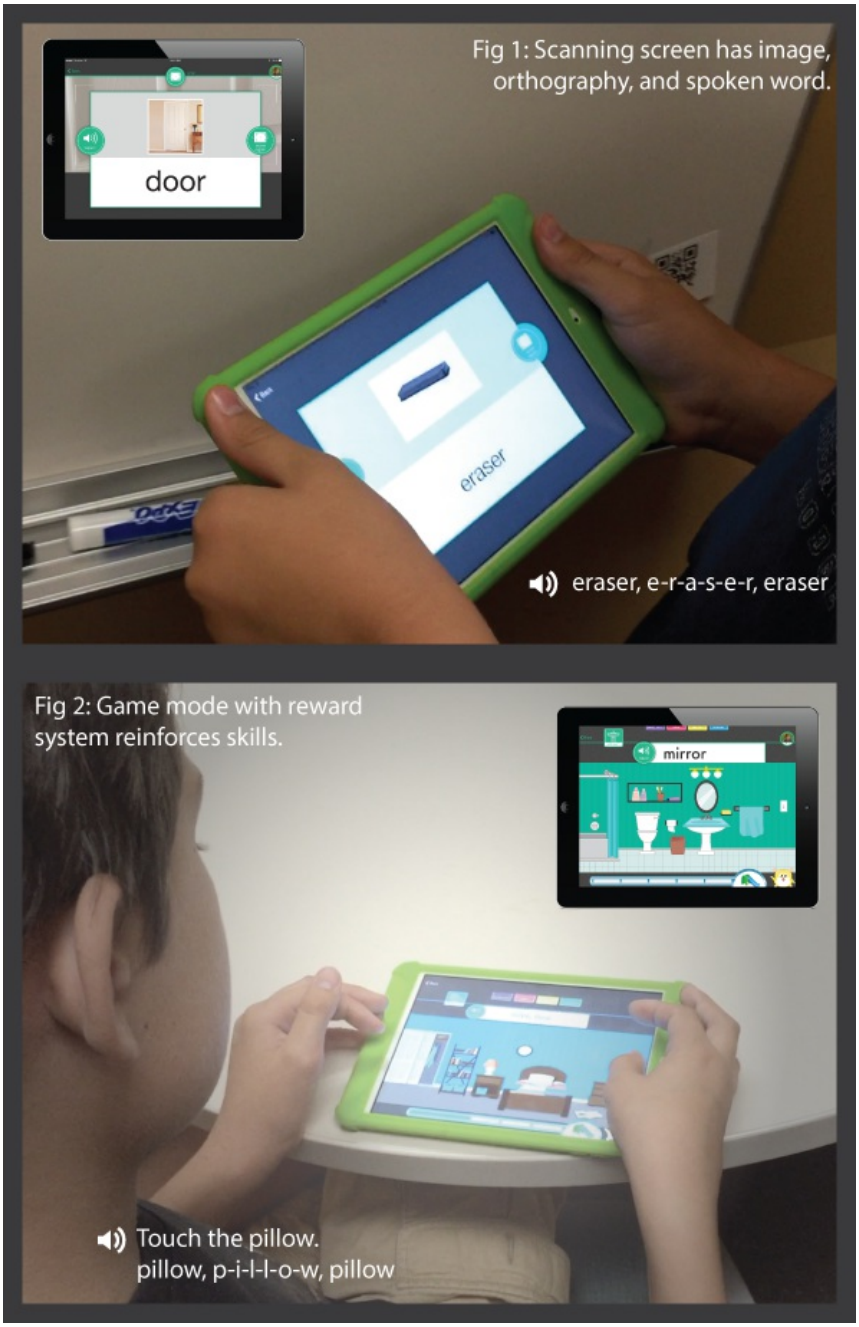
Methods: A pilot study was conducted with eight children diagnosed with autism recruited from a pediatric dental clinic (Mage= 8.75 years). Assessments included clinical examinations and survey data completed by the children's caregivers. Additionally, the Social Responsiveness Scale-2, Parent Report (SRS-2; Constantino & Gruber, 2002) was also completed. Participants were randomly assigned to either the experimental (N=4; 3 boys and 1 girl) or control (N=4; 2 boys and 2 girls) group. Parents received a link twice a day for three weeks prompting them to watch a video with their child before tooth brushing. The experimental group watched a video of a girl brushing her teeth with spoken instructions and the control group watched a video with moving fractal shapes and with symbolic background music (demo).
Results: Before the intervention both groups had visible plaque and did not differ in dental hygiene as measured by plaque index results (Cohen's d= 0.14). After the intervention the experimental group showed greater improvements in the same measures compared to the control group (Cohen's d= 1.17). The survey data completed by the children's parents revealed a significant increase of oral hygiene for the control group (Cohen's d= 2) but no differences for the experimental group (Cohen's d= 0). Also, low correlation was found between autism severity and SRS-2 scores with plaque index results (r=0.22 and r=0.11 respectively).

Conclusions: Although this study was conducted with a small number of participants, it holds a great potential for future applications on children's with autism oral hygiene. Future directions should include larger sample sizes, greater selection of videos (e.g. different languages, gender of the children actors) and also participants with various cognitive skills levels. The current study involved higher functioning children with autism that they might not deal with the same self-care skills difficulties as lower functioning ones. Results from the current study will help us inform the next steps of the video-modeling for oral hygiene. Our aim is to make the videos applicable to a larger number of participants, with different cognitive and cultural backgrounds and also make them more easily accessible by caregivers, practitioners and individuals with autism themselves. A prototype of this new system will be presented.

227 **142.227** Development of a Mobile Application for Early Literacy and Language Intervention in Children with Autism Spectrum Disorder

N. J. Rasche[1] *and O. Wendt*[2], *(1)Computer Graphics Technology, Purdue University, West Lafayette, IN, (2)Speech, Language, and Hearing Sciences, Purdue University, West Lafayette, IN*

Background: Children with autism spectrum disorders (ASD) exhibit deficits in both expressive and receptive language development. Substantial delays in literacy skills, specifically comprehension abilities, are influenced by these deficits. These children struggle with reading for meaning and lack the ability to comprehend text (Randi, 2010). Identification of letters and recognition of sight words are inconsistent. An intervention strategy to improve comprehension must put "an emphasis on their ability to understand language as well as working on their expressive language and communication skills" (Weismer, 2010). One possible intervention approach is multi-skill language instruction using a visual representation of an object with the orthography while teaching expressive communication. In order to assess this type of intervention and test its validity as a tool to improve early language and literacy, a mobile application was developed.
Objectives: The objective was to design a mobile application that will target the delay in literacy skills, specifically comprehension, by teaching expressive and receptive language together. The goals for the application are listed below.
1) Use the early literacy skill of labeling to teach receptive and expressive language skills while monitoring any improvement in learning the meaning of new words. A prototype was piloted in a university speech and language clinic with a 13-year-old participant with severe-moderate autism and minimal speech.
2) Utilize the mobile application to provide opportunities for repetition of learned skills and the customizable settings to accommodate user needs. During formative evaluations, we evaluated the usability of the game modes and tested the customization of the user defined settings.
Methods: An innovative mobile application, Literacy LABELS©, was created on the iOS platform that utilizes QR code technology. The application scans the QR codes on the printed labels that are placed on actual physical objects (Fig 1). New labels can be created within the application to customize the intervention for the participant's needs. The application has games that provide repetition of skills learned during the scanning of the physical labels (Fig 2). A more elaborated single case, A-B design study is underway replicated across three children who have severe-moderate autism to measure the identification of previously unknown words before and after intervention. Maintenance data will be collected on the retention of word identification skills. As an ancillary measure, we will document oral ability to attempt spelling and/or speaking newly learned words. This will produce empirical evidence documenting the benefits of intervention with Literacy LABELS©.
Results: Preliminary results from the formative evaluation suggest that the application has positive effects on receptive and expressive language development. Initial feedback from parents and clinicians has been favorable praising the ease of customization to learner needs and the engaging and motivating nature of the game-play mode. Further development of this technology will make an early literacy curriculum more accessible to students impacted by ASD and resulting language delays.
Conclusions: N/A

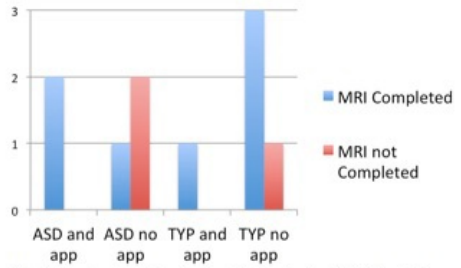


228 **142.228** Using an Ipad Application to Prepare Children with ASD for Research MRI

N. L. Johnson[1], *N. Salowitz*[2], *M. Van Abel*[3], *A. V. Van Hecke*[3], *S. I. Ahamed*[3] *and R. A. Scheidt*[4], *(1)College of Nursing, Marquette University, New Berlin, WI, (2)Marquette University, Franklin, WI, (3)Marquette University, Milwaukee, WI, (4)Marquette Univeristy, Milwaukee, WI*

Background:
Undergoing an MRI for a research study can be stressful for children with ASD and their parents. Many children have trouble staying still in the scanner due to the overwhelming sensory experience, including noise. There is limited research on technology to prepare children for the new experience of research study MRIs in order to decrease their stress and gain their compliance. Our past research found that ill children with ASD and their parent had less anxiety (than the control group that received typical care) and challenging behaviors and better compliance with diagnostic imaging when they were prepared with an iPad application (app) that foreshadowed the imaging process and appropriate behavior.
Objectives:
(1) To assess the experience of undergoing research study MRI for a child with ASD or a typically developing child (TYP) and an accompanying parent.
(2) To evaluate the feasibility, efficacy and acceptability of the 'Going to MRI for a Research Study' iPad app consisting of research task, mock scanner and MRI photographs and audio recording.
Methods:
We recruited 10 English-speaking parent/child dyads [(n=5 male children with ASD) (aged 14.8 ± 1.2 years)] and n=5 TYP [(4 male, 1 female) (aged 14.2 ± 3.2 years)] who were offered the option of using the app before the MRI in an interdisciplinary study on neural correlates of goal directed movement. Diagnosis of ASD or TYP was confirmed by the Autism Spectrum Screening Scale, and the Autism Diagnostic Observation Schedule, along with normal or corrected normal vision, and Intelligence Quotient > 70. Frequencies were calculated for app use and MRI completion rates and demographics were collected to describe the sample. Qualitative data were collected by individual, one-time, question guide facilitated, audiotaped telephone interviews. Audiotapes were transcribed into a Word document. Two researchers discerned themes via an iterative process, guided by the Family Self Management Theory, for participant experience with the research MRI, and the feasibility, efficacy and acceptability of the app for those that chose to use it.
Results:
Seven of the 10 children (70%) completed the MRI (n=2 ASD with app; n=1 no app but prior MRI experience; n=1 TYP with app; n=3 TYP no app). Three children (30%) did not complete the MRI (n=2 ASD no app; n=1 TYP claustrophobic) (see Figure). All parent/child dyads (N=10 parents and 10 children) were white, and the majority of parents were college educated with a Bachelor's degree or higher (n=8, 80%). Two themes emerged from the transcripts: (1) Desire to help others with autism (2) ASD child/parent without app had trouble with expectations for MRI. Participants described the iPad app's feasibility, efficacy, and acceptability (see Table).
Conclusions:
The results demonstrate the effectiveness of the app for preparing ASD children and their parent for completion of research study MRI. Use of the app could strengthen the protective factors that positively impact the child experience with MRI and family experience during research MRI. Results of the study will guide the development of interdisciplinary intervention studies of ASD parents and children undergoing MRI.

Figure. *Frequency of MRI Completion by Diagnosis and App Use*



ASD= Autism Spectrum Disorder, App= iPad application, MRI=Magnetic Resonance Imaging, TYP = Typically developing

Table. *Evaluation of iPad*

	ASD	TYP
Feasibility Ease of use?	Parent 6- *"very straight forward"*	Parent 7-*"I thought it was very good that she was able to comprehend it and do very well."*
Efficacy Helpful? Challenges?	Child 3- *"pictures helpful....it (MRI) was pretty long, but it wasn't all that bad"*	Parent 7-*" The actual test (research task with joystick) was more challenging as it got harder, but other than that, actually it went well."*
Acceptability What went well?	Parent 6- *"I thought it was great because she is very such a visual learner."*	Child 7- *"I signed up for everything because I was interested in trying new things."*

229 **142.229** Evaluating the Usability of a Social Skills Training App for Children with ASD

B. G. Kinsella[1]*, A. Kushki*[2] *and S. Chow*[1]*, (1)Autism Research Centre, Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada, (2)Bloorview Research Institute, Toronto, ON, Canada*

Background:
Deficits in social communication are defining features of autism spectrum disorder (ASD). These deficits negatively have been associated with long-term negative outcomes such as unemployment and under-employment, low rates of independent living, and increased risk of psychiatric disorders. While prognosis can be significantly improved with intervention, few evidence-based interventions exist for social skill deficits in ASD. Existing interventions are resource-intensive, their outcomes vary widely for different individuals, and they often do not generalize to new contexts.
Technology-aided intervention is a motivating, low-cost, and versatile approach for social skills training in ASD. It can provide a safe and controlled venue for rehearsal of skills in a self-paced and personalized manner, allow for treatments to be implemented with high precision and fidelity, and reduce the cost, resource, and other accessibility barriers to existing treatments. Although early studies support the feasibility and potential effectiveness of technology-aided intervention for social skills training in ASD, existing approaches have been criticized for teaching skills based on human-computer interaction. This can paradoxically lead to further social isolation and hinder skill generalizability.
Objectives:
A Google Glass-based application ("app") was developed to help guide children with ASD through social interaction. The Glass is a head-mounted wearable technology that uses a microphone to listen to its environment and an optical heads-up display (HUD) to prompt and interact with the user. The app coaches a child through human-to-human interaction by listening to the conversation and providing appropriate responses as prompts on the HUD. Before testing clinical efficacy, the objective of this study was to determine the technology's viability as an appropriate medium.
Methods:
10 children (mean age=13.2 σ=1.5, verbal IQ=104.4 σ=20.9, Social Communication Questionnaire score=19 σ=3.5) with ASD were recruited to be participants. During each session, the participant used the app while engaging in a structured restaurant-themed interaction with a research assistant. The app was evaluated on its effectiveness (i.e. how accurately the app responds), efficiency (i.e. how quickly the user and the app), and user satisfaction (based on a post-session questionnaire that includes a 5-point Likert scale).
Results:
The application's detection accuracy (i.e. how often it detected a participants' utterances) was 97%, and recognition accuracy (i.e. how accurately it recognized the participants' phrases) was 89%. The users' average response time after being prompted was 2.5 seconds, and the system's average response time to recognize the user's speech was -0.25 seconds. User feedback on perceived experience of system use was collected and compiled. Notable responses include the participants believe the app can help them in daily life (4.0/5), the app was fun to use (4.4/5), and the app can help children communicate to people (4.0/5).
Conclusions:
To the best of our knowledge, this system is the first technology-based intervention for ASD that employs human-to-human coaching in naturalistic settings, and the results show that the device is an appropriate medium for treatment delivery. Future directions will include improvements to the prototype by incorporating relevant usability feedback, and a study to evaluate the clinical effectiveness of the app as a social skills intervention.

230 **142.230** An Investigation into the Effectiveness of an Arabic AAC Solution for Minimally Verbal Children with Autism

M. Habash[1]*, F. Alnemary*[2] *and F. Alnemary*[2]*, (1)A Global Voice for Autism, Ottawa, ON, Canada, (2)UCLA, Los Angeles, CA*

Background: Despite receiving interventions, about 20-30% of children with autism spectrum disorder (ASD) might be unable to use spoken language as they are classified as minimally verbal[1]. Thus, reliance on other means of communication becomes the alternative option. Several studies reported the successful use of augmentative and alternative communication (AAC) methods for children with ASD. As such, AAC solutions have become very common over the past few years, particularly with the availability of many devices and application for the English-speaking people; however, there have not been any equivalent AAC solutions for their Arabic-speaking counterparts. This is primarily due to the lack of institutional or corporate development interest and the complexity of the Arabic language when it comes to using text-to-speech engines and to the many dialects used in different countries. The "***Kalami***" pilot project developed as an icon-based AAC solution with multiple dialect and natural language.
Objectives: The purpose of this paper is to investigate the effectiveness of "Kalami" on facilitating communication, helping on developing language, and supporting positive behaviour of children with Autism in Arabic speaking families in the Middle East countries.
Methods: Ten children with minimally or non-verbal children with autism are participating in this investigation. Quantitative data collected through the application itself. Qualitative data is collected from families using weekly reporting schedule and parent survey.
Results: This is an ongoing investigation, which is expected to be complete in March 2016. Results will be published upon completion
Conclusions: The results from this study are expected to highlight the potential benefits and the challenges and barriers to bringing an Arabic AAC solution to families and their children

231 **142.231** An Investigation into an Internet of Things (IoT) Framework for Improving the Quality of Life of People with Autism in Low Income Countries

M. Habash*, A Global Voice for Autism, Ottawa, ON, Canada*

Background: With the immense developments of smart technologies and improvement in digital communication methods, the “Internet of Thing” has become a new standard for the design and development of connected devices and smart environments. There has been progress in utilizing the IoT framework for assistive technologies in different fields such as inclusion and independent living for seniors. Such smart environment (and associated devices) could have great potential for delivering and serving as means of assistive technologies for people with autism and their families as well. Furthermore, the low costs for such technologies could make them available for regions with low income, potentially helping improving the lives of people with autism and their families in underserviced and economically challenged regions of the world.
Objectives: The purpose of this paper is to investigate the potential of an Internet of Things (IoT) framework in delivering services and improving the quality of lives of people with autism and their families in low-income countries. In particular, this work aims to define the areas in which such framework can help, the services that can be delivered, the associated costs, and the possible challenges.
Methods: A framework is developed based on existing literature, available technologies, and needs assessments of people with autism and their families. Detailed design and associated components are discussed through panels of experts and volunteer families in multiple countries. Qualitative data is collected and presented based on discussions, surveys, and feedback.
Results: This is an ongoing investigation. The framework and associated approaches, devices, and outcomes of the assessment are expected to be complete in February 2016.
Conclusions: The results from this study are expected to highlight the potential benefits of the Internet of Things Framework for serving as means of delivering services and improving the quality of life of people with autism and their families

232 **142.232** App for Autism: Identifying Trends in the App Market

L. Hart[1], *S. Valencia*[2], *M. Mademtzi*[3] *and F. Shic*[1], *(1)Yale Child Study Center, Yale University School of Medicine, New Haven, CT, (2)Yale University School of Medicine, New Haven, CT, (3)University of Birmingham, Bimringham, United Kingdom*

Background: Apps for autism” are not only a fraction of the price of the devices that predated them (e.g. DyanaVox $10,000 plus), but are also non-stigmatizing and multi-functional (Parette & Scherer, 2004). However, llittle to no effort has been made to characterize the current state of this market of “apps for autism.” This represents a pressing issue as parents of children with autism and practitioners in the field can quickly become overwhelmed by the thousands of “apps for autism” and thousands more apps that could be useful but are not explicitly labeled for autism.
Objectives: To characterize the current state of apps for autism and explore current trends within this market by 1) creating an up-to-date database of apps for autism following Goodwin et al.’s classification scheme for interactive technologies for autism, with 2) Priori Data’s download, revenue, and app user ratings metrics for 55 countries, that will 3) be capable of automatically retrieving this information from Priori Data’s websites and compiling it within excel.
Methods: Apps are from two sources: databases listing apps for autism, and ongoing autism specific key-word search within Priori Data based on the “Domain” dimension of Goodwin et al.’s classification scheme (i.e., the technology’s focus area relevant to autism). Key words and terms included in the search were chosen that would expand the positive results returned of each of the label 6 labels comprising this dimension (e.g. social/emotional skills, language/communication, life/vocational skills, etc.). The current sample is comprised of 620(something) apps fitting the study’s inclusions/exclusion criteria. Priori Data’s app metrics for the past 13 months were then used to run the following analyses: 1) Global downloads – to 1.1) identify top 20 downloaded apps, 1.2) rank the 6 Domains areas according to their global downloads; 2) User Ratings, to 2.1) rank domains average user rating, 2.2) compare these average user rating of each domain to the all time average user rating for Priori Data’s primary app category; 3) App revenue, to identify 3.1) the top 20 individual apps with the highest revenue, 3.2) the rank the domains by mean total revenue, and 3.3) use app install revenue divided by app download revenue to determine the 50 apps with the highest unit price/the domain with the highest unit price.
Results: the data collected provides a picture of the most downloaded apps around the world, their revenues, the best rated apps and the number of user ratings. academic skills, language and communication and life and vocational skills are the most popular domains with biggest amount of downloads. The most user rated domains (user rated number> 100 ratings) are again Life/Vocational Skills and Academic Skills respectively.
Conclusions: Two distinct indicators of app success emerged within total downloads and revenue as metrics of success, one characterized by highly specific apps (e.g. AAC apps) with a high initial install cost but relatively low overall downloads, and another with a less specific focus that might appeal to broader audience (e.g. Life and vocational skills and apps that could be classified as “edutainment”).

233 **142.233** Using Technology to Promote the Implementation of Evidence-Based Practices in the United States and Internationally for Learners with ASD

A. Sam[1], *A. W. Cox*[2], *O. Alhaqbani*[3] *and S. L. Odom*[4], *(1)Frank Porter Graham Child Development Institute, University of North Carolina, Chapel Hill, Carrboro, NC, (2)Frank Porter Graham Institute, University of North Carolina - Chapel Hill, Chapel Hill, NC, (3)Center For Autism Research, Riyadh, Saudi Arabia, (4)University of North Carolina, Chapel Hill, NC*

Background:
There is a national need for preparing teachers and other educational staff to implement evidence-based practices (EBP) with students with ASD. A new report from the National Professional Development Center on Autism Spectrum Disorder (NPDC) details 27 evidence-based practices, supported by research, that are effective for individuals with ASD (Wong et al., 2014). However, selecting and implementing EBP for individuals with ASD poses challenges for practitioners in special education and related fields. The US Department of Education recently funded a new, e-learning resource, AFIRM (http://afirm.fpg.unc.edu/), for 2 years. AFIRM is developing online, self-paced learning modules on these 27 practices for teachers of students with ASD. To assess the effectiveness of AFIRM, users complete surveys on the usefulness, relevance, and quality of the online modules.
Objectives:

1. Describe the demographics of the users who access the AFIRM modules (nationality, profession).
2. Examine the usability, relevance, and quality of AFIRM modules through collected survey data.
3. Compare survey ratings of international users and users from the United States.

Methods:
Users complete a survey with Likert-type questions on a four point scale with 4 being the highest possible rating. The survey addresses the usability, relevance, and quality of the AFIRM modules. Descriptive statistics and analyses will be used to examine similarities and differences in the ratings among international users and users from the United States.
Results:
Collection of data is ongoing as the number of modules expands and more users complete modules. Currently, the AFIRM website has over 2,600 users of the current 7 modules, representing more than 40 countries world-wide. The **quality** of the current modules were rated highly ranging from a mean of 3.33 for the Reinforcement module (n=96) to 3.70 for the Social Narrative module (n=13). Users rated the AFIRM modules as **relevant** to the work they do ranging from a mean of 3.35 for Time Delay (n=34) to 3.62 for Visual Supports (n=206). Users found the modules **useful** ranging from a mean of 3.32 for Time Delay (n=34) to 3.54 for Social Narratives (n=12). As development continues, an additional 10 modules are scheduled for release before March 2016. Data collected through March 2016 will be used to describe findings.
Conclusions:
Initial findings indicate that teachers, practitioners, and professionals (in more than 40 countries) who complete the AFIRM modules find them relevant to their work, useful, and the quality of the modules high. Further analyses will determine differences in how international users and users in the United States rate the usefulness, relevance, and quality of the modules.
Both the AFIRM and NPDC websites are in English. Recently, NPDC entered into a partnership with the Center for Autism Research, King Faisal Specialist Hospital, Riyadh, KSA to translate resources and materials into Arabic *(cfar.kfshrc.edu.sa/HomeEnglish.aspx).* Once the translation is underway, links will be added between the CFAR and AFIRM websites to facilitate access to the materials by Arabic speaking communities.

234 **142.234** User-Centered Design for Research Data Management Software: Evaluating and Improving Designs By Testing with Users (Early and Often)

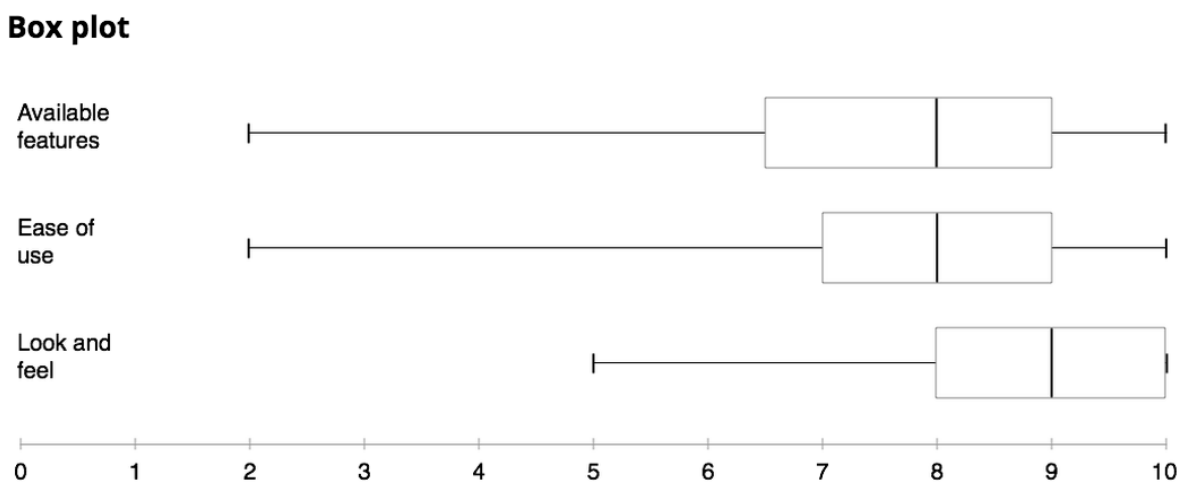
H. Agnew[1], *J. A. Salim*[2], *T. Schantz*[1] *and L. Rozenblit*[1], *(1)Prometheus Research, LLC, New Haven, CT, (2)Marcus Autism Center, Atlanta, GA*

Background: The Marcus Autism Center uses RexDB, an open-source platform for data management, to collect, organize, and analyze research data. Marcus sought to tailor their RexDB application to support specific needs regarding participant enrollment and visit tracking.
Objectives: The design team identified several constraints: (1) a short development schedule, (2) a modest budget, and (3) an established technology framework. We sought to design a technically feasible user interface that was demonstrably (a) useful (exclusive of unnecessary features, and inclusive of all necessary features), (b) usable (as measured by efficiency, learnability, memorability, error prevalence, and user satisfaction) [Nielsen, J. (2012) Usability 101: Introduction to Usability. http://www.nngroup.com/], and (c) appealing to users.
We aimed to be confident in the design's probability of success by testing prototypes before beginning the more costly and less flexible programming phase.
Methods:
After defining the client's needs, we brainstormed potential screen layouts and interaction patterns. We generated several alternative designs using inexpensive paper drawings, selecting the most promising based on their technical feasibility and similarity to previously validated design patterns. We converted the selected designs into

digital prototypes.
We then conducted user testing [Nielsen, J. (1994) Usability inspection methods. Conference Companion on Human Factors in Computing Systems, p.413-414.], in which eventual users completed realistic tasks with the prototypes. We observed interactions and asked questions to better understand their mindset and expectations (e.g., "What do you think you can do here?"; "What would you do next?"). We noted the frequency and cause of user errors.
At the end of each session, we asked:

1. How useful is this workflow to you?
2. Is there anything missing?
3. Is there anything here that you don't need?
4. How would you rate the application's ease of use?

Following each round, we updated our design and repeated the testing process until we believed the design was strong enough to move to the programming phase.
Results:
After programming and launching the interface, we measured perceptions of the application's usefulness, usability, and appeal ("look and feel"). We asked 52 users to rate the following three aspects on a 0 (worst) to 10 (best) scale (average responses shown):
1. Available features (Does it have the features you need?) 7.5 / 10
2. Ease of use 7.7 / 10
3. Look and feel 8.6 / 10
Conclusions:
By iterating and testing with users, we designed a useful and usable interface. The application was successfully launched and adopted without the need for a costly redesign. The final design was substantially different from the initial version. For example, some screens were removed completely because they were found to be unnecessary. The application's navigation was re-designed from scratch.
Teams designing complex web applications for domain-specific uses, such as autism research data management, may benefit from the user testing approach described here.



The box plot shows the minimum and maximum response (left/right tick marks), the first and third quartiles (left/right edges of the box), and the median (vertical line in the box).

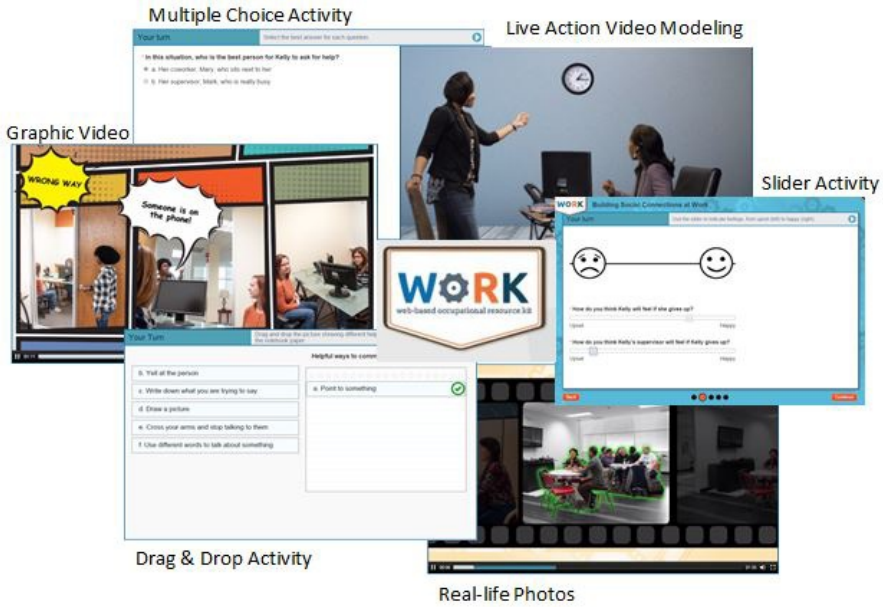
235 **142.235** Stakeholder Perspectives on the Utility of the Web-Based Occupational Resource Kit (W.O.R.K.): An Interactive Curriculum to Support Students with Mild Intellectual Disabilities with and without ASD in the Successful Transitioning to Employment

***K. Adkisson**, D. Childress, K. Melillo, C. Hehman, I. Coleman, T. Phillips and J. Chin, 3C Institute, Durham, NC*

Background: Employment is essential for helping individuals with intellectual disabilities (ID) achieve independence, financial security, self-sufficiency, and to be active members in the community as well as foster a higher quality of life more generally (Test, Aspel, & Everson, 2006). However, only 25% of individuals with ID are employed two years after high school (Wagner et al., 2005). Additionally, 25% of students with ID also have a diagnosis of an Autism Spectrum Disorder (ASD), further impacting employment outcomes (Shea, 2006). While teachers often provide the first exposure to work and help students determine the type of job or employment they would like to pursue after high school, only 31.6% of high school classes focus on preparing students for employment (Guy et al., 2009).
Objectives: To develop and conduct usability and feasibility testing of an internet accessible, interactive employment preparation program, the Web-based Occupational Resource Kit (W.O.R.K.), keyed to the learning and adaptive needs of students with ID with and without ASD who are entering the workforce.
Methods: Following prototype development of the W.O.R.K. program, usability and feasibility testing was conducted. Students with ID and their parents (n=21 dyads, 11 with ASD) reviewed W.O.R.K. at home for two weeks. Educators of these students (n=30) also reviewed the program. Prototype content focused on communication skills with didactic instruction in the form of brief videos and interactive exercises to test understanding and application. Following this open review period, usability and feasibility testing of the program, online delivery platform, and student understanding of issues related to the successful transition to employment was assessed via survey and semi-structured interviews.
Results: All stakeholder groups found the program components to be of high quality and value as well as a highly usable intervention package (5-point Likert scale, 1=Strongly Disagree to 5=Strongly Agree; mean ratings > 4). Parents reported W.O.R.K. to fill a need for students with ID (M=4.57, SD=0.51) and believed the program would be effective in helping students transition to employment (M=4.33, SD=0.86). Educators rated W.O.R.K. of high overall feasibility and indicated W.O.R.K. would be a useful tool for supplementing lesson plans. Students reported the program was easy to use and engaging. Students with just ID (no ASD) enjoyed the content that contained humor and recommended more in future development. Student with ASD and ID provided comments focused more on the details of the video production (i.e., scenes recorded on green screen) and concrete applications of the presented strategies. Students with ASD and ID recommended videos about different work settings that applied more to their interests.
Conclusions: These data provide evidence for the usefulness and need of the W.O.R.K. program for students with ID with and without ASD preparing for employment. Gathered data is being used to create a blueprint of modifications and additions needed to key the intervention to the needs of students with ID with and without ASD (e.g., different blends of instructional elements and methods, customized graphic design, tailored activities). Future steps include fully developing the instructional content, followed by a pilot efficacy study.

Table 1. Student and parent ratings Construct	Students Mean (SD)	Parents Mean (SD)
Will be useful in a high school setting	4.43 (0.65)	4.43 (0.51)
Would be valuable to schools	4.54 (0.66)	4.64 (0.63)
Will help students transition into work	4.42 (0.69)	4.33 (0.86)
Content organized in a way that made sense	4.43 (0.76)	4.57 (0.51)
I (my child) learned something	4.46 (0.78)	4.43 (0.83)
Overall experience was positive	4.26 (0.74)	4.62 (0.50)
Innovative way to learn job skills	4.35 (0.75)	4.43 (0.63)
Would recommend further development	4.14 (0.77)	4.64 (0.50)
Content complements skills learned at school.	N/A	4.57 (0.51)

Figure 1. Screen captures of video and interactive activities



236 **142.236** Development of the Postsecondary Resilience Education Program (PREP): An Interactive, Web-Based College Readiness and Resilience Skills Building Program for Students with High Functioning Autism Spectrum Disorder

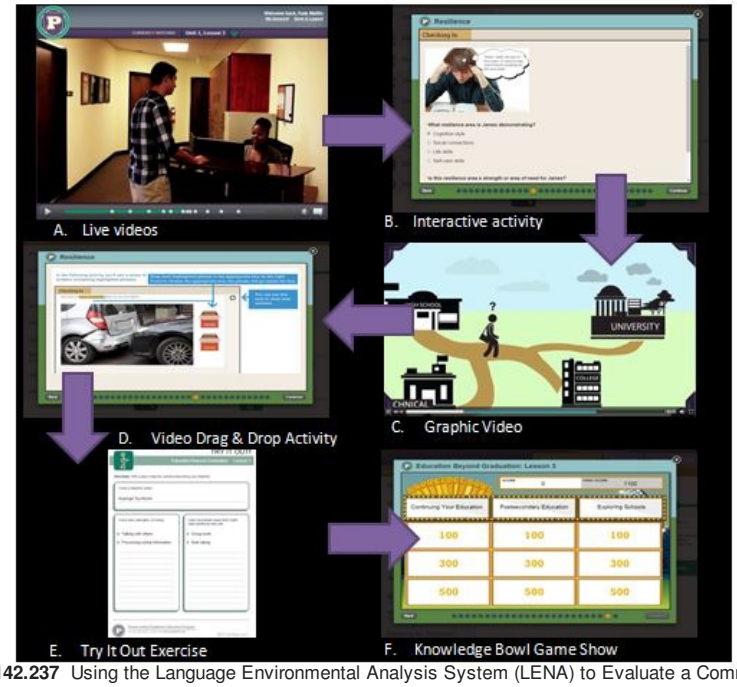
***D. Childress**, K. Melillo, K. Adkisson, A. Sam, I. Eremeev, B. Cassell, P. Allen and S. Rothman, 3C Institute, Durham, NC*

Background: Despite cognitive strengths, individuals with high functioning autism (HFA) pursue college at much lower rates than their typically developing peers with approximately 24% of individuals with ASD without intellectual disability reporting no regular educational or employment activities following high school (Taylor & Seltzer, 2011). Further, when these intellectually capable students pursue college, they tend to drop out prematurely (Glennon, 2001). A growing literature underscores the crucial role of resilience strategies for academic and social-emotional adjustment as well as persistence in postsecondary education (Walton & Carr, 2012). The lack of well-designed and accessible interventions to support students with HFA transitioning to postsecondary education contributes to the marked under-education and under-employment experienced by these individuals, thereby, negatively impacting their overall quality of life.
Objectives: To iteratively develop and conduct testing of a dynamic, customizable college readiness and resilience program. The *Postsecondary Resilience Education Program (PREP*) is keyed to the unique learning and social-emotional characteristics of students with HFA.
Methods: Usability and feasibility testing of *PREP* and semi-structured interviews were conducted. High-school students preparing for the entry to postsecondary education and their parents (n=13 pairs), as well as educators (n=25) reviewed *PREP* in their homes for 2 weeks. The online platform allows the user to view each unit addressing a specific skill domain with instruction provided through a combination of video presentation styles, including motion graphics, animation, illustration, and video modeling. Interactive exercises provide individualized feedback and reports based on user responses. Following the review of the program, participants met with research staff individually or in small groups to give feedback on the usability of the program, online delivery platform, and their understanding of issues related to the successful transition to college. Data sources included Likert scale responses about the program design, usability, qualitative responses on the usefulness of the program and the family's and educator's experiences with PSE transition.
Results: Overall, parents and students found *PREP* to be of high quality and value as well as a highly usable software (5-point Likert scale, 1=Strongly Disagree to 5=Strongly Agree; mean ratings > 4). Parents reported that they thought *PREP*would likely be effective in facilitating the transition from high school to postsecondary education for students with HFA (M=4.64, SD=.50). Students rated the program as likely to enhance the transition and preparation skills of students who are transitioning to college (M=4.27, SD=.65). Professionals reported the program fills a need for helping high school students with HFA transitioning to college (M=4.53, SD=.61). Qualitative comments supported Likert ratings.
Conclusions: These data provide preliminary evidence for the usefulness of the *PREP* program for students with HFA considering postsecondary education. Gathered data from the usability and feasibility testing was used to create a blueprint of course content and interactive styles needed to key the intervention to the needs of students with HFA (e.g., new instructional elements and methods, tailored activities). A subsequent pilot efficacy study of PREP for enhancing resilience and transitioning skills needed for successful transition to postsecondary education is underway in regional high schools.

Table 1. *PREP* Unit Themes

Education Beyond Graduation
Building Resilience
Using Disability Services
Understanding Stressors
Building Social Connections
Maintaining Social Connections
Self-Advocacy
Accessing Resources on Campus
Organization Skills
Self-Care
Goal-Setting
Transitioning to Postsecondary Education

Figure 1. Screen Captures of the User Experience



237 **142.237** Using the Language Environmental Analysis System (LENA) to Evaluate a Community Based Pivotal Response Treatment (PRT) Parent Coaching Model for Autism Spectrum Disorder

M. Stolte *and V. Smith, University of Alberta, Edmonton, AB, Canada*

Background: Though evidence-based practices (EBP) for autism spectrum disorder (ASD) intervention exist, adoption is low in community practice (Dingfelder & Mandell, 2011). There is a need to partner with service providers and evaluate community based interventions as there is often a loss of quality when EBP is disseminated into real world settings. Additionally, there is a need to evaluate new technologies, such as the Language Environmental Analysis System (LENA), to determine if they may expedite efficient, reliable and valid embedded program evaluation, as a means of providing feedback on program effectiveness.
Objectives:

1. To provide a comprehensive description of a community based Pivotal Response Training (PRT) parent coaching model including teaching topics and format.
2. To evaluate the effectiveness of the model on child, parent and parent-child interactional communication patterns using the LENA.
3. To evaluate the use of LENA as a new technology to measure program effectiveness in a real world setting.

Methods: Using a single-subject research design matched with new digital language processor technology (i.e., LENA) and through partnership with a large accredited autism service provider in Western Canada, a community based PRT parent coaching model was evaluated. Eighteen independent video and audio recordings of baseline, intervention and follow-up data were evaluated on child, adult, conversational turns, and ratio of child initiated conversational turns for one parent-child dyad over a 16 week period. Detailed descriptive information, fidelity of PRT implementation, PRT content validity, and hypothesized relationships between coaching condition and communication patterns are appraised.
Results: Good content validity and program description of the coaching model was obtained. A functional relationship between adult language and coaching condition was identified. Hypothesized relationships between conversational turns and coaching condition could not be evaluated due to high variability in child vocalizations across conditions. PRT fidelity improved though was not fully achieved. Advanced LENA analysis of 29,469 communication blocks suggest balanced child and adult initiations also improved as a result of the coaching, though did not sustain once the coach was no longer present.
Conclusions: The PRT parent coaching model is an EBP that holds promise for community based implementation and the LENA is a useful adjunct evaluation measure, allowing for more in depth analysis of longitudinal communication patterns. However, given PRT fidelity was not achieved by the parent and child vocalization data was variable, interpretation of results is limited. Further research on this coaching model is needed. Positively, a clear description of the model in community practice was obtained including teaching format, topics and procedures. Additionally, parent-child ASD communication patterns were identified in a reliable, valid and user friendly manner over time, using new technologies, as they participated in this EBP coaching model. This study demonstrates the importance of evaluating EBP in community settings and how new technologies, such as LENA, can support this objective.

238 **142.238** Inhome: A Multimodal Bio-Behavioral Data Capture System for Autism Research

I. Riobo[1]*, O. O. Wilder-Smith*[2]*, J. C. Sullivan*[2]*, C. Cumpanasoiu*[2]*, C. Kim*[1]*, Y. Liu*[1]*, G. D. Abowd*[1]*, J. M. Rehg*[1] *and M. S. Goodwin*[2]*, (1)Georgia Institute of Technology, Atlanta, GA, (2)Northeastern University, Boston, MA*

Background: The majority of existing research in Autism Spectrum Disorder (ASD) relies on parent- or informant-report measures and/or behavioral assessments collected at a limited number of time points, often in unfamiliar settings (laboratory, clinic). Recent advances in commercially available multimodal recording technology make it possible to move beyond reliance on both approaches and collect intensive longitudinal video and physiological data in home-based settings. These technologies have the potential to provide greater statistical power, measurement precision and sensitivity, and enhanced ecological validity.
Objectives: (1) Develop a multimodal bio-behavioral data capture system to unobtrusively, efficiently, and accurately record and analyze behavior and physiology in individuals with ASD in home settings for up to 1 contiguous month. (2) Evaluate usability, feasibility, and data quality of our system in a sample of children with ASD and their families.
Methods: We developed *inHome* (In-Home Observation Measurement Equipment), an integrated system consisting of commercially available cameras, laptop computers, electrodermal activity sensors (Q Sensor), sleep sensors (AMI), and tablet computers that provide video review and annotation capabilities. *inHome* is currently configured to collect up to 30 days (5 hours per day) of continuous video, audio, physiological, physical activity, sleep, and informant-report data that is automatically synchronized and recorded to a central repository.
Results: To-date, 10 children with ASD (age 4-14 years) and their families have completed trialing the system in their homes for 2-4 weeks, for a total of 27 weeks of data collection, and approximately 900 hours of video, audio, physiological, and physical activity data. Installation of the system in a family's home and training on its use can be

completed in less than 90 minutes. Parent feedback from post-deployment interviews indicates that the system is easy-to-use, unobtrusive, and able to capture data that they believe is representative of their children's behavior.
Conclusions: We have successfully developed a novel system for collecting intensive longitudinal multimodal data on behavior, physiology, physical activity, and sleep, in individuals with ASD in home settings. The data obtained thus far represents a first-of-its-kind, long-term intensive longitudinal dataset of bio-behavioral data from children with ASD in home settings. In addition to complementing traditional survey and lab-based measures, enabling parents to efficiently gather high quality quantitative assessments of their children's behavior and physiology in the home over time could enhance intervention and clinical trials by establishing more sensitive and detailed outcome measures. It may also facilitate more basic research to the extent that our systems' measures can be associated with other biological indices (genetic, metabolic, proteomic, immunologic, neurologic, psychiatric, etc.) obtained from a large number of individuals on the autism spectrum. Our demonstration will include opportunities to try out and interact with the inHome system, as well as review examples of data collected from our end-user deployments.

239 **142.239** Assessment of the Olfactory Trait in Children with Autism Spectrum Disorders Using an Olfactory Software Application

H. Kumazaki[1,2], *T. Muramatsu*[2], *M. Miyao*[3], *T. X. Fujisawa*[1], *H. Kosaka*[1], *A. Tomoda*[1] *and M. Mimura*[2], *(1)University of Fukui Research Center for Child Development, Yoshida-gun, Japan, (2)Keio University, Tokyo, Japan, (3)DONGURI clinic for children with developmental disorders, Tokyo, Japan*

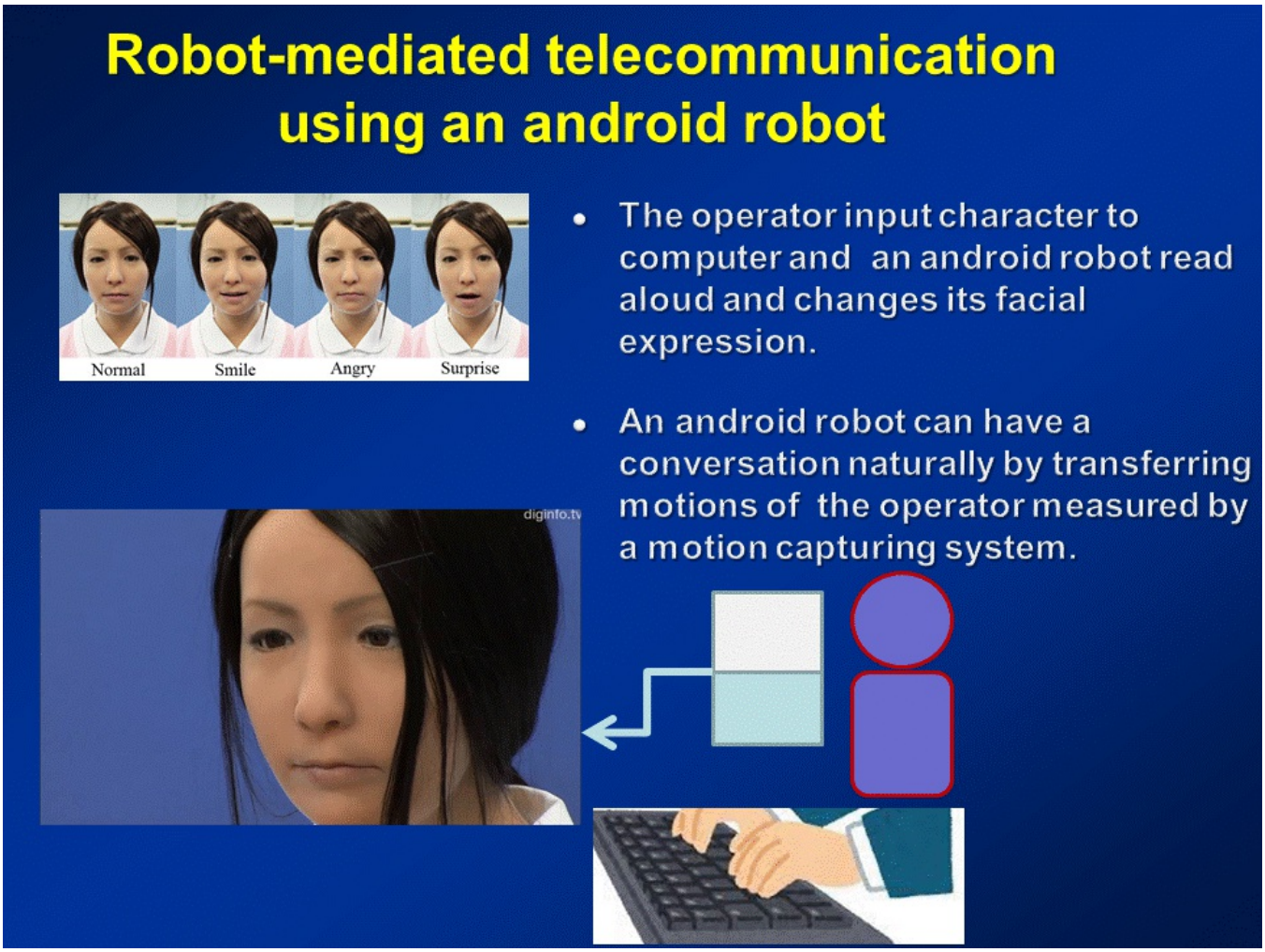
Background: Olfaction is regarded as one of the most important diagnostic or prognostic markers in a number of neuropsychiatric disorders. Abnormal reactions to olfactory stimuli in children with autism spectrum disorder (ASD) have been described in several clinical studies using sensory questionnaires. However, laboratory-based sensory psychophysical studies to investigate the olfactory trait in children with ASD using olfactory testing have produced inconsistent results. Previous research has failed to show significant correlations between autism severity and laboratory data. Adaptation is an important process, allowing individuals to adjust to changes in their environment. Few studies measure olfactory adaptation in children with ASD. Olfactory laboratory tests have provided limited information about such abnormalities in those with ASD.
Objectives: In this study, we used an olfactory measurement that uses a pulse ejection system as well as olfactory application software, which we developed. Previous olfactory measurement techniques cause problems with scents scattering and lingering in the air, making accurate measurements impossible. We have attempted to resolve these problems by using a display with a pulse ejection system to present a scent for a short duration at the picoliter level. Using very small quantities of scent reduces lingering scents during measurement and makes it more difficult for olfaction to adapt compared to existing measurement techniques. We also developed an olfactory application software that can measure the adaptation to changes in odor. This study examined adaptation to changes in odor using a pulse ejection system and this new software application in a sample of children with ASD.
Methods: The inclusion criteria were chronological age of 10 to 16 years and previous diagnosis of high-functioning ASD. All participants satisfied the diagnostic criteria for ASD in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (American Psychiatric Association, 2013). To exclude other psychiatric diagnoses, the Mini-International Neuropsychiatric Interview for Children and Adolescents was conducted by a licensed pediatric psychiatric clinician. Thirteen children with ASD participated. Adaptation to changes in odor was assessed using the olfactory measurement system with olfactory display, which uses a pulse ejection system, and the new software application. We used isoamyl acetate and ethyl butyrate flavor for the odorants. The odors of isoamyl acetate and ethyl butyrate flavor were released for 20 seconds each by the display using a pulse ejection system. We investigated whether participants were able to recognize the change of the odorants using touch panel display controlled by the olfactory software application. We used the Childhood Autism Rating Scale (CARS) to measure the severity of the autistic trait. Statistical analysis was performed using the Statistical Package for the Social Sciences, version 15.0.
Results: Seven participants passed, and six did not. The total score and the "Taste, Smell, and Touch Response and Use" score on the CARS were lower in the group who passed than in the group who did not ($p < 0.01$).
Conclusions: Adaptation to changes in odor may be connected with the severity of autism. Implications for further research are discussed.

240 **142.240** Robot-Mediated Interventions for Social Anxiety in Individuals with Autism Spectrum Disorder

H. Kumazaki[1,2], *Y. Yoshikawa*[3], *Y. Matsumoto*[4], *M. Miyao*[5], *H. Ishiguro*[3], *T. Muramatsu*[2] *and M. Mimura*[2], *(1)University of Fukui Research Center for Child Development, Yoshida-gun, Japan, (2)Keio University, Tokyo, Japan, (3)Osaka University / JST ERATO, Osaka, Japan, (4)National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan, (5)DONGURI clinic for children with developmental disorders, Tokyo, Japan*

Background: In some cases, social anxiety is considered to be difficult to treat in individuals with autism spectrum disorder (ASD), and a variety of therapeutic and educational approaches have been attempted. Any of these may have educational benefits in some but not all individuals with ASD. Considering the present situation, there is an urgent need for the development and application of novel and more efficacious treatment strategies. Given recent rapid technological advances, it has been argued that technology, especially in the field of robotics, could be effectively harnessed to provide innovative clinical treatments for individuals with ASD. An android robot designed to look human can be used as a telecommunication medium for distant inter-human communication. Robot-mediated telecommunication using an android robot may encourage children with ASD to exhibit social communication.
Objectives: We propose the initial application of robot-mediated telecommunication using an android robot for targeted interaction to improve communication skills in individuals with social anxiety and ASD.
Methods: The inclusion criteria were chronological age of 18 to 24 years and previous diagnosis of high-functioning ASD (IQ ≥ 70) and social anxiety. This experiment was conducted in a familiar room that was used often by the participants for various activities. The participants typed on the keyboard, and the android spoke. The android was

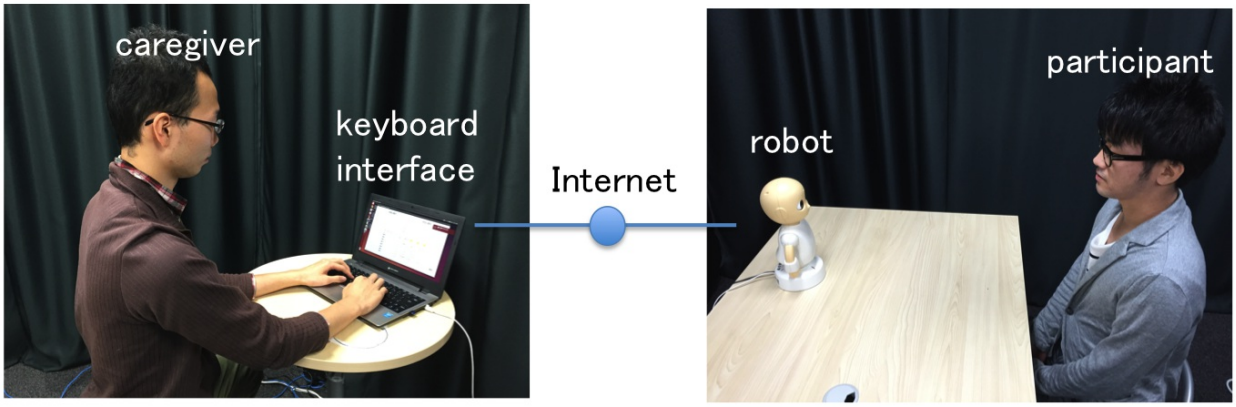
positioned at one end of the room within plain view of the participants. There was a camera image before the participant, which the participant was able to watch. The android robot used in this study was ACTROID-F (Kokoro Co. Ltd.), a female-type humanoid robot with an appearance similar to that of a real person. Its artificial body has the same proportions, facial features, hair color, and hairstyle as a human. At first sight and from a distance, it is difficult to distinguish this android robot from a live adult. ACTROID-F is capable of a range of movements (moving limbs up and down and turning the head from side to side). We adopted the remote control system conventionally used in robotics studies in covert ways. ACTROID-F is tele-operated to perform semi-structured conversations with a person for consultation. Emotion was measured using the Stress Response Scale (SRS).
Results: Twenty-three individuals diagnosed with ASD and social anxiety participated. Based on video recordings of the interactions, quantitative and qualitative analyses were conducted. All participants were able to respond and type in any situation. In all cases, when they typed on the keyboard, their expressions became soft. Before they typed, “enter,” they were stiff, but after they typed, “enter,” they were relieved. They seemed to be deep in conversation. Total score and some item scores on the SRS (i.e., become irritable, mind everything, sink deeply, and cannot concentrate on something) improved from before to after intervention ($p < 0.01$).
Conclusions: Despite the limited effectiveness of the intervention, it is suggested that intervention using an android could be used as a tool for the development of communication. Future research needs to examine the issue using a larger, more diverse sample and multiple levels of analysis of behavioral change.



241 **142.241** Advantages of Robot-Assisted Counseling: Can Caregivers Better Address the Concerns of Children with Autistic Spectrum Disorders Via a Small Humanoid Robot?

J. Shimaya[1], *Y. Yoshikawa*[1], *M. Miyao*[2], *Y. Matsumoto*[3], *H. Kumazaki*[4], *M. Nakano*[5] *and H. Ishiguro*[1], *(1)Osaka University / JST ERATO, Osaka, Japan, (2)DONGURI clinic for children with developmental disorders, Tokyo, Japan, (3)National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan, (4)University of Fukui Research Center for Child Development, Yoshida-gun, Japan, (5)National Center for Child Health and Development, Tokyo, Japan*

Background: Children with ASD may experience difficulties communicating concerns to caregivers (e.g., clinical psychotherapists, special education teachers, etc.) due to deficits in social communication ability. Previous research indicates that children with ASD may be able to communicate effectively with robots; this possibility is partially supported by certain positive response tendencies in non-verbal communication (e.g. Cabibihan et al., 2013). Nonetheless, these tendencies do not confirm whether robots may facilitate therapeutic communication in a counseling context.
Objectives: Tele-operated robots’ potential to assist caregivers in indirectly counseling children with ASD was examined. We provided caregivers with opportunities to talk with participating children via a small humanoid robot; we subsequently qualitatively and quantitatively analyzed the conversations, which concerned the children’s concerns.
Methods: Three female teenagers (referred to as “A,” “B,” and “C”) with ASD participated. The participants’ caregivers had been unable to address their problems with human relationships. All participants directly and indirectly talked with their caregivers. The conversation times ranged from one to four In the indirect phases, participants talked with a 30-cm-height humanoid robot.. The caregiver could remotely control it to utter the caregiver’s messages using a keyboard interface. We qualitatively and quantitatively examined counseling achievements throughout the series of conversations.
Results: The average total time of conversation was 17.0 and 5.5 minutes in the indirect and direct phases, respectively. The utterance ratio (UR) was calculated as the ratio of normalized time spent on utterances by participants in the indirect phase, compared to in the direct phase. The average UR across all participants was 2.2 (SD = 1.1), indicating that participants uttered more in the indirect phases than in the direct phases. All participants were able to discuss concerns that had not previously been disclosed to their caregivers; however, counseling achievements varied among participants. A and B were able to discuss previously undisclosed worries; specifically, A disclosed the names of people she disliked, and B disclosed circumstances under which she felt uncomfortable interacting with her friends. By contrast, C was able to inhibit excessive aggression toward particular classmates; previously, she had been unable to avoid panicking even when merely encountering these classmates, and no caregiver had been able to adequately manage her panic reaction. C conversed with the caregiver for a particularly long time through the robot regarding these classmates, although she had previously experienced difficultly discussing that topic directly with the caregiver. As she promised to the robot in conversation, she successfully met one of these classmates while keeping calm. Significantly, the caregiver reported that C had been able to keep calm in the presence of these classmates including when she met him two weeks after the experiment.
Conclusions: The caregivers generally succeeded in counseling children with ASD via a small humanoid robot. This result encourages us to develop and introduce a robot-assisted counseling environment into the treatment and education of children with ASD, although the sample size has been limited. Long-term follow-ups and investigation of customization of the technique to reflect individual care needs are important issues for future research.



242 **142.242** Robot-Led Intervention for Improving Emotional Cognition in Children with ASD

S. A. Koch[1], *J. B. Lebersfeld*[1], *C. D. Clesi*[1], *C. E. Stevens*[1], *M. E. McNew*[1,2], *A. G. Parker*[1], *F. J. Biasini*[1] *and M. I. Hopkins*[1], *(1)Psychology, University of Alabama at Birmingham, Birmingham, AL, (2)Psychology, Florida International University, Miami, FL*

Background:
Mounting research supports the use of technology, including social robotics, to improve social communication in individuals with Autism Spectrum Disorder (ASD). Robot-assisted therapy has been shown to increase engagement and promote novel social behaviors (i.e., turn-taking, imitation, joint attention) during human-led sessions. However, increased value would be achieved by a robot-led intervention that could be duplicated and more easily accessed. SAM (Socially Animated Machine) was designed to independently lead a social skills intervention aimed at improving emotional cognition in children with ASD.
Objectives:
The aims of this study were to examine whether the robot-led intervention 1) improves task-specific emotion recognition skills, 2) improves generalized social perception skills, and 3) elicits an enjoyable and engaging environment.
Methods:
13 children with ASD and average cognitive skills (ages 5-11) completed this study. Participants were randomly assigned to treatment (n=7) and control (n=6) groups. Participants in the treatment group completed eight sessions with SAM involving several games designed to teach children to identify emotions using pictures, drawings, and social scenarios. Participants in the control group completed pre- and post-intervention sessions with SAM, but were otherwise assigned to a waiting list. Social perception skills, including emotion-matching accuracy and scores on the NEPSY-II Affect Recognition and Theory of Mind subtests, were compared across groups at pre- and post-intervention. Self-reported levels of enjoyment while interacting with SAM were also obtained.
Results:
Analyses were performed using a series of univariate ANCOVAs with adjustment for pre-intervention scores. Although participants in the intervention group improved in their percent accuracy for matching SAM's emotions from pre- to post-intervention (M=80.95 to M=93.45) and control participants did not (M=79.17 to M=81.94), the difference between groups was not significant, $F(1,10) = 3.106$, $p = .108$. On the NEPSY-II, there were no significant differences in post-intervention scores between the groups on Affect Recognition, $F(1,10) = .826$, $p = .385$, or Theory of Mind, $F(1,10) = 4.171$, $p = .068$. Descriptive statistics were used to examine enjoyment ratings at post-intervention. All participants, regardless of group placement, reported feeling very happy (M=9.31, SD=1.18) and comfortable (M=9.09, SD=1.80) while talking with SAM, and were eager to have additional interactions (M=8.23, SD=2.86).
Conclusions:
Preliminary findings suggest that children who completed the robot-led intervention improved in their ability to match SAM's emotional expressions; we expect this trend to reach significance with a larger sample size (estimated N=20). Children in the intervention group did not show improved performance on a measure of social perception compared to the control group. Notably, many of the participants achieved scores at or above the average range on this measure at pre-intervention, and as such had less room for improvement following intervention. Overall, participants enjoyed working with SAM and requested additional interactions. These findings suggest that SAM's robotic design fits the needs of this population and the intervention succeeds at teaching task-specific emotion recognition skills. Future research will be collected to assess the efficacy of the intervention and effect on generalized social perception skills in a group of children with lower cognitive and emotional functioning.

243 **142.243** Emotiplay - a Virtual Environment for Emotion Recognition and Expression Learning

S. Fridenson-Hayo[1], *S. Berggren*[2], *O. Atzmon*[3], *A. Lassalle*[4], *N. Meir-Goren*[3], *S. Tal*[1], *S. Newman*[3], *S. Baron-Cohen*[4], *S. Bolte*[2] *and O. Golan*[1], *(1)Department of Psychology, Bar-Ilan University, Ramat-Gan, Israel, (2)Department of Women's and Children's Health, Pediatric Neuropsychiatry Unit, Karolinska Institutet, Stockholm, Sweden, (3)Compedia, Ramat-Gan, Israel, (4)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom*

Background: Children with Autism Spectrum Disorders (ASD) experience difficulties communicating their own emotions and recognizing the emotions of others. It has been shown that virtual computerized environments can produce simplified versions of the socio-emotional world, reduce sensory stimulation, and support a featured-based learning style of socio-emotional cues, gradually integrating them into a holistic picture. EmotiPlay is a technology initiative that draws on the results of a 3-year EU-funded project called ASC-Inclusion, aimed at developing a virtual world for emotion learning.
Objectives: (1)To demonstrate the advancements of the technology of the virtual environment designed to teach children with ASD how to understand, recognize, and express emotions. (2) To present results of three clinical trials evaluating the environment in the UK, Israel and Sweden.
Methods: The program is embedded in a virtual world and includes highly engaging elements, aimed at enhancing the child's motivation, including games, animation, video and audio clips, rewards, a child's avatar, and communication with smart agents and peers. The system combines several state-of-the art technologies in one comprehensive environment, including computerized analysis of users' gestures, facial and vocal expressions. The evaluations included 6-9 year olds with high functioning ASD who used the environment for 8-12 weeks. Evaluations included face, voice, body, and integrative emotion recogntion tasks, as well as SRS and vineland socialization measures. In the UK, 18 children were tested before and after using the sytstem. In Israel (n=40) and Sweden (n=32) children were either allocated into a treatment or a delayed treatment control group.
Results: The current demonstration will show:

1. How virtual worlds can be harnessed for autism therapy and treatment
2. How the system operates, the user interface, various modalities and rewarding system.
3. Results of the clinical trials and their effects on the product development.

Conclusions: EmotiPlay project offers children with ASD and their families the benefit of state of the art educational technology for enhancement of their socio-emotional communication skills. Clinical trials provide support for its efficacy and call for future randomized controlled trials of the environment.

244 **142.244** 3-D Social Attention Training for Young Children with ASD

Z. Zheng, ***Z. Warren****, H. Zhao, Q. Fu, A. S. Weitlauf, A. Swanson and N. Sarkar, Vanderbilt University, Nashville, TN*

Background: As we unravel ASD's complex neurogenetic origins and environmental influences, there will be increasing need for technological tools that help us better understand symptom profiles for detection and potentially for intervention/prevention. A poor response to one's name being called, in children with adequate hearing has consistently been identified as an early red-flag for ASD in infancy and toddlerhood and is included as part of standardized, widespread screening checklists and diagnostic instruments. We therefore designed and tested a novel technological system that tracks children's visual attention and responds independently in order to measure and scaffold an exemplary social attention task for young children, namely, response to their names being called.
Objectives: The ultimate objective of this study was to empirically test the feasibility and usability of an adaptive technological learning environment, capable of intelligently

administering early social orienting prompts and adaptively responding based on within system measurements of performance.
Methods: This system was comprised of name prompting and attention tracking sub-systems, an animated attractor (a bouncing ball), and a reinforcing feedback mechanism. Eight toddlers with ASD and eight infants and toddlers without developmental concerns participated in a pilot study. Each participant completed a single experimental session consisting of 10 trials of response to name training. During the trials, when a child did not respond to his or her name being called on the target monitor, a bouncing ball appeared on the monitor closest to the child's current gaze. This ball then bounced across monitors to direct the child's gaze toward the target monitor. If the child looked away or failed to follow the attractor, then additional motion and sound effects were added to the bouncing ball to heighten the attractor's effect. If the child looked at the target screen (target hit) in response to his/her name, the attention tracking sub-system recognized the success and promptly delivered praise with a firework animation.
Results: All participants tolerated the system well. No sessions were terminated due to participant distress or engagement challenges. All participants in the ASD group eventually hit the target (turned toward their name) across all trials. On average, children in the ASD group averaged 3.07 seconds between initial prompt and success. TD children, an average of 10 months younger than ASD children, also performed with a high level of accuracy. The average time required for TD children to hit the target was 1.19 seconds.
Conclusions: We studied the application of an innovative closed-loop adaptive technological system with potential relevance to core areas of vulnerability related to ASD in infancy and toddlerhood. The proposed computer system was extremely well tolerated by the children. Toddlers with ASD and typically developing infants and younger toddlers were able to ultimately respond accurately to prompts delivered by the technological system within the standardized protocol. Further, the system was capable of attracting and pushing toward correct performance autonomously without user intervention.

245 **142.245** The Potential of Collaborative Virtual Environments for ASD Intervention

*L. Zhang, H. Zhao, Q. Fu, A. Swanson, A. S. Weitlauf, **Z. Warren** and N. Sarkar, Vanderbilt University, Nashville, TN*

Background:
Over the past decade researchers have explored traditional virtual reality (VR) environments as potential intervention platforms for children with autism spectrum disorder (ASD). Such systems, however, have often been limited by the programming burden of attempting to realize fluid social communication and meaningful conversation within system as well as restraints in the flexibility of employing confederate partners. Collaborative Virtual Environments (CVEs), distributed and multiplayer involved virtual environments, may be have considerable more potential to overcome these barriers for more realistic deployment as ASD intervention tools. Specifically, CVEs can be developed to offer children with ASD opportunities to interact and communicate with peers in a safe and flexible communication environment that may also be more intrinsically motivating and easier to access than traditional forms of social intervention.
Objectives:
We designed and evaluated a CVE where children with ASD and their typically developing (TD) peers engaged in a series of collaborative games. We evaluated the feasibility and tolerability of the system as well as the impact of the CVE on within system performance and metrics of social communication skill.
Methods:
Our CVE was developed with Unity3D game engine (http://unity3d.com/). Three different types of puzzle games were designed, including turn-taking, color-sharing, and enforced collaboration games, to foster different kinds of collaborative interactions and communications. The CVE was designing to be accessed by two users from different locations through internet. The distributed users communicated by voice in real time in the CVE. Seven ASD/TD pairs, and seven TD/TD pairs completed the one visit experiment which involved pre/post-test evaluation as well as an extended period of interaction within the CVE. The pre- and post-test were composed with turn-taking game and enforced collaboration games requiring sharing color for estimation of changes in interactions and communications of participants.
Results:
When examining the interaction pairs, the task-related performance of ASD/TD pairs and TD/TD pairs improved across the CVE interaction session. There was a significant increase in the success frequency as well as a significant decrease in time duration of both turn-taking and enforced collaboration from pre-test to the post-test. The number of the task-oriented spontaneous utterance in ASD/TD pairs and the number of the task-oriented questions utterance in TD/TD pairs significantly increased.
Changes were also seen in examining individual performance metrics. Specifically, the task-related performance of children with ASD, TD children in the ASD/TD pairs, and TD children in the TD/TD pairs improved. TD children in both groups increased in the word frequency, with the number of social utterances of individual children in the TD pairs decreasing.
Conclusions:
CVEs may have the ability to foster collaborative interaction and communication skills for children with ASD. Such environments could yield interesting metrics of social communication and/or potential modalities for intervention. Planned future work will modify the system to add feedback as well as verbal and nonverbal (eye gaze) contingencies to develop potential intervention platforms for peer mediated intervention.

246 **142.246** Customizable, Interactive Toy Platform to Enable Motivation-Driven Cognitive and Physical Development in Children Diagnosed with Autism or Developmental Disorders

K. T. Johnson[1] *and R. W. Picard*[2]*, (1)MIT Media Lab, Massachusetts Institute of Technology, Cambridge, MA, (2)Massachusetts Institute of Technology, Cambridge, MA*

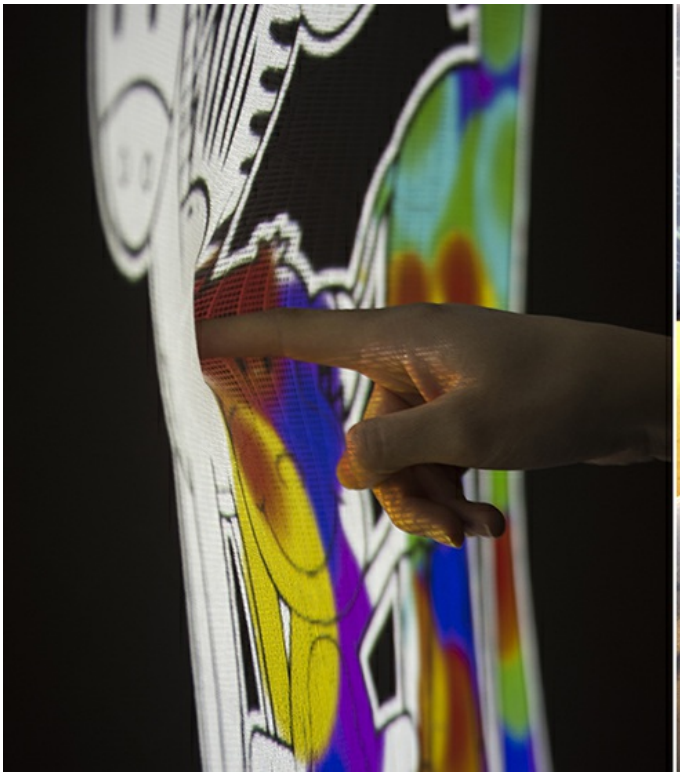
Background: Most typically-developing children are motivated to learn and explore intrinsically, often driven by curiosity or pursuits of mastery and independence (Ryan & Deci, 2000). For many children with neuro-differences, however, this intrinsic motivation may be insufficient to overcome environmental distractions, sensory demands, or motor challenges required to focus, learn, or complete a task. Yet, children diagnosed with Autism Spectrum Disorder (ASD) and/or other developmental disorders often show intense, specific affinities for particular items or topics that can be leveraged to teach skills or ideas (Mancil & Pearl, 2008). Indeed, well-established therapy techniques utilize highly-motivating personal rewards to achieve ambitious therapeutic goals, including increased attention, physiological regulation, and social engagement (Vismara & Lyons, 2007). Ideally, these goals can extend beyond the therapy setting, integrating seamlessly within daily play activities. Technology has the capability to bridge this divide; yet, current devices lack the individualization and dynamic adaptation necessary to teach and engage many atypical learners.
Objectives: To enable independently-initiated play experiences with therapeutic benefits -- including increased engagement, learning, and psychophysiological regulation -- while simultaneously collecting quantitative measures of this progress during play.
Methods: We have developed a customizable, interactive toy platform that can be rapidly tuned to align with a child's intrinsic interests and potential sensitivities, enabling new opportunities for regulation, social engagement, and comprehensive data collection. This self-contained physical smart toy has a removable, modular center piece that allows us to adapt the challenge of the task to the needs of the child by inserting different modules, including shape sorting, ring stacking, and pincer grasp development activities. In addition, embedded digital sensors capture data quantifying a child's engagement and behavior while interacting with the toy. An integrated smartphone allows user-friendly customization of the motivating reinforcement mechanism, such as favorite video clips, music samples, or light displays. In this way, the toy can also become a vehicle to provide controlled stimuli capable of presenting other experimental paradigms in a flexible, ambulatory, and ecologically valid environment.
Results: Preliminary data from three children (age 2-4) with ASD using an early prototype of the toy indicated that individualized reinforcement was highly motivating, increasing the children's abilities to attend to and achieve challenging tasks. We also found a correlation between the challenge level of the task and the necessary preference level of the reward, confirming a need for a tunable device that can match the "just right challenge" to the "just right reward." Our IMFAR demonstration will include opportunities to interact with our next-generation prototype, as well as to discuss additional data from neuro-diverse children engaging with the toy platform.
Conclusions: We have created a new customizable toy platform designed to elicit increased cognition, self-regulation, and social engagement for children with complex neurological needs through a highly-motivating, self-driven play environment. Early results suggest that the toy's personalized reinforcement can help a child achieve ambitious cognitive and motor goals at an accelerated pace, underscoring the promise of innovative technologies for ASD research and intervention and warranting the need for further studies.

247 **142.247** Technologies for Tactile Multi-Sensory Environments

***S. Ahlquist**, University of Michigan, Ann Arbor, MI*

Background: (Category: Technology Demo) Children with autism spectrum disorder (ASD) often face an array of sensory challenges resulting in delayed abilities in fine motor skills and quality of movement. Re-imagining the interface with technology as both a large tactile surface and a physical environment, the senses beyond just the visual can be engaged as a part of the grading of movement and fine motor skill-building process. Deep pressure is often used to provide sensory regulation for those with dysfunctioning tactile, vestibular and proprioceptive sensory systems. Using a highly stretchable textile as a pressure-sensitive responsive interface suggests that deep-pressure can be provided as a part of activities aimed at developing fine motor skills.
Objectives: To improve the grading and quality of fine motor movements.
Methods: The technology utilizes custom knitted textiles as highly stretchable, pressure-sensitive interfaces. The Microsoft Kinect is used to measure the amount of pressure being applied at any point on the textile.Two prototypes have been developed, StretchCOLOR and StretchPLAY, to test the efficacy of activities using large-scale textile interfaces for improving quality of movement. StretchCOLOR acts as a large-scale coloring book where increasing pressure on the textile changes the hue of the color being used, for instance an initial touch outputs a red color, changing to orange and yellow as the amount of pressure applied increases. StretchPLAY is a large-scale play structure where climbing along and through the stretchy textile surface triggers various sounds clips to play and animations to be projected onto the textile.
Results: Diagnostics in the software are measuring aspects of interacting with the textile interface such as frequency of touches to determine pace of movement, depth of touch to determine range of pressures being applied, and location of touch to determine amount of task being completed. Data is currently being collected with the prototypes

being used regularly as a part of the ABA program of several children at a local therapy center.
Conclusions: The development and application of this technology involves collaboration between architecture, psychiatry and kinesiology. It looks to create a robust multi-sensory experience of technology, providing activities aimed at developing fine motor skills. Through anecdotal evidence, the technology has shown to be engaging, rather than engrossing, allowing children to enjoy the activities while secondarily encouraging social interaction.



248 **142.248** The Sensory Toy Box: An Interactive Game-Based Technology As an Assessment Tool

S. Valencia[1], *P. Perez Fuster*[2], *M. Mademtzi*[1], *L. Hart*[1] *and F. Shic*[1], *(1)Yale Child Study Center, Yale University School of Medicine, New Haven, CT, (2)Autism Research Group. Robotics Institute, University of Valencia, Valencia, Spain*

Background: The diversity of sensory styles in individuals with ASD has been widely reported in the literature (Bogdashina, 2003). These diverse sensory profiles have a direct impact on the individual's response to the environment and their perceptual experience. Available evidence suggests that perceptual alterations, independent from social function, can be present in many individuals with ASD (Behrmann et al., 2006). Learning about each individual's sensory profile can help identify sensory strengths and weaknesses that can assist in the selection of appropriate methods for teaching and treatment (Bogdashina, 2003). Current assessment tools to determine sensory profiles are questionnaire based and typically completed by parents. Collecting data on sensory preferences directly from individuals with ASD seems to be challenging, especially from minimally verbal children. An Interactive game-based technology was developed to help children with visual impairments learn about touch perception and to promote their sensory abilities (Valencia & Uribe, 2014). This device presents visual, auditory and tactile features that can also be beneficial for children with ASD and can provide a framework for data collection on individual sensory preferences.
Objectives: the objective of this study is to present a novel interactive technology based on the Valencia & Uribe (2014) prototype that can be used as an assessment tool for the evaluation of sensory preferences in children with ASD.
Methods: The sensory toy box for children with ASD is a device that recognizes different tangible inputs using Radio-frequency identification (RFID) technology. The device is also linked to an app, used for stimuli presentation on a tablet. The tangible inputs, figurines or shapes, have RFID tags that can be programmable through RFID writer devices to create a desired response on the toy box. The user selects tangible objects based on auditory and visual prompts he or she receives from the box or tablet. The system allows data collection on the: 1) frequency of selection of each object and 2) the order in which each object is placed on the box according to each stimulus presented.
Results: In Valencia & Uribe's study, participants included children with visual disability (1 male, 4 females; Mage=7±0.82) and children without visual disabilities (2 males, 1 female; Mage=7.33±0.57). Through different game modes (i.e. storytelling, letters, and musical) and the use of auditory cues, visual rewards and tactile stimulation, the children in this study interacted positively with the toy box. Difficulties in concept associations to physical objects were identified in 3 of the participants. This result opens the way to explore the potential of using different sensory stimuli targeting the auditory, tactile and visual systems to discover strengths and weaknesses in sensory processing in children with ASD.
Conclusions: In this work we have developed an interactive technological tool to assist in the evaluation of sensory preferences in children with ASD. Data collection is ongoing, and by May of 2016 we expect to present on the interactions of 4-6 minimally verbal children with ASD on the toybox.

Poster Session
143 - Animal Models
11:30 AM - 1:30 PM - Hall A

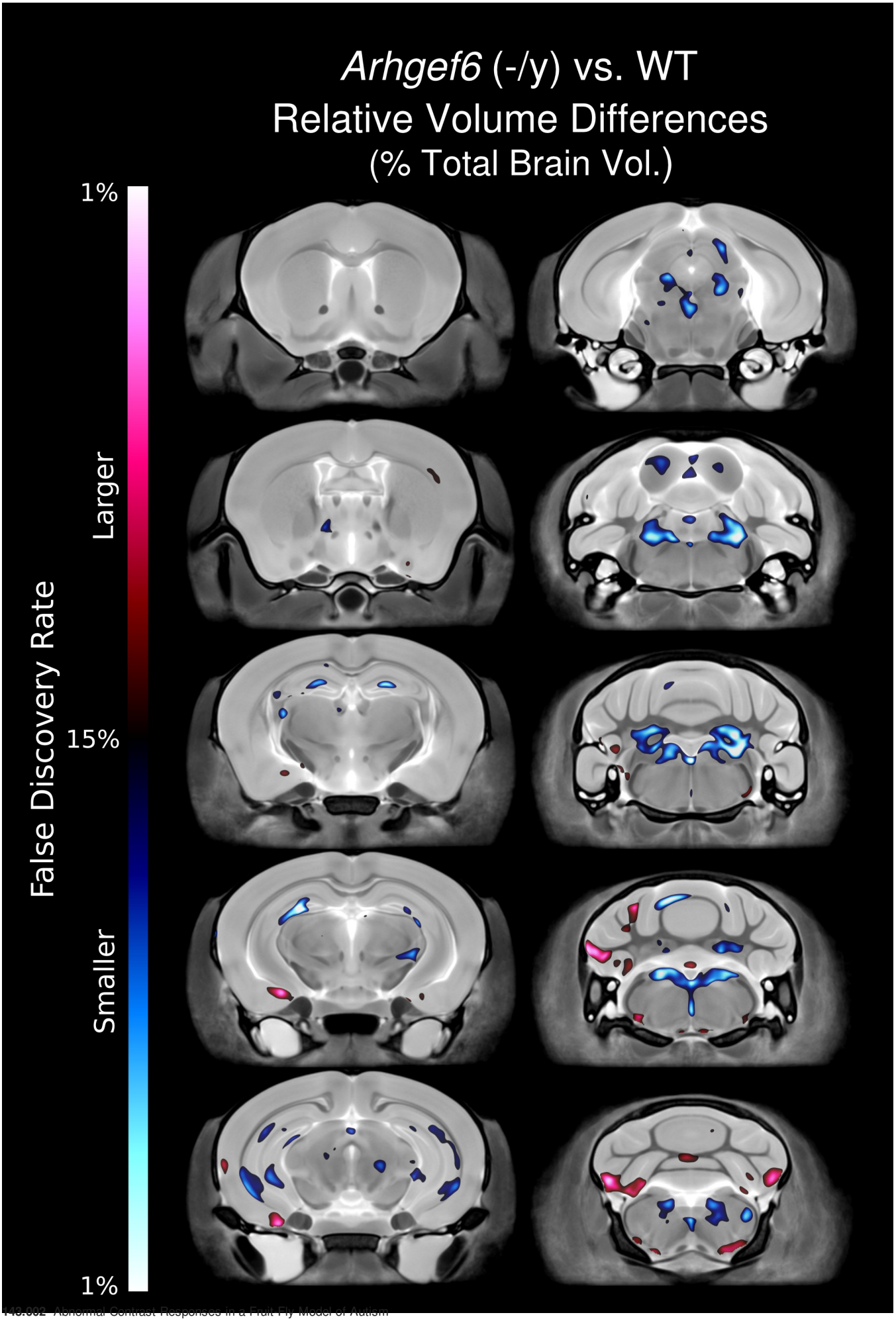
1 **143.001** A Novel Arhgef6 Mouse Model Shows Focal Volume Loss in the Hippocampus and Deep Cerebellar Nuclei

J. Ellegood[1], *R. Yuen*[2], *A. Creighton*[3], *L. Spencer Noakes*[1], *B. J. Nieman*[1], *L. Nutter*[3], *S. W. Scherer*[2] *and J. P. Lerch*[1], *(1)Mouse Imaging Centre, Hospital for Sick Children, Toronto, ON, Canada, (2)Centre for Applied Genomics (TCAG), Hospital for Sick Children, Toronto, ON, Canada, (3)Canadian Mouse Mutant Repository, Toronto Centre for Phenogenomics, Toronto, ON, Canada*

Background: Mutations in the *ARHGEF6* (Rac/Cdc42 Guanine Nucleotide Exchange Factor (GEF) 6) gene have been previously linked to non-specific X-linked mental retardation (Kutsche et al. 2000). A null-mutant was previously created and characterized using histology and electrophysiology (Ramakers et al. 2012). That study found that the gross brain structure appeared normal; however, Golgi staining revealed an increase in both dendritic length and spine density in the hippocampus. Mutations in *ARHGEF6* haven also been recently found in autism (Jiang et al. 2013).
Objectives: To assess the neuroanatomical differences in a novel autism gene candidate, *ARHGEF6* with high-resolution structural MRI.
Methods:
A novel *Arhgef6* loss-of-function mouse model was produced from targeted-trap C57BL/6N ES cells (*Arhgef6*$^{tm2e.1(EUCOMM)Wtsi}$/Tcp) and maintained on a C57BL/6N background. As a first screen 31 fixed mouse brains were examined. Sixteen of which were *Arhgef6*(tm1e.1/y) mice and the other 15 were WT controls (C57BL6/N). The mice were P60 ± 2 days.
MRI Acquisition – A multi-channel 7.0 Tesla MRI scanner was used to acquire anatomical images of the brain. A T2-weighted, 3-D fast spin-echo sequence was used (restricted sampling to a circular region in the two phase encode dimensions). This sequence yielded an image with 40 µm isotropic voxels (3D pixel) in ~14 h.
Data Analysis – To visualize and compare any differences the images from each group are registered together. The goal of the registration is to model how the deformation fields relate to genotype (Lerch et al., 2008). Volume differences are then calculated either in individual voxels or for 159 different segmented regions (Dorr et al. 2008, Ullmann et al. 2013, and Steadman et al. 2014). Multiple comparisons were controlled for using the False Discovery Rate (FDR) (Genovese et al., 2002).

Results: The total brain volume was unchanged (432 ± 6 mm^3 for *Arhgef6*(-/y) and 432 ± 14 mm^3 for WT); however there was a significant difference in the variability in the groups (p=0.02, Levene's test). After normalizing for total brain volume, 11 of the 159 regions were found to be significantly different at an FDR of <5%. Notable decreases were found in the hippocampus (-2.57%, FDR<1%), the inferior and superior colliculi (-3.74 and -3.36, respectively, both FDR <1%), and all three deep cerebellar nuclei, namely the dentate nucleus (-2.65%, FDR=6%), nucleus interpositus (-4.81, FDR <1%), and fastigial nucleus (-4.05, FDR <1%). These findings can also be seen voxelwise in Figure 1.

Conclusions: Ramakers et al. reported that *Arhgef6* was primarily expressed in the hippocampus, where we also identify significant volume losses. In addition, we also identified focal alterations in the deep cerebellar nuclei, supporting recent evidence implicating cerebellar outputs in autism and mental retardation.

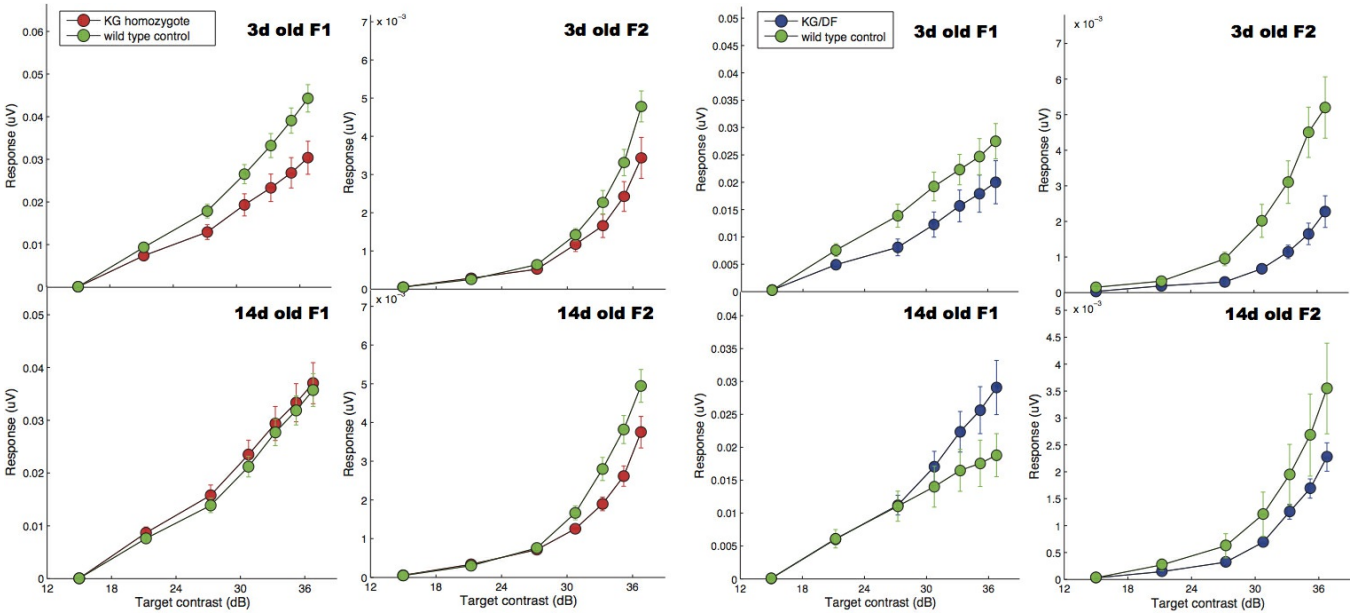


T48.002 - Abnormal Contrast Responses in a Fruit Fly Model of Autism

G. Vilidaite[1], *D. H. Baker*[2], *A. R. Wade*[3] *and C. J. Elliott*[4], *(1)University of York, York, England, United Kingdom, (2)Department of Psychology, University of York, York, United Kingdom, (3)Department of Psychology, The University of York, York, United Kingdom, (4)Department of Biology, The University of York, York, United Kingdom*

Background:

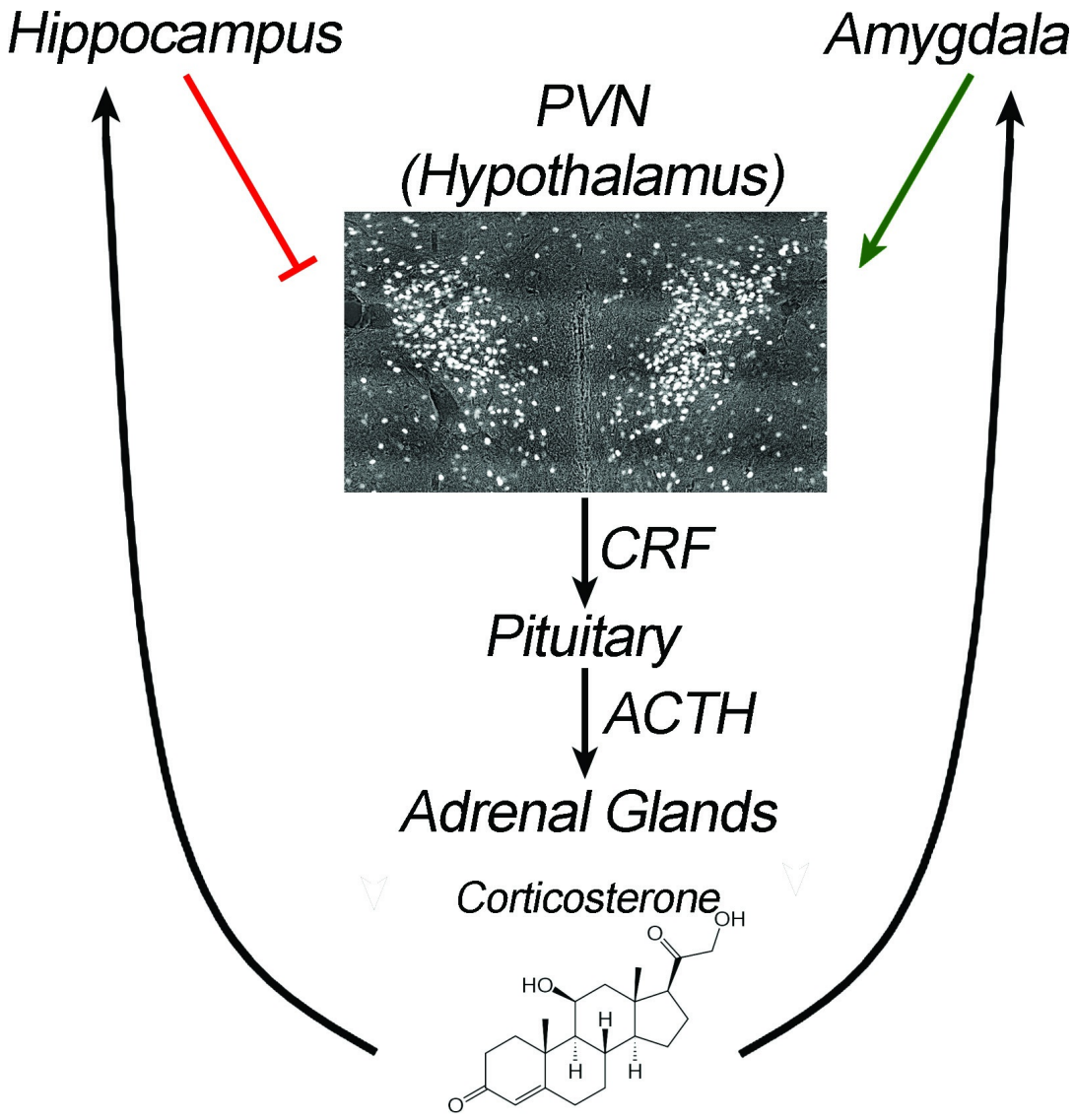
Sensory abnormalities, such as hypersensitivity to bright lights and loud sounds, are a common symptom in human autism spectrum conditions (ASC). Here we investigate a potential biological and genetic underpinning of these effects using a fruit fly model of autism. Mutations in the sodium-hydrogen exchanger gene Nhe9 have been linked with ASC in humans (Morrow et al, 2008), and the fly homologue is the Nhe3 gene.
Objectives:
We investigated whether Nhe3 mutations affect visual responses in Drosophila.
Methods:
Two stocks of *Drosophila* were used: a mutant (KG) and a gene deficiency (DF). Matched eye-colour controls were used. SSVEP (Steady State Visual Evoked Potential) electroretinograms (Afsari et al, 2014) were recorded at 3 and 14 days old (i.e. juvenile and adult flies). The stimulus was a flickering blue LED, with 12Hz temporal frequency and 7 contrast levels (0-69%). The mean amplitudes for each contrast level for the target frequency (1F, primarily the photoreceptor response) and second harmonic (2F, primarily post-retinal neural responses) were calculated. We tested at least 12 flies of each genotype and age, and averaged amplitudes across all individuals.
Results:
All Nhe3 mutant genotypes differed substantially from wild type controls and heterozygotes (mutant-wild type crosses). The key finding is that young (3-day-old) KG homozygote flies show reduced response amplitudes at 1F and 2F (both 30% less than wild types). This was confirmed by testing the KG/DF cross: at 3 days these also had lower response amplitudes at both 1F and 2F. Older (14 days) KG and KG/DF flies had still had reduced 2F responses but their 1F responses were bigger than the controls. The 1F responses of 14-day-old flies were bigger than the 3-day-old flies.
Conclusions:
ERG response amplitudes differ between ASD model fruit flies and wild type controls at both 3 and 14 days of age. Fourteen-day-old mutants show increased sensitivity in photoreceptors as indicated by higher 1F amplitude but decreased response from more complex cells (lamina neurons) as evidenced by their lower 2F amplitudes. This suggests that the transfer from photoreceptors to neurons higher up in the visual stream is reduced. Our results demonstrate that the Nhe3 gene has a critical impact on multiple stages of the visual pathway, and may also mediate neuronal health and function more widely throughout the nervous system. In a companion study, we report analogous effects in EEG data from human adults with a clinical ASD diagnosis (compared with age-matched controls), and in the normal population as a function of autistic traits. The fly data therefore provide a possible genetic model for sensory abnormalities in human autism.



3 **143.003** Autism Mouse Model Exhibits Dysregulated Norepinephrine Innervation and Neural Activity in the Limbic System

C. C. Peng[1,2], *J. Lunden*[1], *M. Genestine*[3], *V. Mirabella*[4], *S. Prem*[5] *and E. DiCicco-Bloom*[6], *(1)Rutgers Robert Wood Johnson Medical School, Piscataway, NJ, (2)Rutgers University, New Brunswick, NJ, (3)UMDNJ, Piscataway, NJ, (4)Child Health institute of New Jersey, New Brunswick, NJ, (5)Neuroscience, Graduate School of Biomedical Sciences, Piscataway, NJ, (6)Rutgers University - Robert Wood Johnson Medical School, Piscataway, NJ*

Background:
Autism Spectrum Disorder (ASD) is characterized by abnormalities in social interaction and restricted/repetitive behaviors. *Engrailed-2 (En2)*, a gene associated with ASD, is a neural patterning transcription factor involved in the development of the embryonic mid-hindbrain region, where norepinephrine (NE) producing neurons emerge. Previous studies indicate that *En2* knockout (*En2*-KO) mice display ASD-like deficits in social interactions, fear conditioning, and depression-related tasks (forced swim, tail suspension), which implicate abnormal stress responses. Environmental stressors elicit physiological responses by increasing Hypothalamus-Pituitary-Adrenal (HPA) axis activity, which initiate in the paraventricular nucleus of the hypothalamus (PVN). HPA axis activation, specifically PVN activity, is modulated by projections from limbic structures, including the amygdala (stimulatory) and the ventral hippocampus (VH) (inhibitory) (Figure 1). While dorsal forebrain structures in the *En2-KO* exhibit reduced NE levels and fiber innervation, innervation patterns into the ventral limbic system, including amygdala and PVN, are undefined.
Objectives:
Characterize NE fiber innervation into the basolateral amygdala (BLA) and PVN using biochemical and anatomical approaches, and determine whether neural activity, indicated by c-Fos immunohistochemistry, in BLA, PVN, and VH following swim-stress correlates with NE innervation.
Methods:
In postnatal day 60-70 wild type (WT) and KO mice (N=4-6/genotype), western blot analysis was performed to determine protein levels of norepinephrine transporter (NET) and tyrosine hydroxylase (TH). NET-containing fibers in BLA and PVN were assessed on tissue sections using immunohistochemistry. To measure stress response, animals were given 10 minutes of swim stress followed by PFA fixation via cardiac perfusion at 120 to 140 minutes. All perfusions occurred between 2:30 to 4:30 PM EST.
Results:
En2-KO mice exhibited increased NET (1.7-fold, $p<0.02$) and TH (1.5-fold, $p<0.002$) protein levels in the amygdala. NET fiber counts were also increased in BLA (2.3-fold, $p<0.0007$) and PVN (1.7-fold, $p<0.016$). Following swim stress, *En2*-KO mice exhibited increased c-Fos nuclei in PVN (2.25-fold, $p<0.006$), suggesting an increase in neural activity. However, c-Fos nuclei were decreased in VH (50%, $p<0.02$) of the same animals following swim stress, suggesting decreased post-stress neural activity in VH.
Conclusions:
Our observations indicate that *En2*-KO mice are hyperinnervated by NE fibers in the PVN and BLA. Additionally, neural activity in the PVN is increased >2 fold under stress conditions, changes that parallel fiber innervation. Conversely, in the hippocampus, where NE levels and fibers are reduced (Genestine et al, 2015), there is a 50% decrease in c-Fos activity. Given that the amygdala plays a stimulatory role and the VH elicits inhibition in the PVN, the changes we detect in fiber patterns and neural activity would be predicted to exaggerate stress circuit activation and responses, which in turn likely contribute to the *En2*-KO deficits in social interactions, fear conditioning, and depression-related tasks. More generally, these studies of the *En2*-KO mouse model provide insights into neurobiological mechanisms by which common genetic variants associated with neurodevelopmental disorders alter the balance of neural pathways. Consequently, these structural and functional differences may increase subject vulnerability to other genetic and environmental factors in disease causation.



4 **143.004** Autism-Associated Gene Engrailed-2 Plays a Cell Autonomous Role in Regulating Proliferation and Cell Death in Hippocampal Neural Stem Cells in Vitro

***M. Durens**, S. Chung and E. DiCicco-Bloom, Rutgers University - Robert Wood Johnson Medical School, Piscataway, NJ*

Background: *Engrailed-2 (En2)* is a homeodomain transcription factor important in the proper development of the cerebellum and midbrain. Two intronic single nucleotide polymorphisms were shown to be over-transmitted to individuals with autism spectrum disorder (ASD) compared to unaffected siblings. Similar neuropathology is observed in the cerebellum of *En2* knockout (*En2*-KO) animals and some ASD patients, including reduced cerebellar vermis size, decreased Purkinje neuron numbers, and defects in foliation. More recently, there is increased attention to changes in the forebrain, in part because ASD-related behavioral phenotypes in the *En2*-KO, such as deficits in social interactions, fear conditioning and learning, depend on forebrain circuits. These behaviors are accompanied by structural changes, including reduced weight, size and cell number in several areas including hippocampus, likely reflecting abnormalities in neurogenesis. Indeed, *En2*-KO exhibits ~2-fold increases in stem cell proliferation and immature neuron apoptosis in the dentate gyrus, which implies that En2 activity in the brain can regulate proliferation and cell survival in the hippocampus. While these differences have been attributed to reductions in norepinephrine innervation, very low levels of *En2*are detected in the hippocampus, raising the possibility of cell autonomous functions.
Objectives: This study seeks to examine cell autonomous roles for *En2* in regulating hippocampal neurogenesis by showing that (1) stem cells cultured in vitro as neurospheres express *En2*, and (2) the absence of *En2*in cultured cells leads to increased proliferation and apoptosis.
Methods: Hippocampi from P7 *En2*-KO and WT mice were dissociated and cells were plated in defined media containing 2% B27 supplement, 20 ng/ml EGF and 10 ng/ml FGF. *En2* mRNA expression was assessed using quantitative PCR. Primary neurospheres were assayed for neurosphere numbers and size after 7 days in culture. Immunofluorescent labeling of whole neurospheres was performed to determine rates of proliferation (BrdU incorporation) and apoptosis (cleaved caspase-3, pyknosis). Experiments were performed at least 3 times, with each experiment consisting of at least one WT and *En2*-KO culture.
Results: Expression of *En2* mRNA as well as its homolog *Engrailed-1* was detected in WT neurospheres. While primary neurosphere assays revealed no change in numbers of primary spheres, measurement of sphere diameter showed increased frequency of larger spheres in *En2*-KO, suggesting potential effects on proliferation and/or survival. Compared to WT neurospheres, the *En2*-KO exhibited a 2-fold increase in BrdU labeling ($p<0.005$) as well as apoptosis ($p<0.05$).
Conclusions: This study suggests that *En2* plays a role in regulating proliferation and apoptosis in hippocampal neural stem cells. While evidence of *En2* expression in hippocampal dentate gyrus cells *in vivo* remains uncertain, we were able to show expression of *En2* in neural precursor cultures. Furthermore, increased proliferation and cell death observed in *En2*-KO neurosphere cultures recapitulates what is observed *in vivo*, suggesting that *En2* may inhibit proliferation and promote survival in a cell autonomous manner. More broadly, these studies indicate how the activities of developmental regulatory genes in diverse brain regions impact brain structure and function, and may contribute to our understanding of how ASD-related behaviors occur in the *En2*-KO mouse.

5 **143.005** Bioinformatics Analysis of Phenotypic Data of ASD Rodent Models

*I. Das, **M. A. Estevez** and S. B. Basu, MindSpec, Inc., McLean, VA*

Background: The Autism Database (AutDB) is a publicly available, manually annotated, modular database that serves as an ongoing collection of genes linked to Autism Spectrum Disorders (ASD). The animal model module of AutDB catalogues over 600 ASD-related rodent models, extracted from primary literature.
Objectives: Although there have been other comparative analyses of ASD rodent models, they have been limited in scope, both in terms of the number of animal models and the extent of phenotypic assessments used. By looking at the total data sets of rodent models that is available in AutDB, we are expanding our analysis to more than 600 ASD rodent models, and about 375 phenotypic parameters, divided in 16 larger categories. A bioinformatics analysis of this scope can be used to elucidate ASD research trends and etiology
Methods: All data is extracted from published, peer-reviewed primary reports. The metadata is standardized in a phenotypic database, which is a routinely updated comprehensive list of phenotypic terms (pheno-terms) and experimental paradigms. These pheno-terms reflect the actual research and are divided into categories that align with human ASD phenotypic features. For each individual model, annotated pheno-terms contain a given value (e.g. *increased*, *decreased*, *no change*, *abnormal*). Using the aggregate of these pheno-term values, models are clustered into functional groups.
Results: ASD rodent models cluster based on phenotypic data that reflect neurophysiological, behavioral and developmental complexity. By looking at a broad genetic and environmental model set we are able to ascertain common underlying biological mechanisms in ASD etiology.
Conclusions: The AutDB animal model module serves as a detailed repository of rodent model phenotypes reported in the ASD field. The scientific standardization of phenotypic parameters allows for data mining and bioinformatics analysis. Our present analysis provides a glimpse of the complexity of ASD etiology, and allows us to visualize the contribution of both genetic and environmental factors by using animal models.

6 **143.006** Characterization of Four ASD Mouse Models Reveals Common Behavioral Phenotypes and Transcriptional Networks in the Striatum

*O. Oron[1], S. Shohat[2], E. Reuveni[1], S. Shifman[2] and **E. Elliott**[1], (1)Faculty of Medicine, Bar Ilan University, Safed, Israel, (2)Hebrew University of Jerusalem, Jerusalem, Israel*

Background:
In recent years, multiple mouse models have been produced to study autism. In order to gain high-impact information from these mice models, we propose that the parallel behavioral and molecular phenotyping of several mouse models will help to identify behaviors and molecular mechanisms that are in common, and are therefore more likely to be directly involved in autistic behavior.
Objectives:
In our current study, we looked at locomotor function, anxiety, and risk assessment behaviors in four well-established autism mouse models. In order to discover common molecular pathways that are dysregulated in all mouse models, we did whole transcriptome sequencing (RNA-seq) of the striatum of these mice models. By comparing the behavior of these multiple models and the transcriptome dysregulation in the striatum, a brain area highly involved in these behaviors, we can determine specific molecular mechanisms that are directly responsible for the relevant behavioral dysfunctions.
Methods:
We performed motor-related and risk- assessment related behavioral and molecular experimentation on four mouse models of ASD: Shank3 KO, CNTNAP2 KO, Chr16p11.2del, and BTBR mice. We performed Open Field (OF), rotorod, Dark Light (DL), and Elevated Plus Maze (EPM) on all mouse models. We used this data to quantify locomotor function, anxiety-levels, and risk assessment behaviors. RNA was extracted from the striatum of all four mouse models, and their controls, and performed whole throughput RNA sequencing (RNA-seq) on all samples. RNA-seq data was analyzed by both differential expression and WGCNA (Weighted Gene Correlation Network Analysis) to identify genes that are dysregulated in all models and that correlate with the behavioral phenotypes.
Results:
We found that all four mouse models showed either hyperactive or hypoactive behaviors (Shank3 KO was hypoactive, and the others are hyperactive), and all mouse models showed differential behavior in the anxiety/risk assessment tests. Of interest, we found that all genetic mouse models displayed a decrease in risk assessment behavior. Striatal gene expression analysis found that three of the four models share 31 genes that are commonly upregulated, including IGF2, IGFBP2, and Sema3b. WGCNA analysis, followed by protein-protein interaction networks, found that specific gene expression networks, such as networks including HDAC genes, could be correlated to the dysregulated risk assessment behavior in the autism mouse models.
Conclusions:
Common dysfunctions in risk assessment and locomotor behaviors are found in multiple autism mouse models. In addition, we can correlate these behaviors to distinct gene expression networks. This study provides evidence that we can discover novel molecular pathways involved in the autism-related behavior through the parallel molecular and behavioral phenotyping of multiple autism mouse models.

7 **143.007** Conserved GABA/GAMMA Coupling Is Seen in a Translational Preclinical Model That Recapitulate a Key Aspect of ASD

***R. G. Port**[1], G. C. Carlson[2] and T. P. Roberts[3], (1)Neuroscience Graduate Group, Biomedical Graduate Studies, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, (2)Psychiatry, University of Pennsylvania, Philadelphia, PA, (3)Children's Hospital of Philadelphia, Philadelphia, PA*

Background:
Autism spectrum disorders (ASD) have been hypothesized to arise from an imbalance of excitation and inhibition (E/I imbalance). In both clinical and preclinical studies, E/I imbalance has been repeatedly observed using a wide range of techniques. One result of E/I imbalance could be altered gamma-band activity (GAMMA), which is thought to be heavily reliant on inhibition for its generation. Accordingly, concurrent to the E/I imbalance findings, alterations to GAMMA are present across modalities in ASD, being recapitulated by multiple independent groups. These GAMMA deficits are also present in preclinical models recreating key aspects of ASD.

In healthy adults GAMMA is related to GABAergic tone in both motor and visual systems, though not without controversy. Preliminary work suggests this is also true for the auditory system, and that concomitant decreases in both GABA and GAMMA are present in ASD within the same participants. Furthermore, the biological coupling of neurochemistry and neuronal GAMMA activity is conserved is ASD. What remains to be known is if this GABA/GAMMA coupling seen in humans translates to pre-clinical phenotypes (as with E/I imbalance and GAMMA activity separately).
Objectives:
Determine if the GABA/GAMMA coupling seen in the auditory system of both typically developing participants and participants with ASD, is recreated in an animal model that recreates a key aspect of ASD.
Methods:
Magnetoencephalography (MEG) and magnetic resonance spectroscopy (MRS) was used to record neuronal activity and GABAergic tone (respectively) in both typically developing participants and participants with ASD. This was contrasted to translational pre-clinical findings from an animal model that recapitulates key aspects of ASD (Protocadherin 10 heterozygous mice [PCDH10 +/-]) and their wild-type counterparts. In-vivo electroencephalography (EEG) and high performance liquid chromatography (HPLC) recorded neuronal responses and inhibitory tone in these mice respectively. To allow for comparison of electrophysiological data, near identical analyses are implemented for both clinical and pre-clinical data.
Results:
GABA and GAMMA are correlated in both typically developing participants and participants with ASD (R^2_{TD}=0.31, $p<0.05$; R^2_{ASD}=0.13, p<0.05), with no difference between group level regression slopes (difference in slope of regression $p>0.1$). While separating based on genotype was not possible due to insufficient sample size, GABA and GAMMA appear correlated in PCDH10 +/- and their wild-type counterparts (R^2 =0.41, $p<0.05$).
Conclusions:
Typically developing participants and participants with ASD demonstrate an association between GABA and GAMMA, with the coupling conserved between groups. A pre-clinical murine model of ASD and their wild type counterparts also demonstrated such a relationship, suggesting this phenotype is conversed across species. Further study is needed to determine if within group associations of GABA and GAMMA differ between PCDH10 +/- mice and their wild type counterparts.

8 **143.008** Effects of Pargyline and Para-Chlorophenylalanine on Mouse Social Behavior

***G. G. Gould**[1], N. Witt[2], J. Allen[2] and A. Sanchez[3], (1)The University of Texas Health Science Center at San Antonio, San Antonio, TX, (2)Biology, University of Texas at San Antonio, San Antonio, TX, (3)Biology, St. Mary's University, San Antonio, TX*

Background: Impaired social behavior is a core symptom of autism that also appears in other psychiatric disorders like schizophrenia, bipolar disorder and depression. It has proven to be among the most treatment-resistant of psychiatric illness symptoms. Serotonin (5-HT) is a monoamine neurotransmitter that regulates mood balance in the brain, it is also a strong shaper of social behavior. For example in some patients and in mice sociability deficits in behavior tests worsen with decreases in 5-HT availability, but improve following administration of the selective serotonin reuptake inhibitor (SSRI) fluoxetine, which enhances 5-HT neurotransmission.
Objectives: The purpose of this study was to determine if increasing serotonin availability in the brain would correspond with improvements in sociability. Conversely we predicted that reducing serotonin availability in the brain would worsen sociability in either innately gregarious or socially deficient mice.
Methods: To test this hypothesis, we performed social interaction, social novelty, locomotor and repetitive behavioral tests on BTBR mice, a socially deficient s inbred strain, and C57BL/6 mice, which display normal social behaviors. Before testing, adult males of both strains were given either a single injection of 100 mg/kg pargyline, a monoamine oxygenase inhibitor, to block the metabolic breakdown of 5-HT in the brain, or 300 mg/kg over 3 days of para-chlorophenylalanine (PCPA), a tryptophan hydroxylase inhibitor to block 5-HT synthesis in the brain. Controls were treated with vehicle on the same schedule with the drug treatments. The behavioral tests employed

were mouse three-chamber sociability and marble burying as an index of restrictive repetitive behavior.
Results: We observed in social interaction preference tests that PCPA treatment enhanced PCPA increased locomotor activity in C57BL/6, but not BTBR mice. More critically PCPA reduced social interaction preference in both strains, with little effect on social novelty preference. On the other hand, pargyline enhanced social interaction preference in C57BL/6 and social novelty preference in both strains. Marble burying was unchanged by either PCPA or pargyline treatments.
Conclusions: Findings from our study demonstrate that pargyline likely induced increases in brain serotonin concentrations that enhanced social behavior in both socially impaired mice, and normal mice. Conversely they also show that PCPA induced-decreases in available brain serotonin generally suppressed mouse sociability. Overall, these findings lend further support to the hypothesis that sociability is shaped by central 5-HT availability.

9 **143.009** Efficacy of Risperidone in an Insulin-Resistant Mouse Model of Hyperactivity and Deficient Sociability

***V. R. Garbarino**, UTHSCSA, San Antonio, TX*

Background: Many patients with autism are given risperidone, an atypical antipsychotic, to control restrictive-repetitive behaviors, impulsivity and aggression. Risperidone has tranquilizing properties, mediated primarily by its actions as an antagonist at dopamine D_2 receptors, and risperidone does little to promote social interaction behavior in most patients. Unfortunately, long-term use of risperidone often produces serious metabolic side-effects including increased appetite, obesity, and early onset of type II diabetes. In doing so, risperidone may also modify the dopaminergic response of patients by elevating their insulin levels. This is because insulin enhances the function of dopamine transporters, making them more efficient at removing dopamine from brain extracellular fluid.
Objectives: We hypothesize that elevated insulin levels will enhance the expression and function of dopamine transporters and D_2 receptors, and mute behavioral responses to risperidone treatment. This hypothesis was tested in mice with natural mutations that alter circulating levels of insulin. Since autism is 5x more prevalent in males than in females, and because insulin levels in male mice were more responsive to these genetic modulators, only male mice were used in this study.
Methods: Black-and-tan Brachyury Tufted (BTBR T+Itpr^{3}tf/J mice, crossed with C57BL/6 mice yield F1 hybrid offspring that are socially impaired and insulin resistant. The F1 mice have increased abdominal adiposity, and elevated insulin levels relative to either parent strain by 10 weeks of age. Levels of insulin are greatest in F1 hybrids > BTBR > C57BL/6 mice. These mice were treated acutely with risperidone (0.01 mg/kg) or vehicle and behaviorally tested in three-chamber sociability and marble burying tests. Their social dominance was also compared in a tube test. Brains from naïve mice were also used in-vitro in radioligand binding and uptake studies for the dopamine transporter and D2 receptor to compare binding site density and functional response in mice within a physiologically-relevant range of insulin levels.
Results: F1 mice were socially deficient in three-chamber tests, and were more impulsive than either parent strain in a social dominance test. Their social and repetitive behavior was not improved by risperidone administered acutely. In fact, risperidone treatment was less effective in BTBR and F1 hybrid mice at reducing marble burying than it was in C57BL/6 mice. [^{3}H] WIN 35,428 binding to dopamine transporters was similar among strains, but [^{3}H] dopamine uptake was significantly increased in BTBR mice. [^{3}H] dopamine binding sites were higher in BTBR and F1 hybrids than in C57BL/6 mice.
Conclusions: Dopamine transmission may be suppressed in F1 and BTBR mice by elevated insulin levels, which may alter their responsiveness to risperidone. As evidence of this, marble burying in F1 mice was unaffected by an acute risperidone treatment, while the same dose of risperidone reduced this in C57BL/6 mice. The BTBRxBL6 F1 mouse appears to be a useful physiological model for investigation of long-term drug treatment effects on the social brain and on glucose metabolism.

10 **143.010** Estrogen Receptor Î² Protects Against ASD-like Behavior in Mice

***A. M. Crider**, Georgia Regents University, Augusta, GA*

Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder affecting 1 in 68 children in America and approximately 1% of the population worldwide. Although the underlying neurobiological mechanism for ASD pathophysiology is not clear, recent studies have suggested the role of endoplasmic reticulum stress in ASD. Moreover, our recent study has shown that ER stress induces ASD-like behavior including communication deficits, social deficits, depressive behavior, and repetitive behavior mechanism in mice. ASD is generally thought to be gender-specific with 5 times more males diagnosed with the disorder than females suggesting a potential role of female sex hormones in ASD. We recently showed that estrogen receptor β (ERβ) is reduced in the prefrontal cortex of ASD subjects as compared to age- and gender-matched control subjects. However, the mechanisms behind this deficit are not known.
Objectives: This study aims to determine whether estrogen receptor β signaling can protect against endoplasmic reticulum (ER) stress induced behavioral deficits in mice.
Methods: ER stress was induced by administering tunicamycin (1mg/kg I.P.) to mice. Protein levels were measured by western blot analysis whereas RT-PCR was used for gene expression analysis. Behavioral tests were performed including ultrasonic vocalization recordings, social interaction test, grooming test, marble bury test, forced swim test, tail suspension test, and open field test. The role of ERβ was examined by pharmacological as well as genetic manipulations in mice.
Results: We found that ER stress in mice reduces ERβ signaling in mouse frontal cortex. ER stress induced ASD-like behavior such as social deficits, depressive-like behavior, increases in obsessive behaviors, and communication deficits. Moreover, boosting ERβ signaling could reverse ER stress-induced deficits in ASD-like behavior in mice.
Conclusions: ERβ is a possible target for treatment of ASD and related neurodevelopmental disorders.

11 **143.011** Exposure of Juvenile Mice to High-Dose Acetaminophen Confers Elevated Serum Cytokine Levels and Sociability Impairments in Adulthood

***M. T. Edwards**[1], G. G. Gould[1], S. T. Schultz[1] and R. Alvarez[2], (1)Physiology, The University of Texas Health Science Center at San Antonio, San Antonio, TX, (2)Naval Medical Research Unit, JBSA Fort Sam Houston, TX*

Background: Epidemiological evidence suggests that exposure of children younger than 5 years old to acetaminophen may be problematic for social brain development if it can't be properly metabolized. Conjugative disposition pathways may be underdeveloped or compromised in some children treated with acetaminophen. Oxidative degradation pathways for acetaminophen are capable of triggering immune responses. We hypothesized that immune system activation could potentially disrupt juvenile brain development to produce autism-like behaviors in mice. However, the specific factors mediating these effects have not been described, although parallels have been described for mice treated with valproic acid. We have used high dose acetaminophen exposures in juvenile mice (P18-21) to explore mechanisms that might compromise sociability in this population of acetaminophen sensitive children.
Objectives: The hypothesis underlying this study was that high-dose (>100 mg/kg) acetaminophen exposure in weanling (PD 18-21) mice might trigger unique and enduring immune responses that correspond with impairments in the social behavior of C57BL/6J mice, or worsening of them in socially deficient BTBR mice. These enduring changes in the immune system may persist and serve as biomarkers of such exposures.
Methods: Male C57BL/6 and BTBR mice were exposed for 4 days to injections of acetaminophen (400 mg/kg) or vehicle (saline + 10% DMSO), and matured to adulthood (PD 80). Three chamber sociability tests of C57BL/6 mice revealed a significant ($p<0.05$) reduction in social interaction relative to vehicle controls that was comparable to prenatal treatment with valproic acid. However, the social behavior of BTBR mice was unaffected. We postulated that persistent adverse immune responses might have contributed to this outcome. Serum collected after the behavior tests was used for cytokine and chemokine measurements performed using the Bio-plex mouse cytokine 23-plex panel on the Bio-plex 200 suspension array system.
Results: Eotaxin levels were significantly higher in C57BL/6 adults treated as juveniles with high dose of acetaminophen. These mice also had high levels of TNF-α and G-CSF, both of which act as stimulation factors for granulocytes. In contrast, in BTBR mice, eotaxin levels were low and along with G-CSF, they remained unaffected by acetaminophen. TNF-α expression was reduced in acetaminophen treated BTBR relative to controls. Eotaxin can inhibit neurogenesis, particularly in the hippocampus. We therefore looked for evidence of reduced hippocampal serotonergic neuronal density based on saturated serotonin transporter binding by quantitative autoradiography, but we found no difference from control treatment values. However, the elevated eotaxin levels in C57BL/6 treated as juveniles with high-dose acetaminophen and differences among strains in their levels may relate in other ways to their sociability phenotypes.
Conclusions: The strain of mouse used in immune system challenge studies strongly influences the outcome of such studies and must be carefully considered. BTBR mice have impaired sociability that was not influenced by high dose acetaminophen. However, in C57BL/6 mice, social behavior was impaired and elevated eotaxin levels may be biomarkers of acetaminophen induced oxidative stress endured during juvenile development that can be measured in adulthood.

12 **143.012** Gestational Valproic Acid Alters Polyamine Metabolism in the Mouse Placenta: Implications for Autism Spectrum Disorders Causation

***A. Sokoloff**[1] and S. M. Mimche[2], (1)Emory University Physiology, Atlanta, GA, (2)Physiology, Emory Uiversity, Atlanta, GA*

Background: Currently ~40% of Autism Spectrum Disorders (ASD) risk is attributed to non-genomic factors. Gestational use of the antiepileptic drug valproic acid (VPA) is one such factor that is associated with substantial increase in offspring risk of ASD. In the mouse, mid-gestational administration of VPA results in ASD-like anatomy and behavior in offspring. Although ASD-promoting effects of VPA are commonly considered to operate by histone deacetylase inhibition, VPA impacts many signaling pathways leaving unresolved the molecular mechanism(s) by which VPA promotes an ASD phenotype.
Objectives: We have realized that many maternal risk factors for ASD correlate with dysregulation of polyamine (PA) metabolism (e.g., rheumatoid arthritis, diabetes) implicating PA dysregulation in ASD causation. To our knowledge it is not known whether VPA can disrupt PA metabolism and thus whether the effects of gestational VPA might be mediated by dysregulation of PA metabolism. As a first-test of a VPA-PA link we here ask whether gestational administration of VPA in the mouse can cause dysregulation of placental PA metabolism.
Methods: Pregnant CD1 mice were injected subcutaneously with 600 mg/kg VPA or with equivalent volume physiological saline on gestational days 12, 13 and 14 and

tissue was harvested ~4 hours post-final treatment. Placentas were dissected and assigned to analysis by (1) qRT-PCR of mRNA of polyamine pathway enzymes ornithine decarboxylase 1 (ODC), adenosylmethionine decarboxylase 1 (AMD1) and spermidine/spermine N1-acetyltransferase 1 (SAT1), (2) SDS-PAGE-Western of ODC protein or (3) Hematoxylin-Eosin histochemistry for determination of placenta mid-sagittal cross-sectional area (following cryostat sectioning).
Results: Compared to controls, mRNA of all PA enzymes was elevated by 1.38±0.09x (ODC, average±SD), 1.90±0.10x (AMD1) and 1.59±0.57x (SAT1) by VPA. By Western, ODC protein was elevated 1.6x by VPA. Placenta cross-sectional area was decreased following VPA treatment (10.8± 2.2 mm^2 VPA versus 14.4± 2.0 mm^2 Control).
Conclusions: These results demonstrate that gestational VPA can alter placental PA metabolism with morphological consequence. Whether VPA impacts PA metabolism in maternal and fetal compartments and in the placenta at other developmental time points awaits further investigation.

13 **143.013** Modulating Excitation: Inhibition Imbalance in ASD As a Means of 'Fractionating the Spectrum'; An In Vivo, Clinical [1H]-MRS Assay

L. A. Ajram[1], *J. Horder*[2], *R. H. Wichers*[3], *S. C. Williams*[4], *R. A. Edden*[5], *C. M. Murphy*[3], *D. G. Murphy*[3] *and G. M. McAlonan*[6], *(1)Institute of Psychiatry, London, United Kingdom, (2)Institute of Psychiatry, King's College London, London, England, United Kingdom of Great Britain and Northern Ireland, (3)Sackler Institute for Translational Neurodevelopment, Department of Forensic and Neurodevelopmental Sciences,, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (4)Centre for Neuroimaging Sciences, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (5)Johns Hopkins University School of Medicine, Baltimore, MD, (6)Department of Forensic and Neurodevelopmental Science, IoPPN, KCL, London, United Kingdom*

Background: There are no pharmacological treatments for the core symptoms of Autism Spectrum Disorder (ASD). However, accumulating evidence suggests an imbalance between excitatory (E) glutamate and inhibitory (I) GABA in ASD; and may explain the early promise of proGABA and anti-glutamate drugs such as riluzole. Here we tested the hypothesis that, compared to unaffected controls, individuals with ASD have differences in the E/I response to a riluzole drug challenge.
Objectives: There are no pharmacological treatments for the core symptoms of Autism Spectrum Disorder (ASD). However, accumulating evidence suggests an imbalance between excitatory (E) glutamate and inhibitory (I) GABA in ASD; and may explain the early promise of proGABA and anti-glutamate drugs such as riluzole. Here we tested the hypothesis that, compared to unaffected controls, individuals with ASD have differences in the E/I response to a riluzole drug challenge.
Methods: Subcortical Glx was significantly lower in men with ASD compared to controls at baseline (placebo, p=0.03). Riluzole significantly increased the inhibitory index in the subcortex of both groups (p = 0.04). However, in the prefrontal cortex, riluzole increased the inhibitory index in the ASD group only (p=0.04). Post-hoc testing suggested that increases in inhibitory indices in both groups were driven by increased GABA. Differences in frontal lobe connectivity in ASD appeared normalized by riluzole. The difference in the effect riluzole has on E:I balance in the ASD cohort is significantly associated with baseline E:I levels and symptom presentation.
Results: Subcortical Glx was significantly lower in men with ASD compared to controls at baseline (placebo, p=0.03). Riluzole significantly increased the inhibitory index in the subcortex of both groups (p = 0.04). However, in the prefrontal cortex, riluzole increased the inhibitory index in the ASD group only (p=0.04). Post-hoc testing suggested that increases in inhibitory indices in both groups were driven by increased GABA. Differences in frontal lobe connectivity in ASD appeared normalized by riluzole. The difference in the effect riluzole had on E:I balance in the ASD cohort was significantly associated with baseline E:I levels and symptom presentation.
Conclusions: Individuals with ASD have differences in E/I balance (lower subcortical Glx in ASD) and responsivity (Riluzole increases inhibition in the cortex of ASD patients only), at regional (shown by MRS) and whole-brain levels (shown by fMRI). Thus, the glutamate-GABA system may be a tractable treatment target in ASD. This MRS/rs-fMRI approach may provide a safe means to fractionate the ASD sample into more biologically homogeneous sub-groups, for example prior to clinical trial. Baseline E:I levels are potentially predictive of E:I 'responsivity', therefore this approach may also help predict who will be responsive to glutamate-GABA treatments (such as riluzole).

14 **143.014** Neurobehavioral Abnormalities Relevant to Autism Spectrum Disorders Are Detected in Mice with Selective Expression of Mutant DISC1 in Purkinje Cells of Anterior Cerebellum

A. V. Shevelkin[1,2], *B. N. Abazyan*[1], *C. Yang*[1], *O. A. Mychko*[1], *G. L. Rudow*[3], *J. C. Troncoso*[3] *and M. V. Pletnikov*[1,4], *(1)Departments of Psychiatry and Behavioral Sciences, Johns Hopkins University School of Medicine, Baltimore, MD, (2)P.K.Anokhin Institute of Normal Physiology, Moscow, Russia, (3)Departments of Pathology, Johns Hopkins University School of Medicine, Baltimore, MD, (4)Solomon H. Snyder Department of Neuroscience, Johns Hopkins University School of Medicine, Baltimore, MD*

Background: Disrupted-In-Schizophrenia-1(DISC1) and its variants have been associated with neurodevelopmental disorders, including schizophrenia and autism spectrum disorders (ASD). Purkinje cells (PC) express DISC1. We generated a mouse model of inducible and selective expression of mutant DISC1 in PC of anterior lobuli of the cerebellum (II-V and internal side of VI).
Objectives: We sought to analyze the brain and behavioral alterations in this mouse model.
Methods: We evaluated volume of the cerebellum and PC in mice at postnatal (P) day 21 and 150 after assessing behavioral phenotypes in male and female mice in novelty-induced activity, elevated plus maze, Y maze, object and place recognition, fear conditioning and rotarod. Conventional western blotting and electrophysiological technics were used in the experiments. All protocols were approved by the Animal Care and Use Committee at Johns Hopkins University.
Results: We found a significant decrease in PC size at P21 but not at P150. Analysis of soma PC size showed small and big soma PC in the anterior cerebellum of control mice, but only small soma PC size in mutant DISC1 mice at P21. Neither total number of PC nor volume of the cerebellum were significantly altered in mutant DISC1 mice. No up-regulation of cellular markers of inflammation was observed in mutant mice. Mutant male but not female mice demonstrated abnormal social interaction, hyperactivity and deficient novel object recognition. We observed no group differences in elevated plus maze, spontaneous alteration or spatial recognition in Y maze. Preliminary electrophysiological experiments found higher frequency and amplitude of mEPSCs, but no changes in excitability and R_{input} of PC in mutant DISC1 mice. Mutant DISC1 mice had comparable expression of NR1 and NR2A but significantly more expression of SNAP-25 and PSD-95 in the cerebellum but not in the cortex.
Conclusions: Our findings indicate that mutant DISC1 affects PC morphology at P21 and produces cognitive and social abnormalities in adult mice. This may have the potential to advance our knowledge of the role of DISC1 in maturation and function of the cerebellum related to neurodevelopmental disorders.

15 **143.015** Peri-Conceptionnal Exposure to Sulphonamide Antibiotic Increases Anxiety and Reduces Social Interactions in Wistar Rat Offpring

S. Degroote, *D. Hunting and L. Takser, Université de Sherbrooke, Sherbrooke, QC, Canada*

Background: There is a growing body of evidence that gut microbiota characteristics might be closely related to mental dysfunctions. However, no studies are available on maternal gut microbiota and fetal brain development, despite large use of antibiotics in obstetric practice.
Objectives: To determine how periconceptional exposure to SuccinySulfaThiazole (SST), a non-absorbable antibiotic, can affect behavior in rat offspring.
Methods: Females Wistar rats were divided in two groups: control, or exposed during one month before breeding until Gestational Day 15 to a diet containing 1% SST. Behavioral tests were then administered to offspring: nest-seeking behavior, open field, marble burying, elevated plus maze, and test of social interactions.
Results: Both males and females offspring exposed peri-conceptionnally to SST showed reduced social interactions. Male offspring showed altered olfactory discrimination of maternal odour in the nest-seeking behavior test and reduced exploration of the open arm in the elevated plus maze test.
Conclusions: Periconceptionnal exposure to SST provoke alterations in offspring's behavior without any maternal infection, and given the fact SST is a non-absorbable antibiotic, we speculate that these neurobehavioral alterations are related to gut microbiota alterations.

16 **143.016** Resveratrol Prevents Behavioral Changes in the Valproic Acid-Induced Animal Model of Autism, Modulating Excitation/Inhibition Balance in Mpfc and Hippocampus

G. Della Flora Nunes[1,2], *M. F. Dutra*[1,3], *V. Bambini-Junior*[1,4], *W. S. Nunes*[1,3], *M. M. Hirsch*[1,3], *G. Z. Staevie*[1,3], *G. B. Negrini*[1,3], *J. S. Terra*[1,3], *G. B. Schwingel*[1,3], *T. Quadros*[1,3], *T. Gonchoroski*[1,3], *R. Riesgo*[1,5] *and C. Gottfried*[1,3], *(1)Translational Research Group in Autism Spectrum Disorder (GETTEA), Porto Alegre, Brazil, (2)SUNY at Buffalo, Buffalo, NY, (3)Research Group in Neuroglial Plasticity, Porto Alegre, Brazil, (4)Oswaldo Cruz Institute, Oswaldo Cruz Foundation, Laboratory on Thymus Research, Rio de Janeiro, Brazil, (5)Child Neurology Unit, Clinical Hospital of Porto Alegre (HCPA), Porto Alegre, Brazil*

Background: Autism spectrum disorder (ASD) is a neurodevelopmental disability characterized by sociability impairments accompanied by communication deficits and stereotyped behavioral patterns. Although ASD etiology is still not known, there is growing evidence that an imbalance between excitation and inhibition is a prominent characteristic at the neuronal circuitry level. One of the known risk factors for ASD is maternal use of valproic acid (VPA) during gestation. Based on this observation, VPA is commonly used to generate an ASD-like condition in rodents.
Objectives: Considering the neuroprotective, antioxidant and anti-inflammatory effects of resveratrol (RSV), we aimed to investigate the influence of prenatal RSV treatment on a set of social behaviors. In addition, we assessed the influence of this treatment on mRNA and protein expression levels of excitatory (PSD-95 and neuroligin-1) and inhibitory (gephyrin and neuroligin-2) synaptic proteins in medial prefrontal cortex (mPFC) and hippocampus.
Methods: Pregnant females were randomly divided into four groups: Control, RSV, VPA and VPA + RSV. Valproic acid (600 mg/Kg) was injected intraperitoneally on embryonic day 12.5 (E12.5). Resveratrol (3.6 mg/kg) was administered subcutaneously every day from E6.5 to E18.5. Control group received only vehicle. Social behavior was assessed through social transmission of food preference (STFP) in young male rats and by three chamber and empathy tests in adults. Two animals per litter of at least 4 litters were tested. Levels of synaptic proteins were determined using qRT-PCR and Western blot analysis. Statistical analysis was performed using the SPSS 20 Software. Two-way ANOVA was used for all tests, except the three-chamber, which was analyzed by a generalized estimating equation (GEE).
Results: In the three-chamber test, VPA rats presented no preference between a new object and a new rat and no preference for social novelty. Prenatal administration of resveratrol prevented these VPA-induced social impairments. In the STFP, VPA animals showed impaired communication, as indicated by the absence of preference for the flavored food consumed by the demonstrator rat. RSV treatment again averted VPA action, but interestingly switched the preference toward the new flavor. The empathy test

revealed that VPA rats have a delay in the first opening of the restrainer to release the trapped conspecific to in comparison to controls. However, once they start opening the restrainer, they opened it in the subsequent days. Resveratrol did not change this pattern. For the expression analysis, we found that RSV led to a trend of decrease in the level of protein PSD-95 in the mPFC of the VPA+RSV group animals compared to the VPA group (p=0,092), probably exerting its actions at the translation level. In addition, RSV increased gene expression of gephyrin in both mPFC and hippocampus.
Conclusions: Therefore, the present study demonstrates a successful prenatal intervention able to prevent social alterations induced by VPA in rats. In addition, we identified possible mechanisms by which RSV could diminish neuronal excitability. This can be the basis for the phenotypic prevention exerted by RSV and adds evidence to the growing body of findings that behavioral alteration can be mediated by excitation/inhibition regulation in ASD.

17 **143.017** Resveratrol Prevents Sensory Deficits in Animal Model of Autism Induced By Prenatal Exposure to VPA

M. F. Dutra[1,2], *G. Della Flora Nunes*[1,2], *M. M. Hirsch*[1,2], *W. S. Nunes*[1,2], *G. Z. Staevie*[1,2], *G. B. Negrini*[1,2], *G. B. Schwingel*[1,2], *J. S. Terra*[1,2], *R. S. Riesgo*[2,3], *C. Gottfried*[1,2] *and V. Bambini-Junior*[2,4], *(1)Research Group in Neuroglial Plasticity, Porto Alegre, Brazil, (2)Translational Research Group in Autism Spectrum Disorder (GETTEA), Porto Alegre, Brazil, (3)Neurology Unit, Clinical Hospital of Porto Alegre, Porto Alegre, Brazil, (4)Oswaldo Cruz Institute, Oswaldo Cruz Foundation, Laboratory on Thymus Research, Rio de Janeiro, Brazil*

Background: Autism spectrum disorder (ASD) is classified as a neurodevelopmental disorder, presenting impairments in social communication and sociability, as well as stereotyped behavioral patterns. Although the etiology remains unknown, there is growing evidence suggesting a complex interplay between genetic and environmental risk factors during pregnancy. Many CNS impairments are related to ASD (e.g. multisensory alterations) and recent data were pointing out to an unbalance between excitation and inhibition with high predominance in excitation compound, particularly in cortical and limbic areas related to sensory processing. Prenatal exposure to valproic acid (VPA) is an environmental risk factor to ASD development and it has been widely used to induce autistic-like behaviors in rodents. We previously showed that a prenatal treatment with resveratrol (RSV) was able to prevent the social deficits induced by VPA in male offspring rats.
Objectives: The present work aimed to investigate the effects of prenatal exposure to RSV and VPA in rats' sensory behaviors. In addition, we aimed to evaluate the gene expression of key synaptic components for the excitatory and inhibitory balance in the amygdala region.
Methods: Female rats were treated at 12.5 days of pregnancy, with VPA (600 mg/kg, i.p.) or vehicle. A low dose of RSV (3.6 mg/kg, s.c.) were administered from E6.5 to E18.5. Male pups from different litters of experimental groups were used for behavioral and molecular experiments. Two sensory behaviors were performed, at PN10 (Nest Seeking Behavior) and PN30 (Whisker Nuisance Task). After 30 days, male rats were euthanized and the relative gene expressions for synaptic proteins were evaluated. All data were analyzed by SPSS statistical program applying one-way ANOVA followed by Tukey's test.
Results: Regarding the nest seeking behavioral test, VPA group presented reduced number of correct choices to the nest, which is in accordance to the literature data. RSV was able to prevent this behavioral impairment (in RSV+VPA group). However, the time to reach any shavings was increased in both VPA and RSV+VPA group. The WNT showed the same pattern of prevention by prenatal administration of RSV. The VPA group presented higher score values (higher nuisance) compared to RSV and RSV+VPA groups. Therefore, the prenatal treatment with RSV was capable to reduce the score values when compared to VPA group. The present work showed for the first time, significant alterations at the genic expression of synaptic proteins related to excitatory and inhibitory synapses in the amygdala region, an important brain structure related to attachment behavior and emotional features in sensory processing integration, known to be altered in ASD. RSV increased the genetic expression level of Gephyrin in the amygdala of RSV group. Also, RSV decreased the genetic expression levels of Synaptophysin in RSV+VPA group. There were no changes in genetic expression of PSD95 among groups.
Conclusions: These data highlights RSV as an important preventive molecule in the study of autistic-like sensory behaviors in VPA model, as well as an important tool for seeking etiological targets and physiopathology studies in TEA.

18 **143.018** Sulforaphane Improved Social Communication Impairment in Valproate Induced Autistic Mice with up-Regulation of BDNF and NR2B in Cerebral Cortex

K. F. Chau, W. Yang, A. Y. T. Choi, W. N. Leung and ***C. W. Chan****, School of Chinese Medicine, The Chinese University of Hong Kong, Hong Kong, Hong Kong*

Background:
Autism (ASD) is a neurodevelopmental disorder in which the etiology remains speculative. There are various causative agents to trigger the onset of ASD. The histone deacetylase inhibitor, valproic acid (VPA) has been linked with the etiology of ASD. Rodent models with autistic features induced by VPA have been widely used in many researchers in the past decade. Various treatments have been applied to these ASD models but there is no remarkable method to ameliorate the autistic behavior. A recent clinical study has showed that sulforaphane (SFN) enriched broccoli extract could improve social communication of autistic children. However, the mechanism behind remains inconclusive. SFN has been reported to involve in various mechanisms such as DNA acetylation and counteracting oxidative stress. In this study, the effect of sulforaphane on VPA-induced mouse model of ASD and the mechanism behind was investigated.
Objectives:
This study aimed to investigate the effects of SFN toward the amelioration of autistic feature in ASD using a VPA-induced mouse model. Besides, the mechanism of SFN-related pathway will be studied in respect to the pathogenesis of ASD.
Methods:
Pregnant BALB/c albino mice were injected intraperitoneally with VPA (600 mg/kg) on embryonic day 12.5, the mothers were allowed to give birth. The sham group mice were prepared by giving the mothers PBS intraperitoneally. The autistic feature of male pups were verified on postnatal day 28 by three-chambers sociability test. Mice with autistic feature were randomly assigned into SFN treatment group and control gorup.The SFN treatment group (VPA-SFN) mice was given with SFN (3.854 mg/kg/day) by oral gavage; while the control group were fed with saline (VPA-SAL). Both groups were fed daily for 22 days. The three-chambers sociability test was performed on postnatal days 35, 42 and 49 to assessthe sociability and social novelty of mice. On postnatal day 50, the mice were euthanized and the cerebral cortices were harvested to perform quanitative PCR analysis ofASD-related genes such as brain-derived neurotrophic factor (BDNF), NMDA receptor subunit2B (NR2B).
Results:
From the results of three-chambers sociability test, VPA-SAL mice spent less time with the stranger mice, showing impaired sociability (Fig 1A and B.); also, less time preference were showed towards the novel mice, demonstrating a lack of social novelty (Fig. 1C and D). At PND 49, after 3-weeks SFN treatment, VPA-SFN mice spent significantly more time than VPA-SAL mice with the stranger mice by 66.9% (p<0.01) in the first 10 minutes of the test (Fig. 1A), and they showed more time preference towards novel mice by 44.4% (p<0.01) (Fig. 1D). Moreover, from quantitative PCR results (Fig. 2), BDNF and NR2B expressions were significantly lower in VPA-SAL mice when compared with the sham group. SFN treatment significantly increased the expressions of BDNF and NR2B by 2.40 (p<0.01) and 2.68 (p<0.05) folds respectively.
Conclusions:
Sulforaphane ameliorated the social communication impairments in valproic acid-induced autistic mice with up-regulations of BDNF and NR2Bin the cerebral cortex.

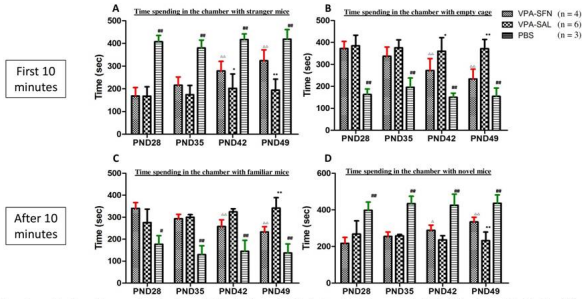


Fig.1. Comparison of the three mice groups in 3-chambers sociability test. In the first 10 minutes of the test, compared with the VPA mice treated with saline, VPA mice treated with sulforaphane showed improvement in sociability in which they preferred staying in the chamber with stranger mice (A) rather than the chamber with an empty cage (B); also, VPA-SFN mice showed improvement in social novelty as compared with VPA-SAL mice. When a novel mice is introduced to the empty cage after ten minutes, they showed more preference to stay in the chamber with the novel mice (D) rather than with the more familiar mice (stranger mice) (C). * $p < 0.05$ ** $p < 0.01$ VPA-SFN vs VPA-SAL by Two-way repeat measure ANOVA *post hoc* Bonferroni Tests; # $p < 0.05$ ## $p < 0.01$ VPA-SAL vs PBS by Two-way repeat measure ANOVA *post hoc* Bonferroni Tests; Δ $p < 0.05$ ΔΔ $p < 0.01$ comparison of various postnatal days (PNDs) vs PND28 within each mice group by One-way repeat measure ANOVA *post hoc* Tukey's test; VPA-SFN: VPA mice fed with sulforaphane; VPA-SAL: VPA mice fed with saline; PBS: sham mice group which had been prenatally injected with PBS.

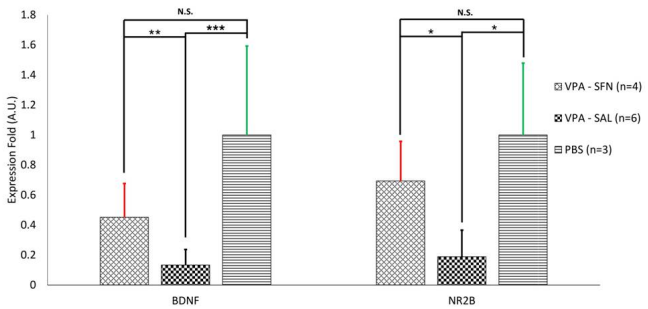


Fig.2. Quantitative PCR for the cerebrocortexes of three mice groups with BDNF and NR2B. VPA-SFN: mice treated with VPA prenatally and fed with sulforaphane; VPA-SAL: mice treated with VPA prenatally and fed with saline PBS: sham mice group which had been prenatally injected with PBS; N.S. not significant * $p < 0.05$; ** $p < 0.01$ *** $p < 0.001$ by One-way repeat measure ANOVA *post hoc* Tukey's test.

19 **143.019** Targeting Glia with N-Acetylcysteine Modulates Excitation/Inhibition Balance, Neural Activity and Rescues Behavioural Deficits in BTBR Mice

A. Durieux[1], *M. M. Petrinovic*[2], *M. D. Saxe*[2], *M. von Kienlin*[3], *D. G. Murphy*[4], *B. Künnecke*[5] *and G. M. McAlonan*[6], *(1)Kings College London, London, United Kingdom, (2)F. Hoffmann-La Roche, Basel, Switzerland, (3)2Roche Pharma Research & Early Development, Neuroscience, Roche Innovation Center, Basel, Switzerland, (4)Sackler Institute for Translational Neurodevelopment, Department of Forensic and Neurodevelopmental Sciences,, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (5)Neuroscience, Roche Pharma Research & Early Development, Neuroscience, Roche Innovation Center, Basel, Switzerland, (6)Department of Forensic and Neurodevelopmental Science, IoPPN, KCL, London, United Kingdom*

Background:
Although the causal mechanisms of autism spectrum disorder (ASD) are poorly understood, recent advances suggest that an imbalance between excitatory (E) glutamate and inhibitory (I) GABA neurotransmission is a prominent feature of the condition and may be contribute to social impairments and repetitive behaviours. Targeting E/I balance pharmacologically may therefore be a promising approach for drug discovery in ASD. Multiple factors converge to modulate E/I balance *in vivo*, including synaptic and glial mechanisms. For instance, ASD is associated with synaptic gene anomalies that directly disrupt glutamate and GABA signalling; however increasing evidence suggests that glial dysfunction also contributes to E/I imbalance in ASD. N-acetylcysteine (NAC), an FDA approved mucolytic drug which has shown some clinical benefits to treat severe stereotypies in ASD, is thought to modulate glutamate levels through activation of the cystine-glutamate antiporter located on glia.
Objectives:
In this study we tested the hypothesis that acute administration of NAC alters E/I balance, and causes related changes in neural activity patterns and behaviour in BTBR mice, an inbred strain which exhibits behavioural and neuro-morphological phenotypes reminiscent of ASD.
Methods: By combining translational neuroimaging modalities, i.e., perfusion-based functional magnetic resonance imaging (fMRI) and quantitative spectroscopy (MRS), with behavioural assessments we investigated the effects of acute NAC treatment on social and repetitive behaviours, as well as their underlying neurochemistry and circuitry in BTBR and control C57BL/6J mice.
Results: Striatal activity and glutamate levels were elevated in BTBR mice, whereas basal neural activity in the mPFC was comparable with that of C57BL/6J mice. BTBR mice also exhibited severe stereotypies and reduced social interactions, as documented previously. Acute NAC treatment reduced cortical glutamate in both strains, though this was not significant in BTBR mice. NAC normalised abnormal repetitive behaviours as well as social interaction duration in BTBR mice, while concomitantly decreasing striatal neural activity to control levels. Similar modulation of neural activity and decrease in stereotypies were also observed in C57BL/6J mice. Notably, locomotor activity was not affected by NAC.
Conclusions:
NAC treatment normalises social and repetitive behaviour in BTBR mice, likely through modulation of E/I balance which has functional consequences on corticostriatal circuitry. This provides evidence that pharmacological modulation of glial mechanisms can shift E/I balance acutely, with associated neuro-functional and behavioural consequences. Glial metabolism may be a potential drug target for the development of new therapies for ASD. Additionally, our findings warrant further investigation into the potential therapeutic use of NAC in individuals with ASD.

20 **143.020** The Contribution of Reduced TrkB Signaling to Autistic-like Behaviour in the Valproic Acid-Induced Mouse Model

C. Nicolini[1], *V. Aksenov*[2], *E. Rosa*[1], *C. D. Rollo*[2], *J. A. Foster*[1], *F. M. Longo*[3] *and M. Fahnestock*[1], *(1)Dept. of Psychiatry & Behavioural Neurosciences, McMaster University, Hamilton, ON, Canada, (2)Dept. of Biology, McMaster University, Hamilton, ON, Canada, (3)Dept. of Neurology & Neurological Sciences, Stanford University, Stanford, CA*

Background: The molecular mechanisms underlying autistic-like behaviour remain to be elucidated. Mutations in autism-linked genes adversely affect molecules, such as brain-derived neurotrophic factor receptor TrkB and Akt/mTOR pathway components, which regulate dendritic spine formation, function and plasticity. In line with these findings, we previously demonstrated reduced TrkB/Akt/mTOR protein and signaling in human idiopathic autism and in the valproic acid (VPA)-induced rodent model of autism. These results support the hypothesis that defective TrkB/Akt/mTOR pathway signaling is a molecular substrate of autistic behaviour and identifies this pathway as a potential therapeutic target for autism. Promisingly, decreased TrkB signaling via Akt has been rescued by administration of the TrkB partial agonist LM22A-4 in an animal model of Rett syndrome, a monogenic disorder associated with high rates of autism.
Objectives: To better establish the contribution of decreased TrkB/Akt/mTOR pathway signaling to autistic behaviour, we aimed to examine whether systemic treatment with the partial TrkB agonist LM22A-4 would restore TrkB/Akt/mTOR signaling and ameliorate autistic-like behaviour in the offspring of VPA-injected mothers.
Methods: Pregnant CD1 mice received a single intraperitoneal (i.p.) injection of 500 mg/kg VPA on gestational day 12.5, while controls were injected with only saline. Pups were weaned on postnatal day (PD) 21 and received an i.p. injection of either saline or LM22A-4 (0.05mg/g) once daily from PDs 21-35. Sociability and repetitive/stereotypic behaviour were evaluated on PDs 29-34 using the three-chambered social approach task and marble-burying test, respectively. Litters were killed and brain tissue harvested on PD 35. Protein expression and phosphorylation levels of the serine/threonine protein kinase Akt, a key downstream effector of TrkB, were measured by Western blotting in the temporal/parietal neocortices of saline- and LM22A-4-treated VPA and control mice.
Results: Behavioral results were dependent on sex, with female VPA-exposed mice displaying a lack of sociability and male VPA-exposed mice displaying increased repetitive behaviour compared to controls. Contrary to VPA-exposed saline-treated females, LM22A-4-treated VPA-exposed female mice displayed normal sociability. Also, VPA-exposed male mice treated with LM22A-4 buried fewer marbles than saline-treated VPA-exposed males, consistent with a decrease in repetitive behaviour. Lastly, both LM22A-4-treated VPA-exposed females and males had higher levels of phosphorylated Akt than saline-treated VPA-exposed mice, similar to untreated controls.
Conclusions: Our results support the hypothesis that reduced TrkB/Akt/mTOR signaling contributes to autistic behaviour and that this pathway might have a therapeutic role in treating idiopathic autism. Indeed, promisingly, we show that systemic treatment with the partial TrkB agonist LM22A-4 appears to restore the reduction in TrkB signaling and improve social and repetitive behaviours in the VPA mouse model of autism.

21 **143.021** Touchscreen Learning in the Shank3B Mutant Mouse Model of Phelan-Mcdermid Syndrome and Autism Spectrum Disorder

N. A. Copping, G. M. Foley, E. L. Berg, B. L. Onaga, J. L. Silverman and ***M. Yang****, Psychiatry and Behavioral Sciences, MIND Institute, Sacramento, CA*

Background: Translocation and breakpoint mutations in *SHANK3* have been implicated in autism spectrum disorder (ASD), Phelan-McDermid Syndrome (PMS) and intellectual disabilities (Betancur & Buxbaum, 2013; Gauthier et al., 2009; Leblond etal., 2014; Moessner et al., 2007), leading to the hypothesis that reduced SHANK3 expression may impair basic brain functions that are important for social communication and cognition (Durand et al., 2007). Shank3 is a synaptic scaffolding protein, localized in the postsynaptic density. Mutant mouse and rat models have been generated to evaluate the biological and behavioral consequences of *Shank3* gene mutations (Bozdagi et al., 2010; Peca et al., 2011; Bangash et al., 2011; Wang et al., 2011; Kouser et al., 2013).
Objectives: The present experiments were designed to evaluate cognitive phenotypes in *Shank3B* mice. The touchscreen pairwise discrimination task was chosen by virtue of its: (a) conceptual and technical similarities to the CANTAB test battery used for testing cognitive functions in humans, (b) minimal demand on motor abilities, and (c) translational validity for future clinical trial outcome measures (Silverman et al., 2013).
Methods: Breeding pairs were purchased from The Jackson Laboratory (JAX catalogue #017688). Mice were bred in a conventional mouse vivarium at the University of California Davis School of Medicine in Sacramento. Pairwise visual discrimination was tested in the automated Bussey-Saksida touchscreen system for mice (Campden Instruments Ltd/Lafayette Instruments, Lafayette, IL, USA), using a procedure slightly modified from the methods described previously (Brigman & Rothblat, 2008; Bussey et al., 2012; Brigman et al., 2013; Silverman et al. 2013). Mice were trained to discriminate two novel images (spider and plane) displayed side-by-side in two windows on the screen in a spatially pseudo-randomized manner. To examine simple learning under a stringent definition, acquisition was assessed with a performance criterion of >80% correct responses (excluding correction trials) over two consecutive sessions and with a minimum of 30 trials completed. Days to reach criterion, number of total trials, number of incorrect responses, and number of correction trials were compared between genotypes.
Results: As compared to *Shank3* wildtype (+/+), *Shank3* heterozygous mutant (+/-) mice exhibited impaired learning in the visual discrimination of luminescent-balanced stimuli. Wildtype controls displayed normal learning typical of the C57BL/6J background strain on all measures. Shank3 +/- mice required more training days to reach criterion and exhibited trends toward making more errors. Both genotypes reached criterion within the 30-day cutoff.
Conclusions: We detected a significant deficit in higher-order cognitive functions in the *Shank3B* mutant mouse model of PMS and ASD, suggesting that this mouse model is a useful preclinical tool for studying neurobiological mechanisms behind cognitive impairments in PMS and ASD. The current findings are the starting point of our future research in which we will investigate multiple domains of cognition and explore pharmacological interventions.

22 **143.022** Transgenerational Transmission and Modification of Behavioral Deficits Induced By Prenatal Immune Activation

U. Meyer[1,2], *U. Weber-Stadlbauer*[1] *and J. Richetto*[1], *(1)Institute of Pharmacology and Toxicology, University of Zurich-Vetsuisse, Zurich, Switzerland, (2)Physiology and Behavior Laboratory, ETH Zurich, Schwerzenbach, Switzerland*

Background: It has been demonstrated that environmentally induced brain dysfunctions are not solely expressed by the individuals directly exposed, but can also be transmitted to the offspring, sometimes across multiple generations.
Objectives: Here we explored whether such transgenerational effects can be induced by prenatal infection, an environmental risk factor of autism and related neurodevelopmental disorders.
Methods: We used a well-established mouse model of prenatal immune activation, which has been shown to induce multiple behavioural deficits relevant to autism and related disorders. Pregnant mice (F0) were injected with the viral mimetic poly(I:C) (5 mg/kg) or control solution in early pregnancy (gestation day 9), and the behavioral effects were tested in the F1 generation. To examine whether such deficits can be transmitted to subsequent generations, we generated F2 and F3 offspring by inter-crossing F1 and F2 offspring, respectively. We performed behavioral testing in adult F1, F2 and F3 offspring and exploited transcriptional profiling to determine gene expression in the prefrontal cortex (PFC) and amygdala (AMY) of F1 and F2 mice using next generation sequencing.
Results: Behavioral analyses in F1, F2 and F3 offspring revealed that deficits in social interaction and cued fear, which emerge in F1 offspring, are also present in the F2 and F3 generation. F1 offspring also showed increased sensitivity to the psychostimulant drug amphetamine. Interestingly, the F2 and F3 generation displayed the opposite pattern, namely reduced amphetamine sensitivity. Deficits in sensorimotor gating, which are typically observed in the F1 generation, were not present in F2 and F3 offspring. RNA-sequencing analysis revealed a total number of 227 genes that are differentially expressed in F1 PFC poly(I:C) versus controls, 359 in F2 PFC poly(I:C) versus controls

and 1226 genes in F1 Amy as well as 1665 genes in F2 Amy poly(I:C) versus controls. Out of the differentially expressed genes in F1 and F2 PFC, a total number of 12 genes are affected in both F1 and F2 brains. In the Amy, 415 genes are overlapping between F1 and F2 brains.
Conclusions: Our findings demonstrate that behavioral deficits induced by prenatal infection can be transmitted and modified across subsequent generations. Furthermore, analysis of the transcriptome in F1 and F2 Amy and PFC revealed differential gene expression in poly(I:C) versus control animals in F1 as well as F2 animals. Future experiments will examine the possibility that the behavioral abnormalities and the differences in gene expression following prenatal immune activation are transmitted to subsequent generations via modifications in the epigenetic machinery.

Poster Session
144 - Genetics
11:30 AM - 1:30 PM - Hall A

23 **144.023** 22q11.2 Duplication Syndrome: Assessment of Autism Spectrum Disorder, Other Neuropsychiatric Symptoms, and Adaptive Skills

C. C. Clements[1], *L. M. DePolo*[2], *A. de Marchena*[2], *D. M. McDonald-McGinn*[3], *E. H. Zackai*[4], *B. Emanuel*[3], *R. T. Schultz*[5], *J. Miller*[2] *and T. L. Wegner*[2,6], *(1)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (2)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (3)Pediatrics, The Children's Hospital of Philadelphia, Philadelphia, PA, (4)Pediatrics, The Children's Hospital of Philadelphia, Philadelphia, PA, (5)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (6)Pediatrics, Seattle Children's Hospital, Seattle, Seattle, PA*

Background: Past research suggests that individuals with 22q11.2 Deletion Syndrome (22q11.2DS) have elevated rates of autism (~15%), ADHD (>50%), and schizophrenia (~25%). Recently widespread use of microarrays has identified duplication of the identical 2.54Mb region in a growing number of patients (22q11.2DupS). Case reports suggest heterogeneous medical and neuropsychiatric profiles, but there has not yet been systematic assessment of ASD and other neuropsychiatric symptoms.
Objectives: To characterize the prevalence of ASD and the presentation of psychiatric symptoms and adaptive skills in individuals with 22q11.2DupS.
Methods: Youth with 22q11.2DupS or 22q11.2DS were recruited from a genetics specialty clinic at the Children's Hospital of Philadelphia, and matching groups of ASD and typically developing controls (TDC) were formed form other studies at the Center for Autism Research. 22q11.2DupS participants (n=28) were matched 1:3 on age and sex, with 1:1 matching for children younger than four years, to participants in all three comparison groups: 22q11.2DS (n=62), ASD (n=70), and TDCs (n=73). Parents of all participants completed measures of social communication skills, psychiatric symptoms, and adaptive behavior skills (SCQ, SRS or SRS-2, CASI-4R, and Vineland-II). Parents of youth with 22q11.2DupS (but not deletions) also completed the ADI-R (n=20). A subset were also administered the ADOS (n= 8). All participants in the ASD comparison group were evaluated with both instruments.
Results: Five of 20 individuals with 22q11.2DupS met research diagnostic standards and clinical judgment for a diagnosis of ASD (25%). All 5 carried a community diagnosis of ASD, as did 7 of the 15 participants who did not meet research diagnostic standards. Parent report questionnaires found that both the 22q11.2DupS and 22q11.2DS groups showed greater impairment than the TDC group on all social indices (all p's < 0.001; d's > 1.80). Duplication and deletion groups did not differ on any social measures. Both duplication and deletions showed impairment on the Vineland-II Adaptive Behavior Composite that was intermediate between TDCs and ASD. The ASD, 22q11.2DS, and 22q11.2DupS groups each demonstrated significantly elevated neuropsychiatric impairments compared to TDCs.
Conclusions: This report is the first study to assess ASD symptoms in a sample of individuals with the 22q11.2DupS. One quarter met gold-standard diagnostic criteria for ASD and showed similar levels of social communication impairment (SCQ and SRS/SRS-2) to children with idiopathic ASD. The estimated 25% rate of ASD observed in children with 22q11.2DupS is much higher than the population prevalence estimates of 1-2%, and is among the highest of any genetic syndrome associated with ASD.

24 **144.024** A Comparison of Polygenic Contribution to Autism Spectrum Disorder Using Common, Rare and Copy Number Variants

K. Benke[1], *B. Sheppard*[2], *K. M. Bakulski*[3], *A. B. Singer*[3], *C. Shu*[4], *C. Ladd-Acosta*[5], *C. J. Newschaffer*[6] *and M. D. Fallin*[7], *(1)Mental Health, Johns Hopkins School of Public Health, Baltimore, MD, (2)Johns Hopkins School of Public Health, Baltimore, MD, (3)Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (4)Mental Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (5)Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (6)A.J. Drexel Autism Institute, Philadelphia, PA, (7)Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD*

Background: Current evidence suggests that the genetic contribution to autism spectrum disorder (ASD) is polygenic, consisting of small, accumulating effects of many variants. While some of the contribution may come from rare single variant mutations or rare copy number variation, the summation of modest effects among common variants is still likely to be important.
Objectives: To create polygenic risk scores (PRS) using large sample results from the Psychiatric Genomics Consortia (PGC) mega-analysis for ASD using genome-wide genotype data from the Study to Explore Early Development (SEED), a multi-site case-control study and compare the performance of these PRS to scores calculated from copy number variant burden, rare variant burden, or other combined metrics.
Methods: We have created a polygenic risk score, derived from discovery results available from the PGC for ASD, using measured genotypes in SEED to investigate the interplay of genetic and environmental risk factors that underlie disease risk. We will further create a score reflective of the burden of rare variation (using 1000 genomes imputed data) and rare copy number variation burden (using Penn CNV calls). Correlations among the three scores, their potential interactions, and their ability to classify membership into case status will be explored.
Results: The association of the common variant PRS with ASD status was significant, but appeared to be due to confounding by genetic ancestry. We will present results adjusted for ancestry as well as comparisons with rare-variant based scores.
Conclusions: This is the first effort to our knowledge to investigate multiple polygenic scores in ASD. Our results can shed light on whether rare, common and CNV burden are correlated or represent independent contributions to the risk of autism.

25 **144.025** A SHANK3 Point Mutation with Phelan-Mcdermid Phenotype, Notably without Autism Spectrum Disorder or Intellectual Deficits

C. Samango-Sprouse[1,2], *P. Lawson*[1] *and O. Goker-Alpan*[3], *(1)The Focus Foundation, Crofton, MD, (2)George Washington University, Washington, DC, (3)Genetics, O and O Alpan, LLC, Fairfax, VA*

Background: The *SHANK3* gene encodes a scaffolding protein in the cortex and cerebellum that plays a role in synaptic signal transmission. *SHANK3* is disrupted in Phelan-McDermid Syndrome (PMS or 22q13.3 deletion syndrome), which is characterized by variable central nervous dysfunction including speech and motor delays, hypotonia, Intellectual Deficits (ID), and Autism Spectrum Disorder (ASD). Expressive language is typically more impaired than receptive language. There is evidence larger deletions correlate with greater developmental dysfunction and higher rates of ASD. As many as 84% of individuals with PMS are also diagnosed with ASD. *SHANK3* haploinsufficiency is also implicated in ASD, and is present in 0.5% of ASD cases (one of the largest monogenic causes of ASD) and 2% of moderate-to-profound ID cases.
Objectives: N/A
Methods: N/A
Results: We present a 5 year-old girl with a single point c.2265+3 A>T variant in intron 19 in the *SHANK3* gene.
She has a history of developmental regression, limb asymmetry, advanced bone age, and coordination difficulties. Feeding disturbances and speech delay with intermittent regression of skills were noted at 18 months. She is diagnosed with Childhood Apraxia of Speech (CAS) with facial and truncal hypotonia, motor difficulties, balance problems, oculomotor apraxia, and visual perceptual deficits (SS=74 on VMI). GARS-2 and GADS scores are below the first percentile, however,the SRS-2 revealed mildly atypical scores in social cognition and social awareness with T-scores of 63 and 62, respectively, compared to a Total T-Score of 56. Intellectual function tends to be in the average range (90-109), with a Fluid Reasoning (FR) of 93, Working Memory Index (WMI) of 103, and a Verbal Comprehension Index (VCI) of 81 (low average). Expressive and receptive vocabulary scores were 97 and 103 on EOWPVT-R and ROWPVT-R, respectively.
Her phenotypic profile including facial dysmorphisms and neurodevelopmental profile are characteristic of PMS, while she does not meet criteria for ASD.
Conclusions: This report highlights the first case –to our knowledge– where a single-point mutation in the *SHANK3* gene has resulted in a constellation of findings associated with PMS, supporting that *SHANK3* is critical to the PMS phenotype, and that smaller deletions/ mutations correlate with more normalized neurocognitive function. Critically, this case supports higher intellectual capability than has been previously reported in patients with *SHANK3* mutations (typically ranging from moderate to severe ID).
Also significant, while the majority of patients with *SHANK3* mutations and deletions have ASD, this patient shows no significant ASD features but does have some social language issues. This fits with the literature showing that smaller deletions/mutations correlate with lower rates of ASD diagnosis, as well as the fact that ASD is not inherent in cases of *SHANK3* mutation.
Lastly, this case is novel in that the patient is diagnosed with CAS. While language delay (especially expressive) is consistently reported in PMS, diagnosed CAS is unreported. Further investigation is merited to evaluate whether CAS is more prevalent in PMS than is currently documented, as well as its potential contribution to the phenotype, especially the delayed speech, expressive language disorder, and any oral motor deficits.

26 **144.026** A System for Gene Ranking through Integrative Variant Annotation in Autism Spectrum Disorders

E. Larsen[1], *I. Menashe*[2], *M. N. Ziats*[3], *W. Pereanu*[1] *and S. B. Basu*[4], *(1)MindSpec Inc., McLean, VA, (2)Ben-Gurion University of the Negev, Beer Sheva, Israel, (3)Baylor*

College of Medicine, Houston, TX, (4)MindSpec, Inc., McLean, VA

Background:
The search for genetic factors underlying autism spectrum disorders (ASD) has led to the identification of hundreds of genes containing thousands of variants that differ in mode of inheritance, effect size, frequency and function. These data are summarized in our Autism Database (AutDB; also known as SFARI Gene), an open-access database for genetic variation associated with ASD. However, a major challenge in the field of ASD biology involves assessing the collective genetic evidence in an unbiased, systematic manner.
Objectives: Here, we describe a scoring algorithm for prioritization of candidate genes based on the cumulative strength of evidence from each ASD-associated variant in AutDB.
Methods:
A total of 928 annotated research articles were analyzed to generate a dataset of 2187 rare variants and 711 common variants distributed across 461 ASD-associated genes. Each individual variant was manually annotated with multiple attributes extracted from the original report, followed by score assignment using a set of standardized scoring parameters that were summed up to yield a single score for each gene in the database.
Results: There were remarkable variations in gene scores resulting in a log-normal distribution of scores with a mean gene score of 16.65 ± 29.57. Interestingly, there were 12 genes with scores deviating more than two standard deviations (SDs) from the mean score of all genes, with very high scores for three genes (*SHANK3*, *CHD8*, and *ADNP*). Importantly, the gene scores generated by our approach were significantly correlated with that in the SFARI Gene scoring module (Spearman r = -0.63; *P<0.0001*) indicating a strong agreement between gene prioritization using our approach and the expert-mediated SFARI Gene scoring initiative. We further validated our scoring strategy using two recently published ASD risk gene lists and prioritized a new set of genes with cumulative evidence.
Conclusions:
Our scoring algorithm provides a framework for assessment of diverse types of genetic variants associated with ASD that are likely to be important for defining the genetic risk architecture in ASD.

27 **144.027** Association Between Copy-Number Variations and Savant Skills Among People with Autism Spectrum Disorder

H. Rosenthal *and I. Menashe, Ben-Gurion University of the Negev, Beer Sheva, Israel*

Background: Savant skills, which are defined as “outstanding skills in individuals with otherwise intellectual impairment,” are significantly more common in individuals with autism spectrum disorders (ASD) than in any other group of people examined to date. The existence of such a considerable and well-defined group of extremely talented people within the autism spectrum suggests common underlying mechanisms that require further exploration. We hypothesized that copy-number variations (CNVs), which are thought to play a role in ASD susceptibility, may also underlie these exceptional skills among people with ASD.
Objectives: To study the association between CNVs and savant skills among individuals with ASD.
Methods: We studied 1108 children diagnosed with ASD from the Simons Simplex Collection (SSC) database. Savant skills were determined based on five designated questions regarding exceptional talent in visuospatial ability, memory ability, musical ability, drawing ability, and computational ability from the autism diagnostic interview revised (ADI-R) questionnaire. CNV data were retrieved from a genome-wide analysis of CNV in these children.
Results: Of the 1108 children with ASD in this study, 467 (42%) had one or more savant skills. This prevalence is significantly higher than the observed 31% of savant skills among children with ASD that did not undergo CNV analysis in the SSC cohort ($P<0.001$). It is also higher than the typically 10%-30% reported prevalence of savant skills among children with ASD in other studies. Similarly to other reports, savant skills in our study were associated with a higher IQ (93.0±24.2 vs. 79.1±25.5; $P<0.001$), and a larger head circumference (HC) (54.3±2.55 vs. 53.8±2.60; $P = 0.003$) among children with ASD. Interestingly, we found association between savant skills and a lower count of rare CNVs among children with ASD (14.0±5.54 vs. 14.8±6.2 for children with and without savant skills respectively; $P = 0.03$). This association mainly reflected differences in copy-number deletions, rather than copy-number duplications, and was particularly noticeable among children with exceptional computational ability (9.1±4.61 vs. 10.1±4.97; $P= 0.02$) even after accounting for their higher IQ and larger HC. We also examined whether certain talents are predisposed by specific ASD susceptibility CNV loci, but no such associations were found.
Conclusions:
Our findings suggest that CNVs contribute to the presentation of exceptional talents among children with ASD.

28 **144.028** Association of Dysfunctional Polymorphisms in Acetylserotonin O-Methyltransferase with Insomnia in ASD

O. J. Veatch*, Z. Warren, J. S. Sutcliffe, M. H. Potter, A. L. Palmer and B. A. Malow, Vanderbilt University, Nashville, TN*

Background: Insomnia, defined as difficulty initiating or maintaining sleep, is a commonly observed comorbidity in autism spectrum disorder (ASD). Dysfunctional polymorphisms in genes encoding enzymes in the melatonin synthesis pathway contribute to risk for both ASD and insomnia. An important gene in this pathway, acetylserotonin O-methyltransferase (*ASMT*), encodes the ASMT enzyme which catalyzes the final step in melatonin biosynthesis. Presence of risk variants in the promoter element of *ASMT* are related to reduced expression of *ASMT*. Reduced expression of *ASMT* has been correlated with reduced enzymatic activity and a reduction in subsequent melatonin production in ASD. Evidence suggests that reduced levels of *ASMT* enzymatic activity relate to comorbid sleep onset insomnia in ASD. However, most previous studies have not looked specifically at the potential contributions of polymorphisms in *ASMT* to insomnia risk in ASD.
Objectives: To examine the hypothesis that polymorphisms in the *ASMT* gene are associated with insomnia in ASD.
Methods: We genotyped three known risk SNPs (rs44469096, rs5989681, rs6644635) shown to relate to reduced expression of the *ASMT* gene. SNPs were genotyped in 120 children (ages 2-13 years) diagnosed with ASD whose parents had completed the Children’s Sleep Habits Questionnaire (CSHQ). These individuals were enrolled in research studies related to sleep in children with ASD, as well as broader autism genetics studies. We initially examined associations of genotypes at each SNP and presence of an insomnia-related problem as indicated by the parent. We additionally evaluated the associations of genotypes at each SNP with sleep onset delay, night wakings, and sleep duration (estimated from parent-reported bedtimes and wake times) to refine the potential relationship of SNPs in *ASMT* with symptoms of insomnia.
Results: There were 84 children with ASD whose parent indicated a problem in an insomnia-related question on the CSHQ and 36 children with no insomnia-related problems reported. There were no associations between the dysfunctional SNPs genotyped in *ASMT* and presence of a problem in an insomnia-related domain, however genotypes in rs6644635 were trending toward significance (p=0.058). Upon further examination of specific CSHQ questions, SNP rs6644635 was associated with shorter sleep duration (β= -14.74, p=0.032), and, interestingly, fewer problems with night wakings (OR=0.43, p=0.027). No SNPs were associated with sleep onset delay problems in this dataset (p≥0.238).
Conclusions: The presence of dysfunctional alleles at SNP rs6644635, in the 5’-UTR of the *ASMT* gene, was associated with short sleep duration. The lack of association of SNP rs6644635 with sleep onset delay and the paradoxical finding of fewer reported problems with night wakings require further examination, including studies that also assess SNPs in genes involved in the metabolism of melatonin (e.g., *CYP1A2*). Examination of melatonin pathway genes in larger datasets appears warranted.

29 **144.029** Autism Pathway Network Analyses Identify Overlaps with Other Disease Groups, Involve Many Functions and Converge upon MAPK and Calcium Signaling

Y. Wen[1,2,3]*, M. Alshikho*[1,3] *and M. R. Herbert*[1,2,3]*, (1)Neurology (Pediatric), Harvard Medical School, Boston, MA, (2)Higher Synthesis Foundation, Cambridge, MA, (3)Neurology, Massachusetts General Hospital, Charlestown, MA*

Background: Autism spectrum disorders (ASDs) encompass many etiologies and heterogeneous phenotypes brought together by common behavioral features and emergence during early development. As of December 2014, the SFARI (Simons Foundation Autism Research Initiative) Gene-Human Gene Module recorded 667 human genes implicated as relevant to ASDs whose diversity challenges efforts at identifying coherent biological mechanisms.
Objectives: Identifying convergent molecular pathways in which multiple candidate genes are involved may be an effective way to gain insight into the underlying molecular bases of ASDs. We sought to combine information from several existing and well-established databases to contextualize autism-associated genes in relation to the functions of gene products, the networking of reactions, pathway-pathway and gene-pathway interactions, and disease-disease relationships.
Methods: We first investigated enrichment within the Human Gene Module of SFARI Gene, by computing overlaps between SFARI genes and MSigDB (Molecular Signatures Database, v4.0) gene set derived from KEGG (Kyoto Encyclopedia of Genes and Genomes) Pathway Database. This allowed us to generate a ranked list of the top 50 pathways within which the ASD genes were enriched. We then applied Redundancy Control in Pathway Databases (ReCiPa) to the enriched pathway list, to minimize the impact of potential redundancy caused by some highly overlapped pathways, which were merged as collections, yielding a final list of 40 pathways, grouped in Disease and Function categories. KEGG pathway maps were used to identify the interactions among pathways, which were fully depicted in a pathway network map. The relative frequencies of representation of components of the pathway network were quantitatively ranked and assessed by tabulating the number of interactions each pathway had within the network. No weighting was applied as there were no standard methods available.
Results: “Calcium signaling pathway”(p-value 2.84E-29) and “neuroactive ligand-receptor interaction” (p-value 2.87E-29) were the most enriched, statistically significant pathways from the enrichment analysis. Pathways were grouped into 10 disease pathways: cancer (4/10), neurodegenerative (3/10), cardiac (2/10) metabolic diseases (1/10); and 30 functional pathways: cell signaling (9/10), cell structure/transport (5/30), immune (3/30), neural (5/30) metabolism (8/30). Perturbations associated with KEGG’s category of environmental information processing were common. The two most interactive pathways, MAPK signaling pathway and calcium signaling pathways, interacted with 20/40 and 12/40 pathways respectively.

Conclusions: Our key findings, derived from methods free of a priori assumptions regarding relevance to autism, demonstrate marked overlap between ASD genes/pathways and those associated with other diseases, and indicate that environmental information processing is broadly impacted. Findings converged upon MAPK signaling and calcium signaling pathways—which impact a large range of biological processes involved in many functions and diseases—as interactive hubs in the autism pathway network. These findings support the idea that, based upon potential compromise of many types of biological output, autism-associated genes may contribute not only to core features of autism themselves but also to vulnerability to other chronic and systemic problems potentially including cancer, metabolic conditions and heart diseases. ASDs may thus arise, or emerge, from underlying vulnerabilities related to pleiotropic genes associated with pervasively important molecular mechanisms, perturbed environmental information processing and multiple systemic co-morbidities.

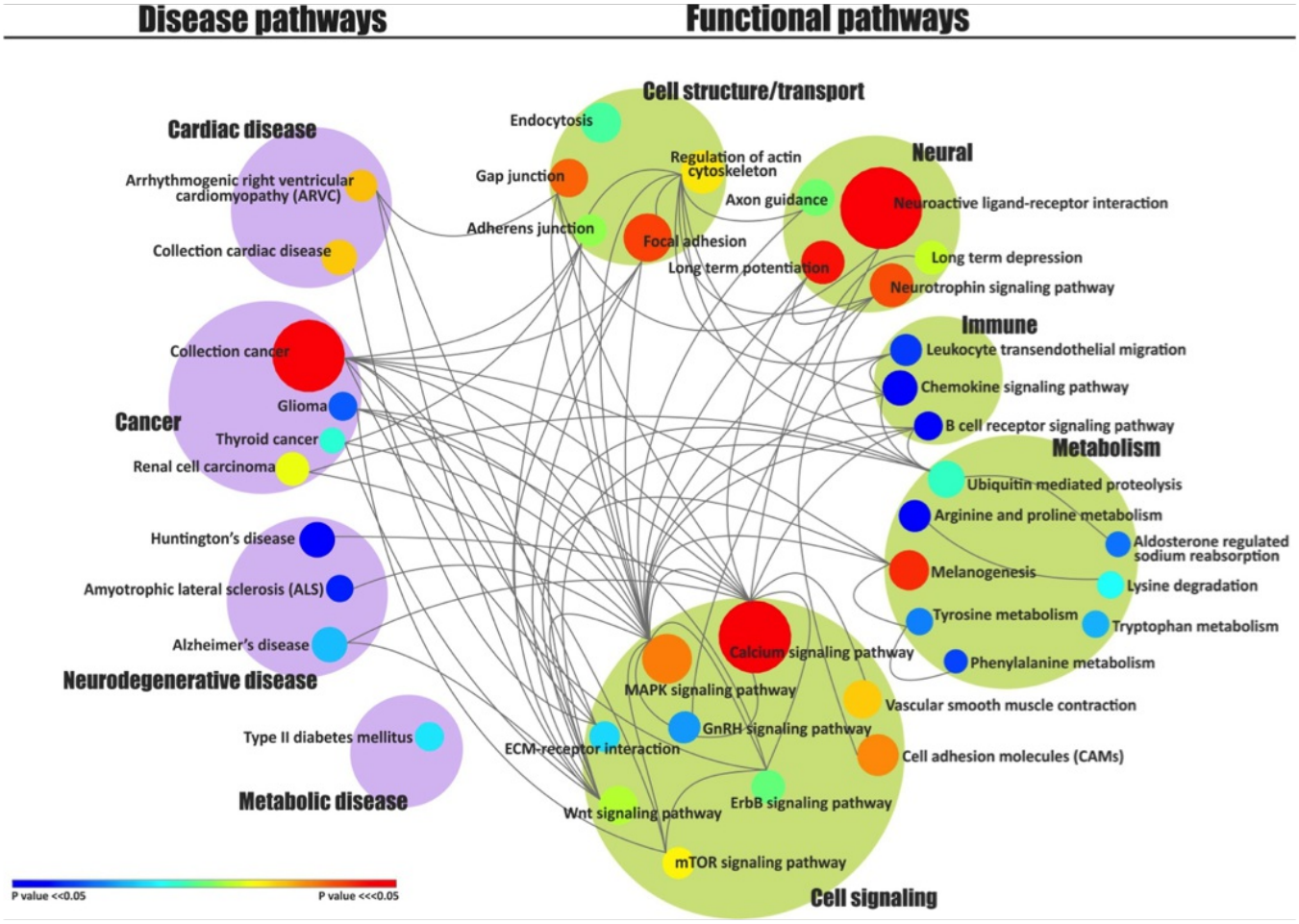


Figure 1 Autism pathway network. Pathways are grouped vertically under two classes, Disease and Function. The color of each node within the groupings represents the p-value of that pathway. The size of each node represents the number of ASD genes in that pathway. Interactions between pairs of pathways are indicated by edges.

30 **144.030** Autism Spectrum Symptomatology in Children with 7q11.23 Duplication Syndrome

B. P. Klein-Tasman[1] *and C. B. Mervis*[2]*, (1)Department of Psychology, University of Wisconsin - Milwaukee, Milwaukee, WI, (2)Dept. of Psychological and Brain Sciences, University of Louisville, Louisville, KY*

Background: Recent findings from studies of *de novo*copy number variants (CNVs) in a large sample of children in the Simons Simplex Collection identified a strong association between duplication of the Williams syndrome region (Dup7q11.23) and autism (Levy et al., 2011; Sanders et al., 2011).
Objectives: Gold-standard diagnostic assessments of ASD symptomatology were conducted for a group of children with Dup7q11.23 who participated in a specialty research clinic for individuals with this syndrome.
Methods: Participants were 63 children with genetically confirmed Dup7q11.23 (25 girls, 38 boys), ranging in age between 4 and 17 years (M age = 8.64 years, SD = 3.77). A comprehensive battery assessing cognitive, language, and psychosocial functioning was administered by a multidisciplinary team, including autism spectrum diagnosis by a Licensed Psychologist with specialized training in the diagnosis of ASD. Parents were interviewed about ASD-related symptomatology with the Autism Diagnostic Interview – Revised (ADI-R). The appropriate module of the Autism Diagnostic Observation Schedule – 2 was administered (ADOS-2; Mod 1 n = 9, Mod 2 n = 21, Mod 3 n = 33).
Results: Based on the ADI-R diagnostic algorithm, which heavily weights retrospective accounts of functioning, 25 participants (39.6%) were classified "autism." Based on the ADOS-2 algorithm, 16 (25.4%) were classified "autism spectrum (AS)" (5 "AS", 11 "autism") and 47 children (74.6%) were classified as "nonspectrum" (NS). Of the children classified "NS," 29 had severity scores of 1 (minimal to no evidence), ten had severity scores of 2, and eight had severity scores of 3. Based on a combination of the ADI-R, ADOS-2, and clinical judgment, 12 participants (19.0%) were clinically diagnosed with ASD. All 12 were classified "AS" or "autism" on the ADOS-2; 9 were classified "autism" on the ADI-R. Of the remaining 47 participants, 16 were classified "autism" on the ADI-R and 4 were classified "AS" or "autism" on the ADOS-2.
Conclusions: Careful characterization of ASD-related symptomatology using gold-standard ASD assessment measures combined with clinical judgment indicated that about 19% of children with Dup7q11.23 showed symptomatology consistent with an ASD clinical diagnosis. This rate indicates an elevated risk in comparison to the general population but also suggests that the presence of Dup7q11.23 by itself is not strongly indicative of the presence of an ASD. Reliance on retrospective parental report alone results in a higher rate (39.7%) of identified ASD-related symptomatology. The potential contribution of the history of language delays coupled with extreme social anxiety and/or shyness characteristic of the syndrome to parental observations of sociocommunicative challenges will be discussed. Additionally, implications of these findings for clinical management of children with Dup7q11.23 and for genotype-phenotype investigations will be addressed.

31 **144.031** Blood-Based Transcriptomic Mega-Analyses Comparing Individuals with Autism Spectrum Disorder and Unaffected Comparison Subjects

D. S. Tylee*, J. L. Hess, T. P. Quinn, R. Barve and S. J. Glatt, SUNY Upstate Medical University, Syracuse, NY*

Background: Microarray technology has been applied in the study of Autism Spectrum Disorders (ASDs) for more than a decade. Blood-based studies offered a promising source of non-invasive biomarker signal and shed light on differences in immune cell functions. However, the collective body of blood-based ASD microarray literature suffers from some inconsistencies.
Objectives: In order to summarize the existing literature, we performed a mega-analysis of all available microarray whole blood and lymphocyte studies that comparing ASD cases (n = 647) and unaffected, non-family member comparison subjects (n = 468).
Methods: We modeled covariate effects and adjusted regression models per gene to remove non-significant covariates, providing best-estimates of transcripts dysregulated

in ASD. We also performed permutation-based gene set and co-expression network analyses. Our results provide the best available characterization of dysregulated gene transcripts and emergent functions in ASD blood samples.
Results: Our results were consistent with diminished interferon-, EGF-, PDGF-, PI3K-AKT-MTOR-, and RAS-MAPK-signaling cascades, and increased ribosomal translation and NK-cell related activity in ASD. We explore evidence that distinct subgroups of ASD cases may contribute to observed effects for different gene sets and network modules. We also explore evidence for sex-differences in the transcriptomic signature of ASD; more studies of female samples will be required to confirm these findings. Finally, we constructed generalizable machine-learning classifiers using the blood-based microarray data.
Conclusions: We contrast our results with respect to blood- and brain-based RNA and protein biomarker (e.g. cytokines, growth factors) studies and we discuss the ways that blood transcriptomic signals implicate some pathways known to play causal roles in syndromic ASDs.

32 **144.032** Brain Structure and Quantitative Trait Shifts in 16p11.2 De Novo Deletions Relative to Non-Carrier Siblings

A. M. Michael[1,2], *D. W. Evans*[3], *A. Moreno De Luca*[1,4], *C. C. Dougherty*[1] *and G. J. Moore*[1,2,4], *(1)Autism and Developmental Medicine Institute, Geisinger Health System, Lewisburg, PA, (2)Institute of Advanced Application, Geisinger Health System, Danville, PA, (3)Department of Psychology, Bucknell University, Lewisburg, PA, (4)Radiology, Geisinger Health System, Danville, PA*

Background: The 16p11.2 deletion syndrome is a copy number variation (CNV) resulting in the deletion of 29 genes. It may be inherited or occur as a *de novo*event, and has been associated with a range of neurodevelopmental and neuropsychiatric disorders (NDPSs) including autism spectrum disorders (ASD) (Moreno-De-Luca 2013; Maillard 2014). The 16p11.2 deletion is found in up to 1% of individuals with ASD, and is associated with increased total intracranial, gray, and white matter volumes as well as volumetric increases in the cerebellum, thalamus, fusiform and superior temporal gyri, precuneus, and insula (Qureshi 2014, Maillard 2014). Recent studies indicate that the 16p11.2 deletions carriers exhibit a 'shift' (delta between the non-carrier sibling) toward greater impairment on a range of phenotypic traits (Moreno-De-Luca 2014). It remains unclear, however, whether similar shifts, relative to non-carrier relatives, also apply to key brain structures.
Objectives: Here, we aim (1) to replicate findings that reveal phenotypic shifts in 16p11.2 deletions relative to non-carrier siblings on a variety of quantitative phenotypic traits; (2) to examine whether deletions exhibit volumetric shifts in brain regions relative to non-carrier siblings; (3) examine whether observed phenotypic shifts in deletions may be explained by corresponding shifts in brain volumes.
Methods: Fifteen families with 16p11.2 de-novo deletions (12.6±4 years) and non-carrier siblings (12.1±5.6 years) from the Simons Variation in Individuals Project (Simons VIP Consortium, 2012) were included in this study. Verbal and non-verbal IQ, CBCL-Internalizing and CBCL-Externalizing, SRS, Purdue Pegboard Test scores and high resolution brain MRIs were examined. Volumes of cortical and subcortical brain structures were computed using FreeSurfer, adjusted for age, sex and BMI and were normalized by each subject's total brain volume.
Results: As noted previously, phenotypic scores of deletion were shifted toward greater impairment relative to their siblings (percentages of families out of 15 and P-values are within parenthesis) in the following domains: verbal IQ (87%, 0.006), non-verbal IQ (80%, 0.02), CBCL Internalizing (87%, 0.006), SRS (100%, 6E-5) and Pegboard (87%, 0.006); see Figure 1. In 11 of 15 families (73%), deletions had larger total brain volume compared to their siblings. But in all 15 families (P<6E-5) deletions' cortical gray matter volume when calculated as a percentage of total brain was smaller compared to siblings (Figure 2). Deletions' ventricles were negatively correlated with both verbal (P<0.02) and non-verbal (P<0.004) IQ; corpus callosum volume was positively correlated with CBCL-Internalizing (P<0.03). In non-carrier siblings, thalamic volume correlated positively to non-verbal-IQ (P<0.02), and the ventral-DC was negatively correlated to CBCL-Internalizing (P<0.03) and CBCL-Externalizing (P<0.02). The shift in ventricular volume predicted shift in verbal-IQ (P<0.04) and non-verbal-IQ (P<0.02).
Conclusions: This study shows that *de novo* 16p11.2 deletions show deleterious phenotypic shifts relative to non-carrier siblings and shifts in brain volume of key structures implicated in ASD and other NDPDs. We show that shifts in certain phenotypes can be mirrored by shifts in brain structures. These findings highlight the importance of considering family background when examining the deleterious impact of the 16p11.2 and other CNV syndromes that are implicated in NDNPs.

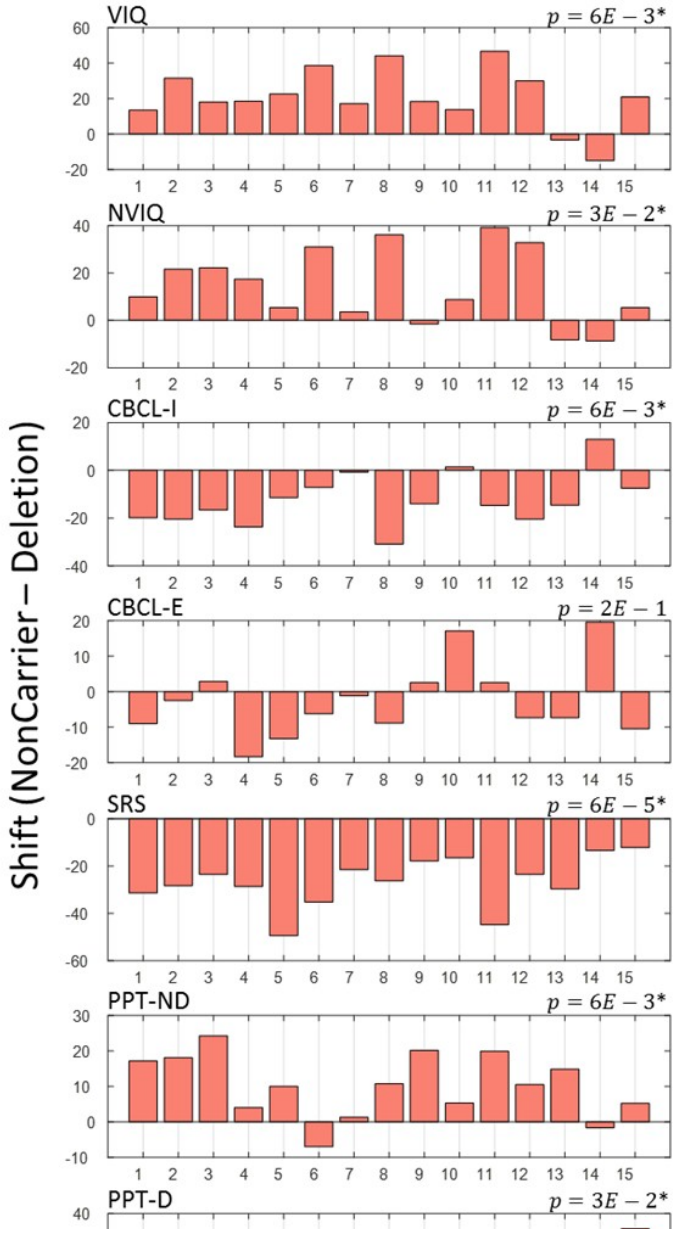
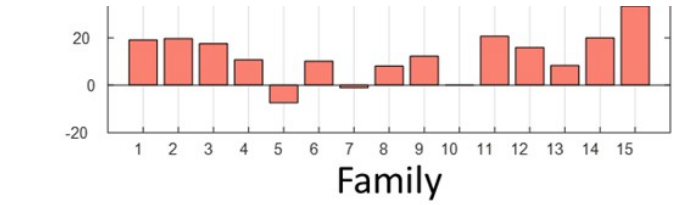


Figure 1: Phenotypic Shift (= NonCarrier – Deletion) for Each Individual Family

Compared to non-carrier siblings, deletions exhibit deleterious phenotypic shifts in cognitive, social and motor domains. Except CBCL-E, the direction of all other test scores are statistically significant at the family level. VIQ = Verbal IQ, NVIQ = non-verbal, CBCL-I = child behavior checklist – Internalizing, CBCL-E = CBCL



checklist Internalizing, CBCL-E = CBCL-Externalizing, SRS = social responsive scale, PPT-ND = Purdue Pegboard Test (PPT) non-dominant hand and PPT-D = PPT dominant hand.

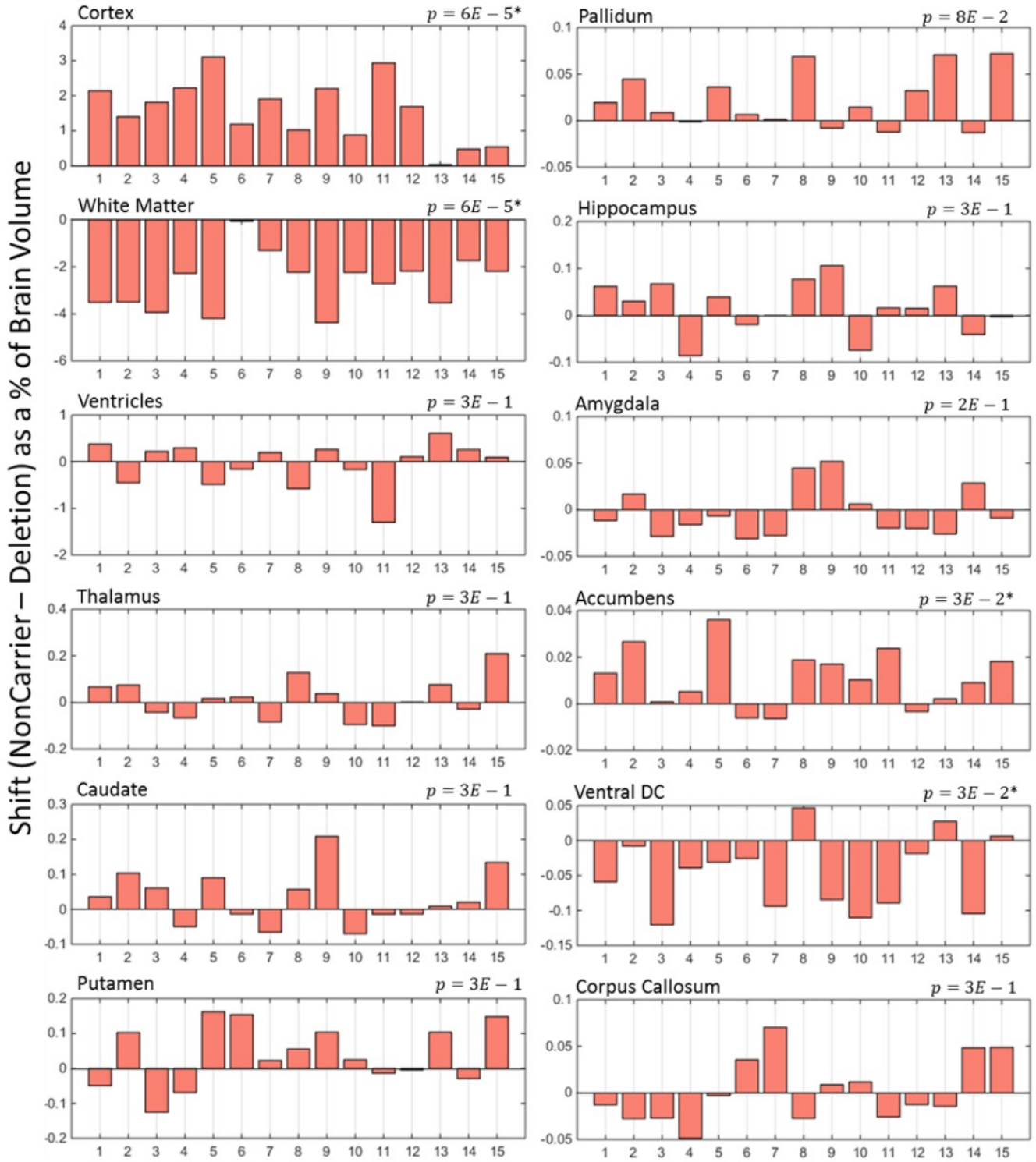


Figure 2: Brain Structure Volume Shift (= NonCarrier – Deletion) for Each Individual Family. Brain structure volume differences between non-carrier siblings and deletion carriers are presented as a percentage of brain volume. Compared to siblings, deletions exhibit lower cortex volume (up to 3%) and larger white matter volume (up to 4%) in all 15 families. Accumbens and ventral diencephalon volumes were significantly larger and smaller respectively in siblings.

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33 **144.033** Building the Open Information Commons for Autism Research and Discovery: The Hartwell Autism Research and Technology Initiative (iHART)

J. Y. Jung[1], *L. Perez-Cano*[2], *M. Duda*[1], *D. Kashef-Haghighi*[1], *J. Kosmicki*[1], *J. K. Lowe*[2], *E. K. Ruzzo*[2], *S. Sharma*[1], *D. H. Geschwind*[2] *and D. Wall*[1], *(1)Department of Pediatrics, Stanford University, Stanford, CA, (2)Department of Neurology, UCLA, Los Angeles, CA*

Background: The search for markers and therapeutic targets has been hampered by the complexity of autism as an integrated system of behaviors, genetics, and environment. This highlights the urgent need for an increasingly larger collection of shared data for open investigations both within and across autism's systems.
Objectives: We have created the first openly available, cloud hosted "sandbox" of autism data. This sandbox is grounded in a foundation of whole genomic DNA sequence of nearly 5000 individuals enriched for multiplex families, twins, and females, coupled with rich phenotypic information. This sandbox has already begun to complement the large collection of autism exomes in the field to enable identification of de novo variants, large structural variants, and the effect of non-coding region variants with large-scale whole genome data. Ultimately, we hope this database as an openly accessible and cloud hosted resource will enable the field to together define the forms of autism and begin making faster gains towards the development of robust diagnostic tools and targets for therapy.
Methods: We have built a cloud resource that utilizes the massively parallel and distributed computing capabilities of Google to integrate genetic markers with phenotype within biological networks. We have also enabled a system for easy queries of the data as well as a universal interface for sharing and integration of new datasets, with the goal of both growing and sharing the data openly now and in the future.
Results: The iHART now contains nearly a petabyte of data including Illumina HiSeq X10, 30X whole genomic sequences of ~5000 individuals that we intend to grow to over 10,000 individuals spanning roughly 2500 families by 2017.
Conclusions: The iHART represents a primary example of what is both possible and necessary to reach, through interdisciplinary collaboration, a truly open "Information Commons" for autism. The effort involves collaborators from Stanford, UCLA, the Simons Foundation Autism Research Initiative (SFARI), and New York Genome Center. In our talk at IMFAR, we will describe the progress on the initiative, demonstrate the user interface to iHART, showcase the preliminary discoveries, and announce its availability for use by our growing community of open access autism researchers.

34 **144.034** CNV Analysis and Exome Sequencing in Japanese Autism Spectrum Disorder Subjects

K. Nakamura[1], *I. Thanseem*[2], *M. Tsujii*[3] *and N. Matsumoto*[4], *(1)Hirosaki University Graduate School of Medicine, Aomori, Japan, (2)Hamamatsu University School of Medicine, Hamamatsu, Japan, (3)Chukyo University, Toyota, Japan, (4)Yokohama City University Graduate School of Medicine, Yokohama, Japan*

Background: Linkage and candidate gene association studies have implicated several genes and chromosomal regions in autism. However, consistent picture of a common susceptibility loci in autism is still lacking. Hence there is paradigm shift away from the previously held "common disease – common variant" hypothesis to a "common disease – rare variant" model, for the genetic architecture of autism. There is a growing consensus among geneticists that rare structural variants including genomic copy number variations (CNVs) may contribute to the autism etiology. Most recently, exome sequencing (ES) studies have also revealed the importance of rare single nucleotide variations (SNVs).
Objectives: In this study, we have examined the global CNV, with special emphasis on rare *de novo* and inherited CNVs in Japanese samples. We have also sequenced the exomes of individuals which include patients with sporadic autism and their parents, reasoning that these families with no previous history of ASD or related phenotypes would be enriched for *de novo* mutations.
Methods: The 203 families were recruited on collaboration with a non-governmental organization, Asperger Society Japan (http://www.as-japan.jp/) in central Japan. The Affymetrix Genome-Wide Human SNP *Nsp*/*Sty* 6.0 array was used to screen the samples. PennCNV and Birdsuite package were used to identify autosomal CNVs from the genome wide SNP data. We have also sequenced the exomes of 60 individuals which include 20 patients with sporadic autism and their parents. For exome sequencing, Genomic DNA was captured using SureSelect Human All Exon v5 kit, and sequenced on HiSeq2000. Image analysis and base calling were performed by sequence control software real-time analysis and CASAVA software v1.8. Single-nucleotide variants and small indels were identified using the GATK UnifiedGenotyper and filtered according to the Broad Institute's best-practice guidelines v3.
Results: Among a total of 7305 CNVs detected in affected children after all QC corrections, 3728 were found to be affecting genes. Among the remaining 378 CNVs, 17 novel/ultra-rare *de novo* events were identified through a series of filtering and validating strategies. Among the *de novo* events, there were four novel, five partially novel and eight ultra-rare CNVs; many of these regions has genes involved in neurodevelopmental pathways. Among the inherited CNV, we found 53 ultra-rare events. All of the ultra-rare/novel CNVs were re-confirmed by relative qPCR. A total of 32 rare novel *de novo* events were observed though ES. This includes 15 missense mutations, a nonsense mutation, 2 frameshift mutations caused by indels, one splice site mutation, and 7 synonymous mutations. 25 de novo events had occurred within the coding sequences, while the remaining 7 de novo events were located within 20 bp of the exon/intron boundary. Majority of these mutations were predicted (PolyPhen or SIFT) to have a damaging effect on the respective protein structure/function. Several of these genes have been implicated in neural functions.
Conclusions: We discovered several novel/ultra-rare *de novo* and inherited CNVs and SNVs, many of them are potentially deleterious; further highlighting the genetic heterogeneity of the disorder. Many of these variations affect genes that play major roles in crucial neurodevelopmental processes.

35 **144.035** Chinese Control Sample Collection for Genetic Studies of Autism Spectrum Disorder

S. An[1], *W. Zhou*[2], *Q. Wu*[2], *J. Zhang*[1], *C. Yang*[1], *H. Zhao*[1], *B. Zhao*[1], *S. Wang*[1], *X. Zheng*[1], *X. Yang*[2], *J. Li*[2], *H. Gao*[2], *Y. Dou*[2], *L. Yan*[2], *M. Wang*[2], *Y. Ye*[2] *and L. Wei*[1,2], *(1)National Institute of Biological Sciences, Beijing, Beijing, China, (2)Center for Bioinformatics, School of Life Sciences, Peking University, Beijing, China*

Background: Autism spectrum disorder (ASD) is a complex neurodevelopmental disorder characterized by deficits in social communication and social interaction, and repetitive behaviors and restricted activities. Family and twin studies of ASD showed that genetic factors contribute to the etiology of ASD.
Objectives: To promote the genetic studies of ASD in Chinese population, we collected blood samples and personal information from typically developed Chinese adults.
Methods: Sample collection was approved by international review board. Informed consent was obtained from each participant before sample collection. We collected personal information of each participant from three aspects. Firstly, we collected their basic information including gender, age, born city, ethnic group, and education level. Secondly, we collected the history of ASD and other neurological and psychiatric disorders (such as intellectual disability, schizophrenia and depressive disorder) of all the participants and their relatives including their children, parents, siblings, and second and third degree relatives. Thirdly, broader autism phenotype of each participant was evaluated using autism spectrum quotient(AQ), which is a widely used self-report questionnaire used to quantify autistic traits of adults with average intelligence. The Chinese version of AQ has 35 items

and was generated using data from Taiwanese (Lau, W. Y., et al. (2013)).
Results: In total, we collected 10 ml whole blood from 776 males and 261 females. The ratio of males to females is 2.96:1. Their ages ranged from 18 to 59 years, with an average of 29.67. Participants were from 21 provinces, 3 municipalities, and 4 autonomous regions. 53.62% of participants were from north of China. Percentages of participants whose own bachelor's degree or high school diploma, respectively, were 21.60% and 32.01%. Both were higher than the levels from nationwide survey. 92.2% of participants were from Han ethnic group. For 9.45% of participants, they or their relatives were diagnosed with or suspected of neurological and/or psychiatric disorders. The total AQ scores of males (77.52645 ± 9.458683) were higher than that of females (76.1341 ± 9.656864) (two sided t-test, p-value=0.04), which was consistent with previous studies.
Conclusions:
We collected control blood samples from typically developed Chinese adults with detailed personal information, which will greatly contribute to the genetic studies of ASD in China.

36 **144.036** Clinical Characterisation of Neurexin1 Deletions and Their Role in Neurodevelopmental Disorders

J. E. Fitzgerald[1], *J. Hall*[2], *M. van den Bree*[2], *R. Delorme*[3], *T. Werge*[4], *A. C. Tabet*[5,6], *L. T. Duong*[7], *H. Peeters*[8], *I. Noens*[9], *N. Cosemans*[8], *S. Esteba*[10], *M. Al-Shehhi*[11], *R. Novell*[10], *S. Lynch*[11], *A. Green*[12], *S. Shen*[13] *and L. Gallagher*[14,15], *(1)Trinity College Dublin, Dublin, Ireland, (2)Cardiff University, Cardiff, Wales, (3)Child and Adolescent Psychiatry, Robert Debre Hospital, Paris, France, (4)University of Copenhagen, Copenhagen, Denmark, (5)Robert Debre Hospital, Paris, France, (6)GHFC unit, Pasteur Institute, Paris, France, (7)Forensic Psychiatry of Zeeland, Mental health of the Region of Zeeland, Slagelse, Denmark, (8)Center for Human Genetics, KU Leuven, Leuven, Belgium, (9)Parenting and Special Education Research Unit, KU Leuven, Leuven, Belgium, (10)Institute for Health Assistance (IAS) and Julia Martin Park Hospital, Girona, Spain, (11)National Centre for Medical Genetics, Dublin, Ireland, (12)Our Lady's Children's Hospital, Crumlin, National Centre for Medical Genetics, Dublin, Ireland, (13)REMEDI, National College of Ireland Galway, Galway, Ireland, (14)Psychiatry, Trinity College Dublin, Dublin, Ireland, (15)Linndara Child and Adolescent Mental Health Services, Dublin, Ireland*

Background:
The Neurexin1 (NRXN1; 2p16.3) gene has been identified as a rare but significant genetic risk factor for a number of neurodevelopmental disorders including autism spectrum disorder (ASD), schizophrenia, intellectual disability and bipolar disorder. NRXN1 encodes neurexins, presynaptic neuronal adhesion molecules that bind to postsynaptic neuroligins to stabilise synapse formation and facilitate neuronal transmission. Common clinical features are associated with NRXN1 deletions but these have not been deconstructed using in-depth neuropsychological, neurocognitive and neuroimaging techniques.
Objectives:
This European-wide collaboration aims to deep phenotype individuals and characterise the clinicopathological features of NRXN1 deletions in order to establish diagnostic biomarkers and targeted therapeutic interventions.
Methods:
Individuals with NRXN1 deletions are currently being identified and recruited through clinical genetic services at each site. All consented participants are completing a battery of semi-structured neuropsychological assessments and questionnaires to probe for existing and/or sub-threshold psychiatric disorders or symptoms. A comprehensive cognition battery (CANTAB), which includes tests of reaction time, attention, executive functioning, working memory, cognitive flexibility and social cognition are administered to all participants to assess neurocognitive functioning. Abnormal brain structure and function is investigated using both MRI and EEG techniques. High resolution T1, diffusion weighted, magnetic resonance spectroscopy and resting state functional data are acquired using MRI. EEG measured brain activity is probed during resting state in addition to visual and auditory oddball paradigms. Parallel investigations of patient derived iPSCs are also ongoing.
Results:
To date, 117 individuals from 61 families have been identified with NRXN1 deletions across 6 European sites and recruitment is ongoing. Neuropsychological assessments have been administered to 26 individuals (8 de novo, 8 inherited and 10 familial carriers). From these, 12 individuals have met criteria for ASD, 7 for intellectual disability (3 mild ID and 4 severe ID), 5 for epilepsy, 5 for an anxiety disorder, 3 for a psychotic disorder, 3 for ADHD and 2 for a mood disorder. Neurocognitive assessments to date (n=6) indicate that poor attention and executive dysfunction are most characteristic of individuals with NRXN1 deletions. Preliminary MRI data (n=6) suggests individuals with NRXN1 deletions have an altered cortical structure, characterised by reduced cortical thickness, greater surface area and disrupted white matter organisation.
Conclusions:
Although the study data are preliminary, interesting clinical characteristics of NRXN1 deletions are emerging. NRXN1 deletions are an important risk factor for neurodevelopmental disorders. Additional clinical and neurobiological phenotyping in addition to mapping of the NRXN1 genotype may elucidate the underlying neurobiological processes contributing to neurodevelopmental disorders.

37 **144.037** Comprehensive Autism Spectrum Screening for Infants (CASS-i): A Screening Tool for Autism Spectrum Disorder (ASD) and Developmental Learning Delay (DLD) and the Incidence of Copy Number Variance (CNV)

C. Samango-Sprouse[1,2,3], *C. Keen*[1], *K. Haskell*[1], *F. Aliabadi*[4], *C. Parmele*[5] *and A. Gropman*[6], *(1)The Focus Foundation, Crofton, MD, (2)George Washington University, Washington, DC, (3)Molecular Genetics, Florida International University, Miami, FL, (4)The Pediatric Group, Crofton, MD, (5)Annapolis Pediatrics, Annapolis, MD, (6)Neurodevelopmental Disabilities and Neurogenetics, Children's National Medical Center, Washington, DC*

Background: The CDC estimates ASD occurs 1:88 children, and an increased incidence of CNV in ASD and DLD has been documented [Roberts et al., 2014]. The earlier at-risk infants with ASD or DLD and the associated CNV are detected, the sooner the infant can receive targeted interventions to reduce the impacts of these disorders and improve outcome. The CASS-i is based on previously published findings on a combination of early indicators of motor, social and physical attributes associated with ASD and DLD [Samango-Sprouse et al., 2015].
Objectives: To develop a screening tool that identifies salient biomarkers for efficient, easy, quick and effective utilization by primary care providers (abbreviation not used again so deleted to save space). To identify infants prior to 12 months of age for ASD and DLD, and to use Chromosomal Microarray (CMA) to quantify the incidence of CNV.
Methods: Two large pediatric groups located in suburban Maryland assessed 4 biomarkers at 9-month well baby visits (WBV). These biomarkers were: head tilt reflex (HTR), accelerated head growth and increased head circumference (HC), pulls to sit (PTS), and turns to name (TTN). The Pervasive Developmental Disorders Screening Test (PDDST) was given at 30 months as an exit screening test to identify infants who may have been missed during 9 month WBV. An absence of any of the 4 biomarker screeners, or an abnormal PDDST were indicated as "red flags" and followed up with a neurodevelopmental evaluation. Institutional Review Board approval for the study was given and updated annually.
Results: A total of 339 typical developing infants with no known history of ASD or neurogenetic disorders were enrolled in the study. Of the 339, 302 had appropriate responses on all 4 biomarkers. 37 had abnormal results in 1 or more of the biomarkers or the PDDST. Of the 37 with abnormal results, 23 came in for neurodevelopmental evaluations, 7 declined, 5 gave no response, and 2 did not show. From the 23 who came in for evaluations, 10 infants (43%) were identified at risk for ASD or DLD; specifically, 5 infants were identified to be at risk for ASD and 5 were identified to be at risk for DLD. So far, CMAs were completed on 11 of the 23 infants (not all in 'at risk' group, 8/10 at risk had CMAs completed – chart below) and 2 had CNVs (18%). Both with CNVs were part of the 'at risk' cohort (20%). One of the CNVs found is associated with ASD, and the other CNV places the infant at risk for an autosomal recessive genetic condition and is associated with DLD.
Conclusions: CASS-i is an expansion of earlier findings and further supports that it's a quick, easy and effective screening tool to identify at risk infants for ASD and DLD prior to 12 months [Samango-Sprouse et al., 2015]. The incidence of CNVs within our 'at risk' DLD infant population support previous findings and is supplementary to existing research of the increased incidence of CNV and ASD [Roberts et al., 2014].

Table 1 – 'At Risk' Cohort	Reason for Evaluation	Result of Evaluation	Result of CMA
Patient1	HC	ASD	Pending
Patient2	HTR	DLD	CNV
Patient3	HC	DLD	Normal
Patient4	HC	ASD	Normal
Patient5	HC	ASD	Normal
Patient6	HC	ASD	Declined CMA
Patient7	HC	DLD	Normal
Patient8	HTR	ASD	Declined CMA
Patient9	HC	DLD	CNV
Patient10	PDDST	DLD	Pending

38 **144.038** Effect of Autism Risk CNVs on Autistic and Neuropsychiatric Traits in a Population Based Adolescent Sample

E. Loth[1], *R. Toro*[2], *J. B. Poline*[3], *G. Huguet*[4], *G. Schumann*[5] *and T. Bourgeron*[6], *(1)Institute of Psychiatry, King's College London, London, England, United Kingdom, (2)Institut Pasteur, Paris, France, (3)Berkeley University, Berkeley, CA, (4)Génétique médicale, CHU St Justine, Montréal, QC, Canada, (5)SGDP Centre, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (6)Institute Pasteur, Paris, France*

Background: Like many neurodevelopmental and neuropsychiatric disorders, Autism Spectrum Disorder (ASD) is viewed as lying on a continuum that shades into sub-clinical traits in the 'normal' population. Current estimates suggest that 10-20% of cases are caused by one or more copy number variants (CNVs) in the genome (see Simons Foundation Autism Research Initiative, SFARI). However, it is not known whether these same CNVs also affect autistic and related social-affective traits in the 'general population'. Furthermore, possible sex differences are indicated by recent findings suggesting that the increased male:female ratio in ASD may be due to a 'protective' effect in females, who may require a greater burden of CNVs. Finally, our understanding of potentially mediating neural and neurocognitive mechanisms is still incomplete.
Objectives: To investigate in an adolescent sample from the general population (1) the effect of ASD-risk CNVs (as compiled by SFARI) on ASD symptoms and other neuropsychiatric traits (overall, and stratified by sex); and (2) to examine whether differences in cognitive profile, brain structure and/ or function in CNV-carriers mediate the link between genetic risk factors and clinical symptoms.
Methods: Participants are 1,713 adolescents (841 males, 872 females) from the IMAGEN cohort. CNV detection was performed based on the Illumnia 610/660 arrays, using two different algorithms (QuantiSNP and PennCNV) on samples that passed Quality Control to minimize the number of potential false discoveries. For each participant we computed the number of intronic and exonic deletions/ duplications in SFARI risk-genes. In a first step, SFARI risk-gene carriers were compared to no-risk gene carriers on ASD symptoms (Social Responsiveness Scale); emotional, conduct, peer, hyperkinetic and overall problems impacting daily adaptive functioning (Strength and Difficulties Questionnaire), and IQ (WASI). In a second step, we plan to compare the groups on a number of a) neurocognitive domains: empathy/ perspective-taking, impulsivity, reward processing, attention, and working memory; (b) cortical thickness/ surface area, and (c) and strength of functional connectivity.
Results: 1,369 adolescents carried no deletion/duplication in SFARI risk genes, 297 one, 32 two, 6 three, and 9 four deletions/ duplications. We found that boys carrying one or more ASD-linked CNVs had nominally significantly higher ASD symptoms than no-risk carriers (p=.036). This effect was not observed in girls. At age 13-14 years, both male and female SFARI risk gene-carriers also had significantly more peer problems (p=.001), emotional problems (p=.028), and overall problems that impacted daily functioning (p=.00001). However, SFARI-risk gene carriers did not differ from non-carriers in terms of IQ.
Conclusions:
In a population-based sample, boys carrying one or more ASD-linked risk genes exhibited higher ASD traits than non-carriers. However, these CNVs also increased broader emotional and social (peer) problems, and overall problem impact in boys and girls at a similar rate. Consistent with findings from clinical groups, this indicates that these CNVs may not map onto a 'specific' vulnerability for ASD but a broader range of (sub-clinical) social-emotional dysfunctions. We will also report findings from ongoing analyses on the potentially mediating role of brain structure and function, and neurocognitive profile in these associations.

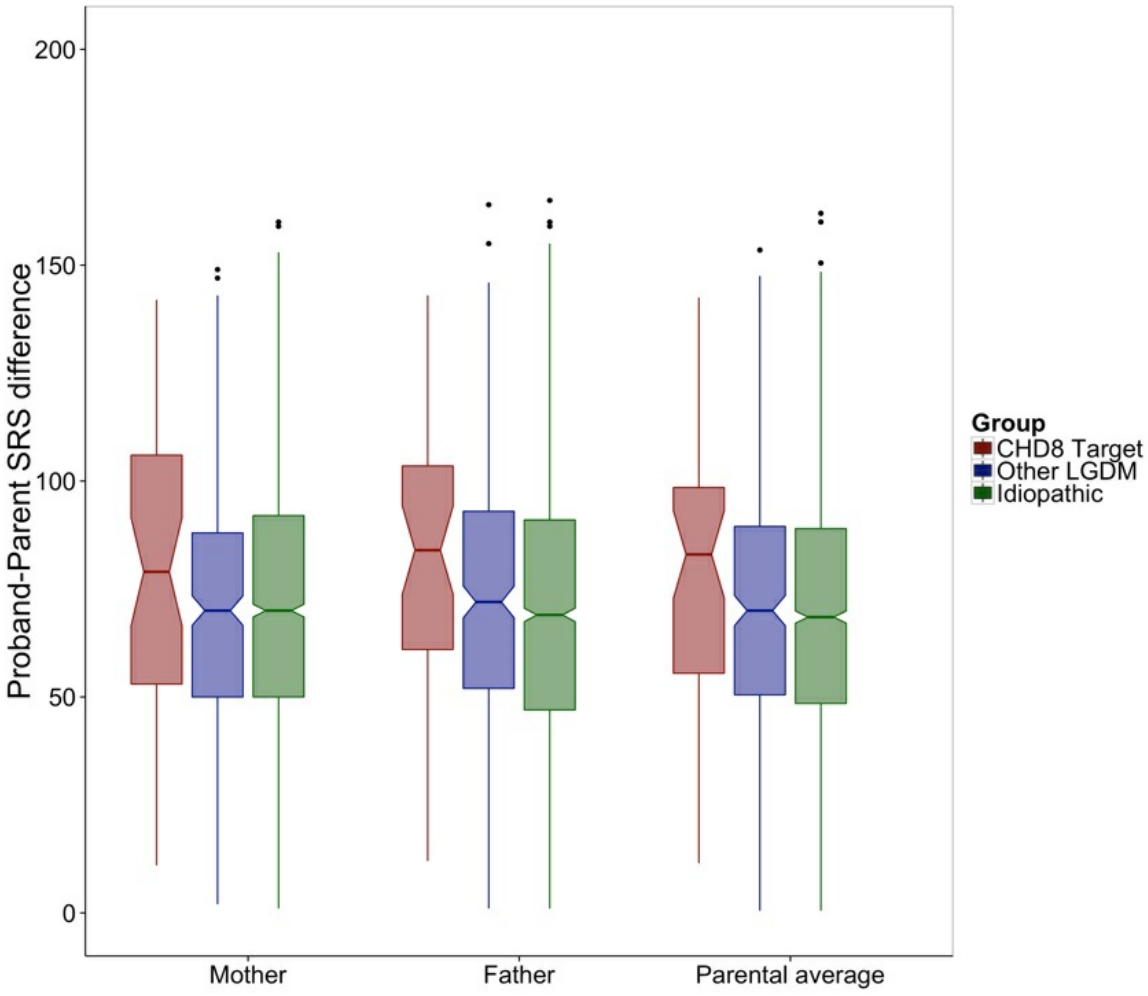
39 **144.039** Familial Contribution to Clinical Variability in Social Responsiveness for Individuals with Disruptive Mutations to CHD8 and CHD8 Target Genes

R. K. Earl*, C. M. Hudac, J. Gerdts, E. E. Eichler and R. Bernier, University of Washington, Seattle, WA*

Background:
Chromodomain helicase protein 8 (*CHD8*) is one of the most frequently identified *de novo* likely gene disrupting mutations (LGDM) occurring in simplex ASD (Iossifov et al, 2014; O'Roak et al, 2012). *CHD8* is a key regulator for a network of associated ASD risk genes involved in neurodevelopment (Cotney et al, 2014). Distinct phenotypic patterns have emerged for *CHD8*, yet considerable variability in ASD presentation remains (Bernier et al, 2014). Considering this variability in observed phenotype, the impact of *CHD8* and associated LGDMs may be better captured by the extent that observed performance deviates from expected outcomes. Given high familial heritability of phenotypic traits such as social behavior (Constantino, 2005), parental functioning serves as a measurement of expected outcome and informs penetrance of *de novo* gene variants (Moreno-de-Luca et al, 2014). This promising approach can help quantify genetic contribution to phenotypic variability for mutations to *CHD8* and *CHD8*-target genes.
Objectives:
First, to explore the genetic impact of disruptive events to *CHD8* and *CHD8*-targets on phenotypic variability in social functioning by quantifying observed-expected (e.g., proband-parent) discrepancy. Second, to assess the observed-expected discrepancy for *CHD8* and *CHD8*-targets relative to other ASD-associated gene-disrupting mutations and idiopathic ASD.
Methods:
Participants were simplex families of children who met strict criteria for ASD and either: (1) a *de novo* mutation of *CHD8* and *CHD8*-target genes (via Cotney et al, 2014, n=45(9 female)), (2) other non-*CHD8*-related LGDM (n=313(53)), or (3) no known gene event (i.e. idiopathic, n=2073(264)). Identified families were participants of the Simons Simplex Collection, the Autism Simplex Collection, and an ongoing study of individuals with identified ASD-risk gene events. Social behavior was measured by the Social Responsiveness Scale (Constantino, 2005) for both probands and non-carrier parents. One-way ANOVAs compared group differences in observed-expected discrepancy between proband and parents for raw SRS scores.
Results:
Overall, participants with *CHD8* and *CHD8*-target mutations had greater discrepancy in proband and paternal SRS than those with a non-*CHD8* LGDM and those with no gene event. More specifically, children with *CHD8* and *CHD8*-target mutations showed a decrement in social ability relative to expected ability as assessed by mean parental social ability (standard deviation, *SD* = 3.01), father social ability (*SD* = 2.71), and mother social ability (*SD*= 2.86). Preliminary analyses indicated that groups differed significantly in proband-father SRS difference score ($F(2, 2411) = 3.25$, $p = 0.039$, see Figure 1), but not in proband-mother or proband-parental average difference score.
Conclusions:
Individuals with *CHD8* and *CHD8*-target gene events show greater impairment in social responsiveness relative to expected (based on parental ability) than individuals with a non-*CHD8* LGDM or no gene event. The presence of this effect for paternal but not maternal comparisons may indicate a differential genetic contribution to social behavior. Overall, findings suggest a unique pattern of penetrance for *de novo CHD8*-related events compared to other LGDMs, which may enhance understanding of symptom

severity and treatment.

Figure 1. Proband-parent difference in social responsiveness by group



40 **144.040** Genome-Wide ASD Phenotype-Genotype Association Study in Two Large Data Sets

A. Yousaf[1], *R. Waltes*[1], *D. Haslinger*[1], *S. Lindlar*[1], *S. M. Klauck*[2], *E. Duketis*[1], *M. Sachse*[1], *A. Voran*[3], *M. Biscaldi*[4], *M. Schulte-Rüther*[5], *S. Kupferschmid*[6], *S. Cichon*[7,8,9,10], *M. Noethen*[7], *J. Ackermann*[11], *I. Koch*[11], *C. M. Freitag*[1] *and A. Chiocchetti*[1], *(1)Department of Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy, Johann Wolfgang Goethe-University Frankfurt/Main, Frankfurt, Germany, (2)Cancer Genome Research Group, German Cancer Research Center (DKFZ), Heidelberg, Germany, (3)Department of Child and Adolescent Psychiatry, Saarland University Hospital, Homburg, Homburg, Germany, (4)Department of Child and Adolescent Psychiatry, University Hospital Freiburg, Freiburg, Germany, (5)Department of Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy, University Hospital RWTH Aachen, Aachen, Germany, (6)University Hospital of Child and Adolescent Psychiatry, University of Bern, Bern, Switzerland, (7)Institute of Human Genetics, University of Bonn, Bonn, Germany, (8)Department of Genomics, University of Bonn, Bonn, Germany, (9)Division of Medical Genetics, Department of Biomedicine, University of Basel, Basel, Switzerland, (10)Institute of Neuroscience and Medicine (INM-1), Research Center Juelich, Juelich, Germany, (11)Molecular Bioinformatics, Institute of Computer Science, Johann Wolfgang Goethe-University Frankfurt am Main, Frankfurt, Germany*

Background:
Autism spectrum disorders (ASD) are a group of genetically and phenotypically heterogeneous neurodevelopmental disorders. Approximately 49% of ASD heritability can be attributed to common variants (Gaugler et al.,2014) which are also suggested to contribute to phenotypic variability (Devlin et al., 2011, Anney et al.,2011, Davis et al.,2012). Only few studies have reported association of specific genetic variants with quantitative ASD phenotypes. Latest research shows that a system-wide analysis of genetics of ASD phenotypes has an important role in understanding the heterogeneity of this disorder.
Objectives:
Here, we aimed at discovering associations of common variants with Autism Diagnostic Interview-Revised (ADI-R) items. We thus performed a whole-genome analysis on ADI-R scores of ASD patients. To interpret the findings in their biological context we mapped significant variants to their genes and tested for enriched pathways. Our approach aims at identifying potential pathomechanisms that modulate ASD symptoms.
Methods:
Using the “1000 Genomes” data containing ~79 million variants as reference, we imputed whole genome data of two large Datasets, the Autism Genome Project (AGP) and a newly genotyped German data set (Illumina 770K OmniExpress). We defined independent ASD phenotypes based on factors extracted from ADI-R scores following the approach of Liu et al. (2011) implementing exploratory and confirmatory factor analysis. SNPs overlapping in both cohorts with a minor allele frequency above 0.05 were included and tested for association with each of the 5 factors extracted using fixed effect linear regression models. Models were corrected for ethnicity, collecting center and gender. Nominally significant SNPs identified in both, the AGP and the German data set, were subjected to downstream analyses including gene mapping, GO-term enrichment as well as identification of co-regulatory gene modules of brain-development significantly associated with each phenotype.
Results:
We generated five Eigen-phenotypes (EP) from the ADI-R factor analysis labeled as Joint Attention, Social Interaction and Communication, Non-verbal Communication, Repetitive Sensory-motor Behavior and Compulsion/Restricted Interests. Ancestry analysis showed that distribution of ethnicities is similar between AGP and German data. In a preliminary approach using 163,136 tagging SNPs only, we identified for each EP more than 400 SNPs that were nominally associated in both cohorts. GO-term analysis revealed that genes associated with EPs were enriched for phenotype specific biological processes including “Neuron projection and development” for Joint Attention or “Locomotor behavior” for Repetitive Sensory-Motor Behavior.
Conclusions:
Our preliminary study showed that the genetic architecture of the individual EPs is specific, suggesting, that the different phenotypic aspects of ASD might have a distinct underlying genetic basis. We expect that our additional analysis including all imputed SNPs will refine our findings and increase our understanding of mechanisms modulating ASD phenotypes.

41 **144.041** Genotype-Phenotype Correlations of Phelan-Mcdermid Syndrome Based on Neurodevelopmental Gene Expression Patterns of the 22q13 Region

L. P. Grosvenor[1], *M. N. Ziats*[2] *and O. M. Rennert*[3], *(1)NIMH, NIH, Washington, DC, (2)NICHD, NIH, Bethesda, MD, (3)NICHD, NIH, Bthesda, MD*

Background: Phelan-McDermid Syndrome (PMS), also known as 22q13 deletion syndrome, is a rare genetic disorder that results from gene deletions on chromosome 22. Hundreds of different deletions of varying size have been reported in this gene-rich region, which contains ~100 coding mRNAs as well as other, poorly characterized non-coding RNAs (ncRNAs). The clinical phenotype of PMS is similarly heterogeneous, characterized by intellectual disability, autism spectrum disorder (ASD), hypotonia, severe delays or absence of speech, and dysmorphic physical features. Investigations into the molecular mechanisms linking deletions on 22q13 to the clinical phenotype have focused on the synaptic scaffolding protein *SHANK3*, despite observations suggesting the phenotype of PMS is dependent on gene deletion size. It is important to understand what role other RNAs on 22q13 may play in human neurodevelopment, and how their disruption may contribute to features of the PMS phenotype.
Objectives: This work attempts to (i) comprehensively assess in an unbiased manner the functional genomic landscape of the 22q13 region and then (ii) to interpret these discoveries in the context of genomic location on 22q13 and the phenotypic features of PMS.
Methods: We used the Allen Brain Atlas database to assess the brain expression patterns of genes on the 22q13 region across typical neurodevelopment (16 brain regions; 2nd trimester through 40 years of age). We identified a subset of genes in the 22q13 region with enhanced expression in early development and in autism-related brain regions, and then analyzed the interactions of these genes and their roles in molecular pathways using the Ingenuity Pathway Analysis (IPA) software.
Results: Surprisingly, we found the majority (38/69; 55%) of genes on 22q13 are not expressed in the brain at all. Furthermore, we found that 9/24 (38%) of *SHANK3* exons do not have detectable expression during human neurodevelopment. The spatio-temporal expression profiles of individual genes vary across development, and multiple trends emerge, such as a decrease in expression during early childhood (ages 2-4 years). In particular, we found *SHANK3* is not expressed in brain prenatally compared to postnatally. In addition to *SHANK3*, we identified 4 genes on 22q13 as critical to typical neurodevelopment based on their expression: *ATXN10*, *MAPK8IP2*, *MLC1*, and *SULT4A1*. Network analyses of these genes revealed significant interactions with *SHANK3* and consistent enrichment on molecular pathways critical to synaptic development, cell-to-cell signaling, and plasma membrane transport.
Conclusions: Our results provide insight into the genomic landscape of the 22q13 region and the role these genes play in neurodevelopment. Most of the genes in this region are not expressed in the brain at all, and the expressed genes exhibit highly variable expression across development. Similar variation and unexpected lack of expression also exist for *SHANK3* exons. We show *SHANK3* is expressed significantly less prenatally compared to postnatally, which has potential implications for developing treatments of PMS. We identified four additional genes on 22q13 that have very high neurodevelopmental expression, play critical roles in cell-to-cell signaling, membrane transport, and synaptic scaffolding pathways, and which may be additional strong candidates for genes underlying the PMS phenotype.

42 **144.042** Glutamatergic Signalling and Autism: A Family Based Association Study on the Glutamatergic Neurotransmitter System

A. Yousaf[1], *H. S. Bour*[1], *D. Haslinger*[1], *E. Duketis*[1], *T. Jarczok*[1], *M. Sachse*[1], *A. Voran*[2], *M. Biscaldi*[3], *S. Kupferschmid*[4], *M. Schulte-Rüther*[5], *F. Degenhardt*[6,7], *S. Herms*[6,7,8], *S. Cichon*[6,7,8,9], *I. Koch*[10], *R. J. Anney*[11,12], ***A. Chiocchetti***[1] *and C. M. Freitag*[1], *(1)Department of Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy, Johann Wolfgang Goethe-University Frankfurt/Main, Frankfurt, Germany, (2)Department of Child and Adolescent Psychiatry, Saarland University Hospital, Homburg, Homburg, Germany, (3)Department of Child and Adolescent Psychiatry, University Hospital Freiburg, Freiburg, Germany, (4)University Hospital of Child and Adolescent Psychiatry, University of Bern, Bern, Switzerland, (5)Department of Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy, University Hospital RWTH Aachen, Aachen, Germany, (6)Institute of Human Genetics, University of Bonn, Bonn, Germany, (7)Department of Genomics, University of Bonn, Bonn, Germany, (8)Division of Medical Genetics, Department of Biomedicine, University of Basel, Basel, Switzerland, (9)Institute of Neuroscience and Medicine (INM-1), Research Center Juelich, Juelich, Germany, (10)Molecular Bioinformatics, Institute of Computer Science, Johann Wolfgang Goethe-University Frankfurt am Main, Frankfurt, Germany, (11)Trinity College Dublin, Dublin, Ireland, (12)Institute of Psychological Medicine and Clinical Neurosciences, Cardiff University,, Cardiff, United Kingdom*

Background:
Common single nucleotide polymorphisms (SNPs) can explain up to 50% of ASD risk. In a previous study we showed that common functional SNPs of genes implicated in Fragile X Syndrome (FXS) are associated with ASD risk (Waltes et al., 2014). Interestingly, the FXS associated protein FMRP is regulated by the glutamatergic system, a pathomechanism discussed for ASD.
Objectives:
Here we tested if functional common SNPs of glutamatergic genes are also associated with ASD risk or ASD specific symptoms in two large ASD family cohorts (Autism Genome Project/AGP set, N=2734 families; German data set N=578 families). Since the genetic architecture between individuals with High IQ (HIQ= IQ>70) and Low IQ (LIQ= IQ≤70) differs (Vieland et al., 2010), we also split the two cohorts into high and low functioning (HIQ, LIQ) individuals.
Methods:
207 functional SNPs of 124 glutamatergic genes with a minor allele frequency over 5% were tested using Plink v 1.9 (DFAM) in the cohort with HIQ, LIQ and the combined cohorts, respectively. Phenotype association was tested using logistic ordinal regression correcting for gender, IQ and clinical site. Phenotype measures were taken from the Autism Diagnostic Interview-Revised (ADI-R) scores for Social Interaction (Domain A), Verbal Communication (B1-B4; verbal individuals only), Non-Verbal Communication (Domain B2;B3; all individuals), Repetitive Behavior (Domain C) and Abnormal Development (Domain D). Variants significant in both cohorts with effect sizes in the same direction were considered as replicated. Similarly, genes with any nominal significant variant in both cohorts were considered as replicated hits.
Results:
We identified nominal significant associations of variants rs7206796 and rs3790112 (*GNAO1*) as well as rs3742926 (*AKAP6*) in both the German and the AGP LIQ cohort. In addition, significant but not overlapping SNPs of *AKAP2* were identified (LIQ only). rs2178865 (*GRIK1*) was associated with Abnormal Development, and rs731826 (*AKT1S1*) was associated with Non Verbal Communication in the HIQ cohorts. In addition, we report 24 genes that are nominally associated with ADI-R scores in both cohorts. Genes that were involved in all five phenotypes tested were strongly related to the TOR Pathway (e.g. genes *MTOR* and *TSC2*) or the second messenger system (e.g. G-proteins GNAS, phospholipases PLCB, protein phosphatases *PPP1CA*). A subset of genes was specific to each phenotype or significant in one of the subgroups (HIQ and LIQ) only. For example *AKAP13* or *RPS6K* are associated with Verbal Communication in Low Functioning Individuals.
Conclusions:
We suggest that variants of genes that are associated with glutamate signaling, and specifically the mTOR pathway are modulators of ASD symptoms. Genes such as *TSC1* or *RPS6K* are known to mediate glutamatergic signaling through mTOR, whereas AKAP proteins are important interactors of glutamate receptors (Sanderson et al., 2011). Both, the mTOR pathways and AKAP proteins have previously been associated with ASD (Chen et al ., 2014; Poelmans et al., 2013). Further functional analyses of glutamatergic variants are thus recommended to elucidate ASD etiology.

43 **144.043** Identification of Convergent Molecular Pathways during the Development of Neurons Derived from Patients with Idiopathic Autism Using Rnaseq Analysis

D. Dykxhoorn[1], *B. A. DeRosa*[2], *M. A. Pericak-Vance*[3], *K. Belle*[1], *J. M. Vance*[4], *C. Garcia-Serje*[1], *D. Van Booven*[5], *M. L. Cuccaro*[3] *and H. N. Cukier*[5], *(1)University of Miami Miller School of Medicine, Miami, FL, (2)The Hussman Instute for Human Genomics, Miami, FL, (3)John P. Hussman Institute for Human Genomics, University of Miami, Miami, FL, (4)Hussman Institute for Human Genomics, Miami, FL, (5)John P Hussman Institute for Human Genomics, University of Miami, Miami, FL*

Background: Recent studies have shown that genes harboring ASD risk loci are highly enriched in sets of genes expressed during early neocortical development and genes encoding proteins that function in specific biological pathways involving regulation of transcription, chromatin remodeling, cell adhesion, signaling complexes, and synapse function. However, the impact that these genetic variants have on ASD pathophysiology remains largely unknown. This is due in large part to a lack of genetically-relevant human disease models. The advent of human induced pluripotent stem cell (iPSC) technology and advances in neural differentiation techniques, have made it possible to study the molecular mechanisms that underlie ASD pathology. These stem cell-based differentiation approaches mimic in vivo neurogenesis and, as such, provide the opportunity to study the neurodevelopmental nature of ASD.
Objectives: Patient-specific induced pluripotent stem cells (iPSCs) present a unique opportunity to examine the hypothesis that heterogeneous ASD loci converge on specific molecular pathways during the early neural development.
Methods: Therefore, we generated patient-specific iPSC lines from 6 unrelated ASD individuals bearing rare variants identified through exome sequencing in extended multiplex families. The patient-specific iPSCs, in addition to iPSCs derived from unrelated control individuals, were differentiated into cortical neurons and transcriptome analysis using RNAseq was performed on the neurons at three time points over a 135 day time course of their *in vitro* development. Pathway and gene ontology (GO) analysis was performed on the set of identified differentially expressed (DE) genes.
Results: Transcriptome analysis implicate disturbances in the regulation of transcription, WNT signaling, chromatin remodeling, cell adhesion and migration, and synapse development across all time points analyzed. Over the course of neuronal differentiation, we observe key changes in gene associated with neural development and synaptic functionality. The greatest number of differentially expressed genes occurred at the earliest time point. To highlight some of these findings, specific pathways enriched in early neurons (day 35 *in vitro*) were identified that include WNT/MET signaling (p = 4.9510-36) and collagen catabolism (p = 7.41-09). Diffferentially expressed genes in midpoint neurons (day 85 *in vitro*) map to pathways involving cell migration (p = 1.34-06) and GABAergic neuron signaling transmission (p = 2.86-09). In later time point neurons (day 135 *in vitro*), differentially expressed genes are enriched in pathways involving WNT-mediated axon guidance (p = 4.71-05), calcium signaling (p = 8.92-20), and chromatin remodeling (p = 1.49-24).
Conclusions: The findings of this study show that common molecular etiologies underlie pathogenesis in subsets of individuals with idiopathic autism, including neuronal differentiation, axon growth, and synapse function.

44 **144.044** Increased Frequency of TSC2 Missense Mutations in Non-Syndromic Autism

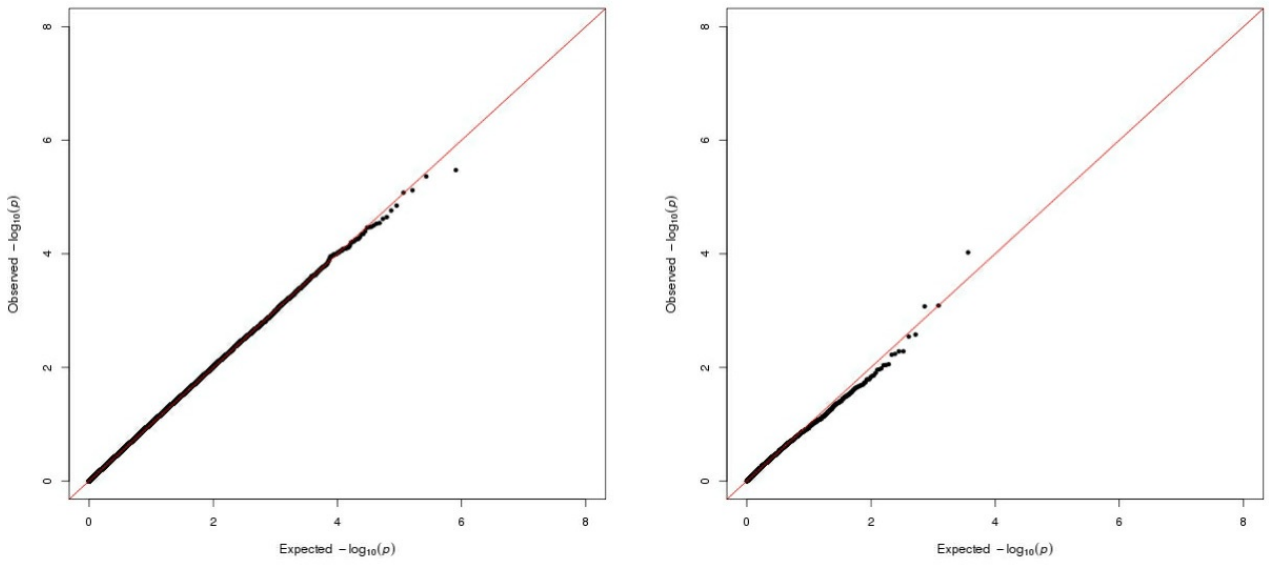
L. Kalsner[1], *B. Manwani*[2], *J. Twachtman-Bassett*[3], *E. Cornell*[4], *L. Derynioski*[5], *A. Milanese*[6], *T. Dumont-Mathieu*[7], *C. Stanley*[8] *and S. Chamberlain*[9], *(1)Connecticut Children's Medical Center, Hartford, CT, (2)Neurology, University of Connecticut Health Center, Farmington, CT, (3)Connecticut Children's Medical Center, Colchester, CT, (4)Research, Connecticut Children's Medical Center, East Hartford, CT, (5)Neurology, Connecticut Children's Medical Center, Farmington, CT, (6)Divison of Developmental and Rehabilitation Medicine, Department of Pediatrics, Connecticut Children's Medical Center, Farmington, CT, (7)Division of Developmental and Rehabilitation Medicine, Department of Pediatrics, Connecticut Children's Medical Center, Farmington, CT, (8)Courtagen Life Sciences Inc, woburn, MA, (9)Genetics and Genome Sciences, University of Connecticut Health Center, Farmington, CT*

Background: Tuberous sclerosis complex (TSC) is a neurogenetic disorder caused by heterozygous loss-of-function mutations in either the TSC1 or TSC2 genes. Classically the condition is diagnosed based on a constellation of clinical findings including hypomelanotic macules, angiofibromas, retinal hamartomas, cortical dysplasias, subependymal nodules, cardiac rhabdomyomas, and renal angiomyolipomas. It is also recognized that autism spectrum disorder is common in children with TSC, affecting roughly 50% of patients. TSC genes operate by inhibiting the mammalian target of rapamycin complex 1 (mTORC1), a complex pathway that controls translation and cell growth. Autism spectrum disorder (ASD) is neurodevelopmental disorder, characterized by impairments in social interaction, social communication and restricted or repetitive patterns of behavior. Numerous genes have been identified in which mutations cause or contribute to autism risk. Though mutations in TSC2 are known to cause tuberous sclerosis complex which is commonly associated with autism, mutations have not been known to independently increase risk for autism in the absence of clinical manifestations of TSC. We hypothesized that missense mutations in the TSC2 gene may contribute to risk for ASD, in the absence of classic signs of tuberous sclerosis complex.
Objectives: The objective of this study was to compare the frequency of TSC2 missense mutations in children with autism spectrum disorder to that found in the general population.
Methods: Peripheral blood samples were collected from 50 children diagnosed with non-syndromic autism at the Connecticut Children's Medical Center (CCMC) in the autism spectrum assessment program (ASAP) after obtaining consent according to protocols approved by the Institutional Review Board at CCMC. TSC2 sequencing was performed by Courtagen Diagnostics Laboratory as part of a multi gene panel using the Illumina MiSeq sequencing system. Variants identified were compared with reported variants in the Exome Aggregation Consortium (ExAC) database, using chi-square test.
Results: In our patient population, 8 out of 50 patients (16%) with non-syndromic autism were found to have non-synonymous missense mutations in the TSC2 gene. This is significantly higher than the reported prevalence of 1.3% in the general population, with 766 missense and loss-of-function TSC2 variants found in approximately 60,000 individuals as reported in the ExAC database, $p < 0.01$.
Conclusions: Our study concludes that patients with missense mutations in the TSC2 gene, but no clinical manifestations of tuberous sclerosis complex, may be at higher risk of autism. This may be due to the disruption of neuronal function through effects on the mTORC1 pathway and may raise the possibility of novel therapeutic targets for treatment of autism in the future.

45 **144.045** Integrating Expression Quantitative Brain Loci in ASD GWAS Analyses

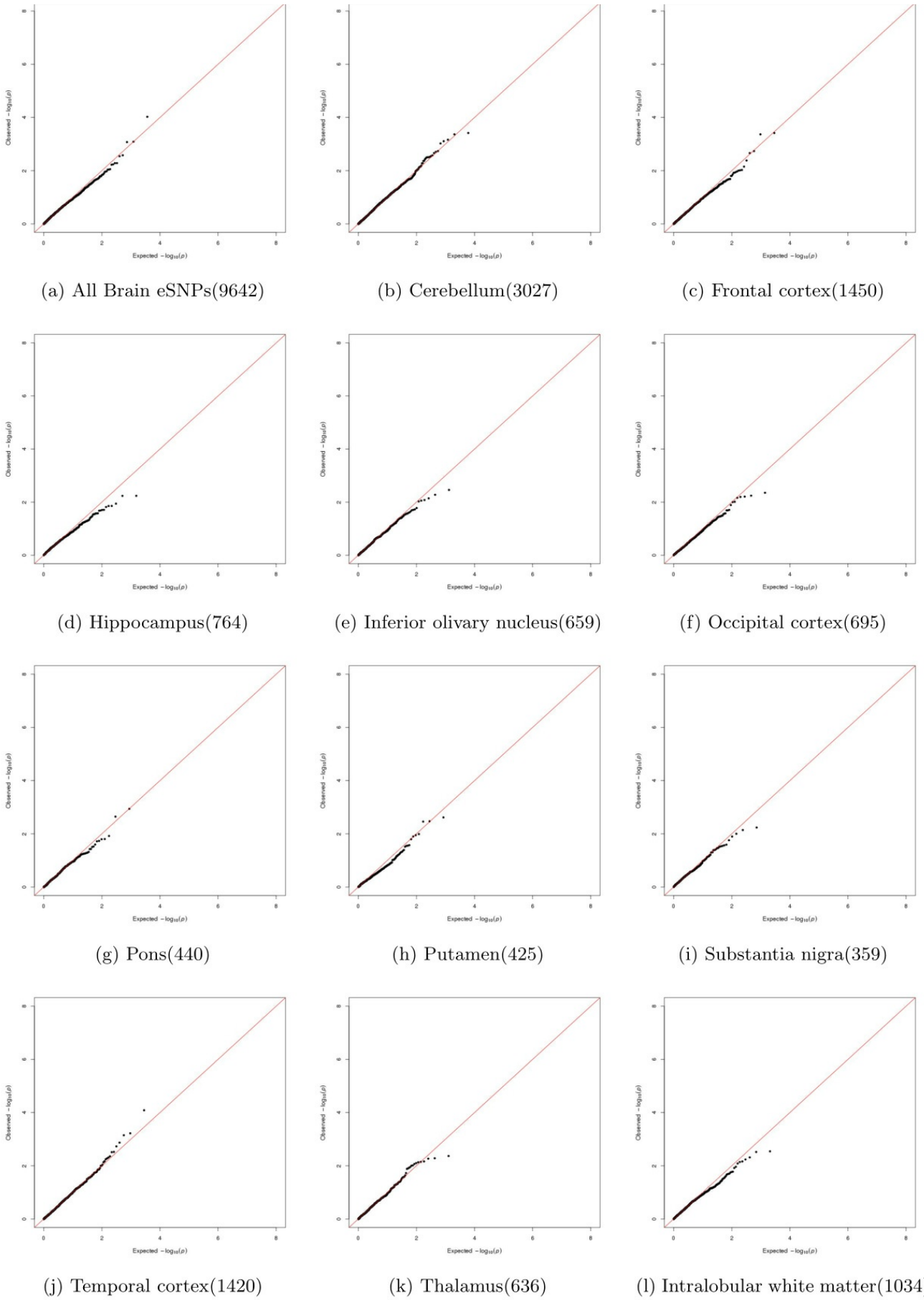
C. Shu[1], *C. Ladd-Acosta*[2], *A. Jaffe*[3], *J. L. Daniels*[4], *C. J. Newschaffer*[5], *A. M. Reynolds*[6], *D. E. Schendel*[7], *L. A. Schieve*[8] *and M. D. Fallin*[9], *(1)Department of Mental Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (2)Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (3)Lieber Institute for Brain Development, Baltimore, MD, (4)University of North Carolina, Chapel Hill, NC, (5)A.J. Drexel Autism Institute, Philadelphia, PA, (6)University of Colorado - Denver, Aurora, CO, (7)Aarhus University, Aarhus, Denmark, (8)National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention, Atlanta, GA, (9)Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD*

Background: Autism Spectrum Disorder (ASD) is highly heritable and there is evidence that common genetic variation plays a major role in this variability. However, genome-wide association studies (GWAS) thus far have had limited success. Genetics studies of other psychiatric disorders have shown enrichment for genetic variants that control brain expression, i.e. brain expression quantitative trait loci (eQTLs). Limiting genome-wide single nucleotide polymorphism (SNP) analyses to subsets known to be brain eQTLs (denoted "eSNPs"), and/or located in genes known to show developmental brain expression patterns, can reduce the search space allowing important association signals to separate from signals simply due to millions of tests performed.
Objectives: To perform genome-scale SNP association analyses for ASD, limited to SNPs known to be brain eSNPs or known to be located in genes expressed in early neural development. Further, to compare patterns of genome-wide association among SNP subsets defined by expression in specific brain regions.
Methods: Brain eSNPs and their proxy SNPs, based on linkage disequilibrium (LD) in 1000 genomes, were obtained from 6 published brain eQTLs studies, with annotation for 11 different brain tissue types. GWAS was performed on all SNPs, subsets of brain eSNPs, and brain tissue specific eSNPs after LD-based SNP pruning, using SNPs data from the Study to Explore Early Development (SEED) from 584 ASD cases and 725 non-ASD controls drawn from the general population. Similar annotation-based subsetting of Psychiatric Genomics Consortium (PGC) ASD SNP results are planned. Comparisons were made by examining the patterns of QQ plots.
Results: A total of 288,675 brain eSNPs were obtained after LD pruning, along with brain tissue specific eSNPs in cerebellum(3,027), frontal cortex(1,450), hippocampus(764), inferior olivary nucleus(659), occipital cortex(695) , pons(440), putamen(425), substantia nigra(359), temporal cortex(1,420), thalamus(636), and intralobular white matter(1,034). GWAS based on brain eQTLs revealed SNPs (rs7625872, rs73861956) that separated from expectation in QQ plots, while no separation was observed in the overall GWAS analysis of SEED data. The QQ patterns were also differential by subset in analyses based on eSNPs for specific brain tissues, where only QQ plots of cerebellum, frontal cortex and temporal cortex eSNP subsets showed positive separation from expectation.
Conclusions: The findings reported here are consistent with literature on the key brain regions involved in ASD etiology, namely cerebellum, frontal cortex and temporal cortex. Subsetting GWAS analysis to brain eSNPs can provide further insight on the ASD common variant signals.



(a) All SNPs, MAF>0.05(288,675) (b) Brain eSNPs, MAF>0.05(9,642)

Figure 1: QQ plots comparing all SNPs vs. brain eSNPs



(a) All Brain eSNPs(9642) (b) Cerebellum(3027) (c) Frontal cortex(1450)

(d) Hippocampus(764) (e) Inferior olivary nucleus(659) (f) Occipital cortex(695)

(g) Pons(440) (h) Putamen(425) (i) Substantia nigra(359)

(j) Temporal cortex(1420) (k) Thalamus(636) (l) Intralobular white matter(1034)

Figure 2: QQ plots of brain eSNPs from specific brain tissues

46 **144.046** Maternally Acting Gene Alleles Contribute to Autism

W. G. Johnson[1], *E. S. Stenroos*[2] *and S. Buyske*[3], *(1)661 Hoes Lane, Rutgers University, Piscataway, NJ, (2)Neurology, Rutgers-RWJMS, Piscataway, NJ, (3)Rutgers University, Piscataway, NJ*

Background:
Environmental, genetic and epigenetic factors contribute to fetal development. Genetic factors acting prenatally include maternal genes acting in maternal tissues, i.e., maternally acting gene alleles (MAGAs). MAGAs act independently of whether or not they are inherited by the fetus. From the mother's perspective, MAGAs are genetic factors, producing gene products that influence intrauterine environment. From the fetus's perspective, MAGAs are environmental factors since they act independently of any

inheritance from mother to fetus and since their effects result from gene action in the mother not in the fetus.
Maternally acting gene alleles, MAGAs, act in the mother during pregnancy to change the intrauterine environment. MAGAs produce gene products that may influence intrauterine environment. Maternal genes may have greatest effect when ratio of maternal to fetal mass is greatest, especially early in gestation. Certain anatomic effects in autism reflect changes in very early development. The role of MAGAs is less well understood than that of fetal genes.
Objectives: To assess the current data on maternal alleles in autism.
Methods: We identified reports of prenatal maternal effects and excluded those resulting from: Parent of origin effect, mitochondrial DNA variations and acute maternal environmental exposures. Methods and results for all publications were evaluated and compared.
Results: Among reports of candidate genes we found 11 reports of maternal alleles implicating 7 genes that altered the risk of autism. Five reports were of immune related alleles including *C4B* and *HLA-DRB1*. Three of these reported increased risk when mothers had the allele *HLA-DRB1*04.* A non-inherited maternal allele, NIMA, *HLA-DRB1*1302* is also a risk factor for autism. Four reports were of alleles of folate / 1-carbon metabolism, (*MTHFR, SLC19A1 and CBS*). Three of these showed altered risk based on maternal pre-natal vitamin intake. One report was of a maternal haplotype in *GSTP1,* ahaplotype made up of 2 missense polymorphisms not in high Linkage Disequilibrium with each other. Last, a maternal association of MAOA is contingent on male offspring having the same allele.
Conclusions: Maternal alleles in autism reported so far act in immune pathways, folate / 1-carbon metabolism, oxidative stress / detoxification pathways and monoamine metabolism, all of which are important in maintaining a proper environment for fetal development. Since MAGA's play an important role in autism but one less well studied then fetal genetic factors in autism, additional study is needed. A large study considering environmental influence, fetal alleles and interactions between mother and fetus and possibly epistasis is needed to better understand maternal allelic contributions to autism.

47 **144.047** Meiotic DNA Repair and Epigenetic Remodeling of the X and Y Chromosomes Could Contribute to the 'gender Bias' in Sex-Linked Autism Spectrum Disorders

***J. L. Hopkins**, M. Jamabo and P. W. Jordan, Biochemistry and Molecular Biology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD*

Background:
Autism Spectrum Disorders (ASD) exhibit a strong gender bias, whereby males are up to four times more likely to develop ASD than girls. Sex chromosome mutations have been associated with ASD, and children with sex-chromosomal aneuploidies, such as Turner [XO] and Klinefelter's [XXY] syndromes have an increased risk of developing ASD. The majority of errors that give rise to sex-chromosome abnormalities in progeny are derived from the paternal germline during meiosis I. Therefore, genomic instability during male meiosis may represent a causal factor for genetic and/or epigenetically-linked ASD pathogenesis and its increased prevalence in males.
In order for homologous chromosomes to accurately segregate during meiosis, they must first pair, synapse, and undergo crossover recombination. During male meiosis, the X and Y chromosomes remain largely unsynapsed and lack a homologous template to facilitate canonical DNA double-strand break repair, and therefore repair and segregation of the sex chromosomes is inherently error-prone. To ensure meiotic progression, the sex chromosomes are epigenetically silenced and compartmentalized into a peripheral nuclear subdomain known as the "sex body" in a process known as "Meiotic Sex Chromosome Inactivation" (MSCI). This process is initiated and maintained by accumulation of DNA damage response proteins (DDR) on the XY chromatin-wide domains. Sex chromosome silencing persists beyond meiosis and can influence imprinting and embryonic development in the next generation.
Objectives:
We hypothesize that the Polo-like kinase4 (PLK4) plays a novel role in DNA repair and epigenetic reprogramming of the sex chromosomes during male meiosis, and that failure to regulate these mechanisms in the paternal germline can lead to aberrations in imprinting and/or increased de-novo mutations in sex-linked genes. These events are likely to contribute towards the molecular etiology of sex-chromosome linked ASD.
Methods:
We have utilized a mutant mouse model (*Plk4*$^{I242N/+}$) to elucidate the meiotic role of PLK4 in male germline-quality, with emphasis on MSCI. Short-term spermatocyte culture, chromosome spreads, protein, and mRNA analysis were performed using purified germ cells from *Plk4*$^{I242N/+}$ and littermate control mice. qPCR and immunofluorescence microscopy were used to assess transcriptional silencing and condensation of the sex chromosomes in spermatocytes. Paternal X-chromosome (X_p) imprinting will be assessed at the 2-16 cell stages in WT pre-implantation embryos by using Cot1 and Xist-RNA FISH, and X-chromosome paint.
Results:
PLK4 localizes to the sex chromosomes during prophase I in males, resembling the localization patterns of DDR proteins known to be involved in MSCI. Meiotic progression, DNA damage repair, and sex-body organization and silencing is abnormal in *Plk4*$^{I242N/+}$spermatocytes.
Conclusions:
PLK4 regulates epigenetic remodeling and DNA repair of the sex chromosomes during MSCI. Ongoing studies will determine whether defective MSCI initiation and maintenance in spermatocytes can give rise to abnormal X_p chromosome imprinting. The precise mechanism by which these abnormalities lead to impaired brain development is not well understood. GWAS will be useful to determine whether any associations exist between parental meiosis-specific genes and increased mutations on the sex chromosomes in children. Assessment of paternal sperm quality might also be considered.

48 **144.048** Mssng - Combining Open Science and 10,000 Whole Genome Sequences to Speed the Delivery of New Understandings in Autism

***M. T. Pletcher**, Autism Speaks, Boston, MA*

Background: Genetics have been successfully leveraged to provide critical insights into the molecular pathology and heterogeneity of Autism Spectrum Disorder (ASD). Yet, there are critical gaps in our understanding of the disorder that prevent efficient diagnosis and treatment. In an effort to speed the delivery of new discoveries and therapeutics, Autism Speaks, along with its key partners, Google and the Hospital for Sick Children have initiated the MSSNG program.
Objectives: Through MSSNG, we have endeavored make available to a broad community of researchers, clinicians, diagnostic laboratories, and educators at least 10,000 whole genome sequences from members of families with ASD, the associated clinical and phenotypic data, and the tools necessary to fully explore and analyze that data.
Methods: After completion of the sequencing, raw genome sequences are placed on Google Cloud Platform where they are reviewed for quality and processed through a annotation pipeline that runs off the Google Genomics API. As soon as this process is completed and permission is received from the appropriate institutional review board or research ethics board, the annotated genomes are published for use by approved investigators. Any investigator with a legitimate research question can gain access to the MSSNG database by applying through a process that is managed by an independent Data Access Compliance Office and is consistent with the donors' informed consent.
Results: Nearly 5000 genomes have been completed to date and all 10,000 genomes are anticipated to be available to approved researchers by the spring of 2016. A track for the UCSC browser has been created so that even those that have not gone through the MSSNG access process can still view the variants identified in the MSSNG dataset and their associated frequencies. Although not originally available, approved researchers can now download BAM files so that they might be able to do custom analyses locally. MSSNG has also provided a web-based interface to allow individuals to identify specific variants, generate gene-specific variant lists, conduct statistical analysis, and browse individual phenotype data. Although still early, investigation of the MSSNG dataset has led to important insights into the role of de novo mutations in ASD and has identified novel genetic variants as potential causative factors in the disorder.
Conclusions: MSSNG provides an open and flexible environment to study the largest genomic resource of its kind. It provides a critical reference dataset for genetic investigations in any number of unrelated diseases while powering efforts to define discrete but clinically meaningful subcategories of ASD. Ultimately, the success of MSSNG will be determined by the value it brings to the families that made MSSNG possible through their donation, by impacting their journey with ASD and improving outcomes.

49 **144.049** Multivariate Analysis of Insomnia-Related Behaviors Profiled in the Simon's Simplex Collection

***O. J. Veatch**, J. S. Sutcliffe, Z. Warren, M. H. Potter and B. A. Malow, Vanderbilt University, Nashville, TN*

Background: Autism spectrum disorder (ASD) is a phenotypically heterogeneous condition with diverse symptomatology and expression of multiple comorbidities. The wide variability in clinical manifestations may be explained by underlying genetic heterogeneity. Incorporating evidence related to expression of comorbidities may identify clinically meaningful subgroups. For example, sleep disorders such as insomnia are common in individuals with ASD, suggesting involvement of shared molecular pathways with sleep or circadian regulation. Identifying subgroups of individuals with co-occurring insomnia may allow detection of clinically relevant genetic mechanisms conferring large effects.
Objectives: We tested the hypothesis that applying multivariate statistical approaches to analysis of insomnia-related questions available in medical histories from individuals in the Simon's Simplex Collection would effectively identify subgroups of individuals with ASD expressing comorbid insomnia.
Methods: We conducted cluster analysis evaluating parent responses on five questions specific to insomnia included in the medical histories of 2,708 children ages 4-17 years with ASD. Input variables included parent responses related to whether their children had ever had difficulty going to bed, difficulty falling asleep, frequent or prolonged awakenings at night, sleepwalking or frequent nightmares, and/or needed their parents to lay down with them in order to sleep. We determined differences between the mean sleep duration reported for individuals between identified clusters. We also evaluated differences in the proportion of individuals with parents reporting problems in sleep-related behaviors, and other comorbidities including seizures, attention deficit disorder and constipation. We also assessed whether the proportion of individuals with exonic mutations in two melatonin pathway genes (*ASMT* and *CYP1A2*), implicated in risk for both ASD and insomnia, were different between clusters.
Results: Clustering algorithms identified two distinct groups of individuals with ASD. Cluster 1 (the non-insomnia cluster) included 1,898 individuals and Cluster 2 (the

insomnia cluster) included 810 individuals. The largest difference in the clusters was related to difficulty falling asleep, followed by whether or not the child needed a parent in order to fall asleep, difficulty going to bed, and frequent or prolonged awakenings. The presence of sleepwalking or nightmares also defined some of the cluster differences; however, differences were substantially less than other questions of interest to insomnia. Individuals in Cluster 2 also had shorter sleep durations than those in Cluster 1. Furthermore, more individuals in Cluster 2 had attention deficit disorder and constipation. There was no difference between the proportions of individuals with mutations in either candidate gene between clusters.
Conclusions: Our clustering algorithm, based on five insomnia-related symptoms assessed in the SSC medical histories, was effective in allowing us to determine the most common sleep concerns in children with ASD. In addition, presence of insomnia was related to the presence of two other important comorbidities in ASD, ADD and constipation. While we did not observe a difference in mutations in the two candidate genes assessed, it is possible that these clusters represent genetically distinct ASD subsets. In order to fully evaluate potential genetic differences between clusters it will be necessary to evaluate more genes that affect sleep patterns, including circadian and melatonin receptor genes.

50 **144.050** NLGN2 Haploinsufficiency Causes a Distinctive Neurobehavioral Phenotype Characterized By Anxiety, Autism, Intellectual Disability, and Obesity

M. Shinawi[1], *D. Baldridge*[2], *G. Douglas*[3], *C. Garriga*[4] *and M. T. Cho*[3], *(1)Pediatrics, Washington University School of Medicine, St. Louis, MO, (2)Washington University School of Medicine, St. Louis, MO, (3)GeneDx, Gaithersburg, MD, (4)St. Louis Children's Hospital, St. Louis, MO*

Background: Dysregulation of synaptic function is considered a common pathophysiological mechanism for a variety of neurobehavioral phenotypes and mutations in several synaptic proteins have been implicated in these disorders. Animal and *in vitro* studies have shown that neuroligin 2 (NL2) clusters in inhibitory postsynaptic membranes and induces, through the mediation of collybistin and gephyrin, an inhibitory postsynaptic specialization by localization of the glycine and $GABA_A$ receptors. These functions are essential for the maintenance of excitatory/inhibitory balance in the brain. Deletion of *nlgn2* in mice leads to changes in the molecular make-up of inhibitory synapses and inhibitory synaptic transmission, and increases anxiety-like behaviors. Conditional knockout (KO) of *nlgn2* in the medial prefrontal cortex of mice causes deficits in anxiety, fear memory and social interaction. The conditional *nlgn2* KO in the basal amygdala, a brain region with prominent effect on fear and anxiety behaviors, leads to a robust anxiety phenotype upon exposure to an anxiogenic environment. In humans, missense variants in *NLGN2* have been implicated in a few cases of schizophrenia.
Objectives: Investigation of the molecular basis of a distinctive neurobehavioral phenotype in a 14-year-old Caucasian male.
Methods: The proband exhibited global developmental delay since early infancy. He was diagnosed with PDD-NOS at age 3 years but later his phenotype has been dominated by short attention span, severe anxiety and obsessive-compulsive behaviors. His other problems included hypotonia, some dysmorphic features, macrocephaly and obesity, which was associated with hyperphagia, food-seeking behavior, and diet-related obsession. His previous work-up has been negative and included chromosomal microarray analysis, molecular testing for fragile X syndrome, and methylation studies for Prader Willi syndrome. Exome sequencing was performed using Agilent Clinical Research Exome kit and Illumina HiSeq 2000 100 bp paired-end reads. GeneDx's XomeAnalyzer was used to evaluate sequence changes between the proband, parental samples and reference. Sanger sequencing was used to confirm positive exome findings.
Results: Exome sequencing revealed a heterozygous *de novo* variant in *NLGN2*designated as c.441C>A (p.Y147X; p.Tyr147Ter), which has not been reported previously as a disease causing mutation nor as a benign polymorphism. It is predicted to cause loss of normal protein function either through protein truncation or nonsense-mediated mRNA decay.
Conclusions: This is the first report of a truncating variant in *NLGN2* that recapitulates the anxiety phenotype in mice. We provide evidence that the *de-novo* loss-of-function variant in our proband is pathogenic. Our data add to the accumulating evidence implicating synaptic proteins in the etiologies of a spectrum of neurodevelopmental phenotypes and demonstrate the power of exome sequencing in psychogenetics. The genetic data may have implications for the treatment of the psychological findings in our proband.

51 **144.051** Placenta Methylation and Autism Risk in the Early Autism Risk Longitudinal Investigation (EARLI)

S. V. Andrews[1], *K. M. Bakulski*[1], *J. Feinberg*[2], *R. Tryggvadottir*[3], *K. D. Hansen*[4], *S. C. Brown*[5], *L. A. Croen*[6], *I. Hertz-Picciotto*[7], *C. Ladd-Acosta*[8], *C. J. Newschaffer*[9], *A. P. Feinberg*[2] *and M. D. Fallin*[10], *(1)Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (2)Johns Hopkins University, Baltimore, MD, (3)Johns Hopkins University, Center for Epigenetics, Baltimore, MD, (4)Department of Biostatistics, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (5)Mental Health, Johns Hopkins University Bloomberg School of Public Health, Baltimore, MD, (6)Division of Research, Kaiser Permanente, Oakland, CA, (7)Dept of Public Health Sciences, School of Medicine, UC Davis MIND Institute, Davis, CA, (8)Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (9)A.J. Drexel Autism Institute, Philadelphia, PA, (10)Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD*

Background: Epigenetic mechanisms are of increasing interest in Autism Spectrum Disorder (ASD) etiology. Previous studies have established an association of altered epigenetic marks in brain and lymphoblastoid tissues of ASD cases compared to controls, including DNA methylation (DNAm) and histone 3, lysine 9 trimethyl (H3K9me3) modifications. The placenta is an important mediator of stress and environmental exposures during the gestational period, shown to be a critical risk window for neurodevelopmental disorders, and is therefore of interest for etiologic investigations of ASD. However, to date, there have been no previous genome-wide studies of placenta DNAm and ASD.
Objectives: We measured DNAm across the genome in placenta tissue to identify genomic regions at which DNAm differed according to autism risk as quantified by the Autism Observational Scale for Infants (AOSI) administered at 12 months.
Methods: We isolated genomic DNA from the fetal side of 133 placenta samples from the Early Autism Risk Longitudinal Investigation (EARLI), an ongoing autism-enriched pregnancy cohort which enrolls families with a previously diagnosed ASD child during a new pregnancy. Families are followed throughout the gestational period and infants are followed from birth through 36 months. Recruitment was carried out at 4 sites: Drexel University School of Public Health & Children's Hospital of Philadelphia, University of California Davis & MIND Institute, Johns Hopkins Bloomberg School of Public Health & Kennedy Krieger Institute, and Northern California Kaiser Permanente. Sequencing libraries were prepared using the NEBNext Ultra DNA Library Prep Kit for Illumina by New England BioLabs Inc. Whole-genome bisulfite sequencing at 13x coverage used 125 base pair, paired-end reads with the Illumina HiSeq 2500. We are currently performing alignment using Bowtie2, calculating methylation at single-nucleotide resolution, and searching for differentially methylated regions (DMRs) according to AOSI score, adjusting for ancestry and sex using the BSmooth algorithm as implemented in the R package 'bsseq'.
Results: AOSI score was available on 115 of the 133 children with available placental samples (range 0-19, mean [sd] = 5.25 [3.86]). We will report at the meeting the top-ranked DMRs and explore their implicated regions for their potential functional relevance to ASD and towards placenta functionality more generally.
Conclusions: This study comprises the largest and most comprehensive survey of the placenta methylome in the context of ASD to date. Discovered regions may help define the role of placenta methylation in ASD etiology and may support the development of a placenta-based DNAm biomarker for autism risk.

52 **144.052** Prevalence of Prenatal and Perinatal Birth Complications in Individuals with and without ASD-Associated Copy Number Variants

J. Han[1], *A. Wolken*[2], *S. Barber*[1] *and R. Bernier*[1], *(1)University of Washington, Seattle, WA, (2)Seattle Children's Hospital, University of Washington, Seattle, WA*

Background: Although the etiology of ASD is unknown, both genetic and environmental factors have been implicated in autism spectrum disorder (ASD) risk. Recent advances in identifying ASD associated genetic events, such as copy number variation (CNV), underscore the role of genetics in the etiology of ASD (Sanders et al., 2015). Studies have also found that prenatal and perinatal birth complications are associated with increased risk for ASD (Gardener et al., 2009, 2011). However, the relationship between pre- and perinatal birth complications and genetic events associated with ASD is not well understood.
Objectives: The objectives are: 1) To examine the prevalence rates of birth complications in individuals diagnosed with ASD with an ASD associated CNV and those with idiopathic ASD. 2) To examine whether rates of birth complications differ between individuals with deletion versus duplication CNVs. 3) To assess the prevalence of prenatal and perinatal birth complications separately within these groups.
Methods: Participants included 285 individuals with at least one CNV (178 duplications, 107 deletions) and 2083 individuals without CNVs from the Simons Simplex Collection (SSC), none of whom had likely gene disrupting mutations (Iossifov et al., 2014). ASD associated CNVs were identified by Girirajan et al., 2013. We obtained prenatal and perinatal data from the Medical History Interview completed with parents. As defined by Froehlick-Santino et al., 2013, prenatal complications included vaginal bleeding, low gestational age, and maternal medication usage and perinatal complications included low birth weight (<2500g), jaundice, and "markers of hypoxia". We performed chi-square analyses to assess prevalence rates of birth complications for individuals with ASD associated duplications, deletions or no-CNVs.
Results: 70 (65.4%) of cases with a deletion had reported pre- or perinatal complications, while 104 (58.4%) of cases with a duplication and 1252 (60.1%) of the no-CNV group had birth complications. Non-parametric analyses examining the relationship between genetic status (presence of a deletion CNV, duplication CNV or no CNV) and presence of birth complications revealed no differences in rates of birth complications: X^2 (2, N = 2368) = 1.458 p= 0.482. When pre- and perinatal complications were examined separately, rates of perinatal complications were higher (50.5% of the total sample) than prenatal complications (20.4% of the total sample) but no significant differences between groups were observed.
Conclusions: Our results show that children with ASD associated deletions and duplications have similar rates of birth complications compared to children without any CNVs. The rate of perinatal complications was higher than the rate of prenatal complications, but no significant differences between groups were found. These findings provide strong evidence that there is no relationship between ASD associated CNVs and birth complications; however, an alternative explanation is that this may be due to study exclusion criteria, which eliminated individuals with serious birth complications and restricted sample variability. Previous work has identified the presence of specific phenotypic patterns (e.g. head circumference) related to duplications and deletions at the same locus (Jacquemont et al., 2011). Therefore, future work to investigate the

interactions of environmental factors and CNVs on birth complications is needed.

53 **144.053** Quantification of FMRP in Human and Mouse Tissues By Capture Immunoassays

W. T. Brown[1], *T. Adayev*[2], *R. Kascsak*[2], *R. Kascsak*[3], *C. Dobkin*[4], *S. Nolin*[2] *and G. LaFauci*[2], *(1)Human Genetics, Institute for Basic Research in DD, Staten Island, NY, (2)Institute for Basic Research in DD, Staten Island, NY, (3)New York State Institute for Basic Research, Staten Island, NY, (4)NYS Institute for Basic Research in Developmental Disabilities, Staten Island, NY*

Background: The Fragile X syndrome is a leading inherited cause of ASD. The Fragile X syndrome is due to mutations of the FMR1 gene that result in the absence of fragile X mental retardation protein (FMRP).
Objectives: To develop a screening test for FMRP.
Methods: We have developed a rapid, highly sensitive method for quantifying FMRP from dried blood spots and lymphocytes. This assay uses two new antibodies mAb 6B8 (Biolegend) and R477, a bacterially expressed abbreviated FMRP standard, and a Luminex platform to quantify FMRP.
Results: The assay readily distinguishes between samples from males with fragile X full mutations and samples from normal males. It also differentiates mosaic from non-mosaic full-mutation male samples. We have employed the assay to screen 2000 newborn dried blood spots (DBS) and present their distribution. We also applied the assay in a retrospective study of 76 newborn DBS that had been stored for an extended period and included full mutation males as well as normal individuals. We were able to correctly identify all 5 known male fragile X positive cases among samples stored up to 47 months.
Using mAb 5C2 (Biolegend) and R477, we have also developed a similar immunoassay for the quantification of Fmrp in mouse tissues. This assay was used to quantify Fmrp in brainstem, cerebellum, hippocampus, and cortex strains of mouse (C57 BL and FVB) in seven and ten week-old animals, showing developmental variation.
Conclusions: This sensitive assay allows for the quantitation of FMRP for purposes of newborn screening. The assay will also allow studying the developmental variation of mouse Fmrp expression in different organs.

54 **144.054** Risk Pathways to Autistic Traits and Autism Spectrum Disorder in Tuberous Sclerosis Complex (TSC)

F. S. McEwen[1], *C. R. Tye*[1], *H. Liang*[1,2], *E. D. Barker*[3], *E. L. Woodhouse*[4], *L. Underwood*[1], *F. Sheerin*[5], *N. Higgins*[6], *M. Clifford*[1], *.. Tuberous Sclerosis 2000 Study Group*[1], *J. R. Yates*[7,8] *and P. F. Bolton*[1,9], *(1)Child & Adolescent Psychiatry / Social, Genetic & Developmental Psychiatry Centre, King's College London, Institute of Psychiatry, Psychology & Neuroscience, London, United Kingdom, (2)Southwark Child & Adolescent Neurodevelopmental Service, South London & Maudsley NHS Foundation Trust, London, United Kingdom, (3)Department of Psychology, King's College London, Institute of Psychiatry, Psychology & Neuroscience, London, United Kingdom, (4)Forensic & Neurodevelopmental Sciences, King's College London, Institute of Psychiatry, Psychology & Neuroscience, London, United Kingdom, (5)Department of Neuroradiology, Oxford University Hospitals NHS Trust, Oxford, United Kingdom, (6)Department of Radiology, Addenbrooke's Hospital, Cambridge, United Kingdom, (7)Department of Medical Genetics, University of Cambridge, Cambridge, United Kingdom, (8)East Anglian Medical Genetics Service, Addenbrooke's Hospital, Cambridge, United Kingdom, (9)South London & Maudsley NHS Foundation Trust, London, United Kingdom*

Background: Tuberous sclerosis complex (TSC) is an autosomal dominant genetic condition caused by mutation of either the TSC1 or TSC2 gene, and characterised by tumour-like lesions in the skin, brain and other organs. The majority of children with TSC have epilepsy and around half have autism spectrum disorder (ASD) and/or intellectual disability. While the risk for ASD is elevated in TSC, there is marked variability in outcome, from autism, through the broader autism phenotype, to unaffected. It is not clear what causes this variability in outcome or what the underlying mechanisms might be. A number of risk factors have been associated with ASD, such as mutation, number of tubers in the cerebral cortex, and epilepsy. However, it is not known how these risk factors act together to influence the risk for ASD.
Objectives: To investigate how multiple risk factors, including mutation (TSC1 vs. TSC2), cortical tuber load, and type and severity of epilepsy, act together to increase the risk for ASD.
Methods: TS2000 is the first UK population-representative, prospective longitudinal study to chart the development of TSC throughout childhood. All cases identified as newly diagnosed during 2001-2006 were recruited (N=125) and have been followed for up to 14 years. Genotyping was carried out to determine the causal mutation; cortical tuber load was determined using brain MRI or CT scans; detailed seizure history was taken from parents and supplemented with information from medical records to rate seizure severity (Early Childhood Epilepsy Severity Scale, E-Chess); children were assessed with the Autism Diagnostic Interview-Revised (ADI-R) and the Autism Diagnostic Observation Schedule (ADOS-2) to characterise ASD outcomes.
Results: Forty-three percent of participants met criteria for ASD on both ADI-R and ADOS-2, and a further 25% met criteria on one instrument. Thirteen percent showed subthreshold autistic traits. A minority (20%) did not meet criteria on either the ADI-R or ADOS-2. Mutation (TSC1 vs. TSC2) was not significantly associated with ADI-R or ADOS-2 scores ($t(64)=0.34$, $p=.72$; $t(62)=0.51$, $p=.61$). Higher ADI-R and ADOS-2 scores were associated with: higher cortical tuber load (ADI-R rho=.23, p=.048; ADOS-2 rho=.24, p=.038); epilepsy severity in the 1st and 2nd years of life, at age 3+ years and age 7+ years (rho .25-.48, all p<.03); and a history of infantile spasms (d=0.73, p<.001; d=0.81, p<.001). Structural equation modelling suggested a risk pathway from mutation to cortical tuber load (TSC2 predicted higher tuber load), to epilepsy severity in the first two years of life, to ASD risk.
Conclusions: Children with TSC are at very high risk for ASD, as well as social/communication difficulties that fall short of diagnosis of ASD but might nonetheless be clinically important. Epilepsy in the first two years of life, especially that characterised by infantile spasms, early onset, and greater severity, leads to a high risk of ASD. The prompt diagnosis and treatment of seizures in infancy may improve the prognosis in these high risk children.

55 **144.055** Sexual Dimorphism of Regulatory Small Non-Coding RNAs in the Superior Temporal Gyrus Brain Region of Autism Spectrum Disorders: A Pilot Study

B. Stamova[1], *B. P. Ander*[1], *F. R. Sharp*[1] *and C. M. Schumann*[2], *(1)Department of Neurology, University of California, Davis, School of Medicine, Sacramento, CA, (2)UC Davis MIND Institute, Sacramento, CA*

Background: Autism spectrum disorders (ASD) are more common in boys than girls. The bases for sex differences in ASD are poorly understood. It is theorized that higher etiologic load, including genetic and/or environmental load, is needed for females to develop ASD. Though sex differences in ASD neuropathology have been reported, sex differences in ASD brain transcriptomes remain largely unexplored. Male and female ASD subjects could have different molecular mechanisms for normal regional patterning in the brain which could contribute to sex differences in ASD. Thus, we investigated differential expression of small non-coding RNAs (sncRNA, including microRNA) in the superior temporal gyrus (STG) of male and female brains of ASD compared to typically developing (TD) controls. We investigated the superior temporal sulcus (STS) and primary auditory cortex (PAC) within the STG. STS is an association cortex involved in social perception, joint attention, face perception and speech perception and is implicated in ASD. PAC is a primary sensory cortex modulating auditory processing.
Objectives: To assess sncRNA expression in STS and PAC in postmortem male and female human brains of ASD compared to TD controls.
Methods: Affymetrix miRNA 3.0 arrays were run on 34 samples (5 ASD Female, 5 ASD Male, 2 TD Female, 6 TD Male; two brain regions – STS, PAC; 4-58 years of age; 2 of the 18 subjects had only one brain region available). ANOVA was used to identify sexually dimorphic differentially expressed sncRNA ($p<0.005$, $|\text{fold-change}|>1.2$). REML variance estimate suitable for unbalanced designs was used. To account for normal sexual dimorphism, we compared ASD female to TD female and ASD male to TD male, and overlapped the differentially expressed sncRNA to identify sexually dimorphic sncRNA expression specifically in ASD (Fig.1).
Results: We found sexually dimorphic sncRNA expression in the ASD postmortem brain, with a higher number of sncRNA being dysregulated in females compared to males (Fig.1). There were 27 sexually dimorphic sncRNA in ASD STS (7 in male and 20 in female), 9 in ASD PAC (2 in male, 7 in female), and 71 regionally dysregulated (between STS and PAC) (31 in male, 39 in female, and 2 common) (Fig. 2). The predicted mRNA targets of the mature miRNAs are over-represented in different pathways in male and female in STS and PAC. Axonal Guidance Signaling was the most over-represented canonical pathway in the regionally dysregulated (STS vs PAC) mature miRNAs both in male (FDR-corrected p=3.1E-12) and female (FDR-corrected p=2.4E-09). However, most of the predicted dysregulated target mRNAs were different in males compared to females. A number of predicted targets have been implicated in ASD, such as MET (in female), NTRK3 (in male), and SHANK2 (in both).
Conclusions: The sexually dimorphic sncRNAs in male and female ASD brains likely contribute to aberrant development and function of STS and PAC and likely contribute to some of the sexually dimorphic features of ASD. Future studies will need to confirm these findings.

Figure 1. Numbers of Sexually Dimorphic sncRNAs in ASD

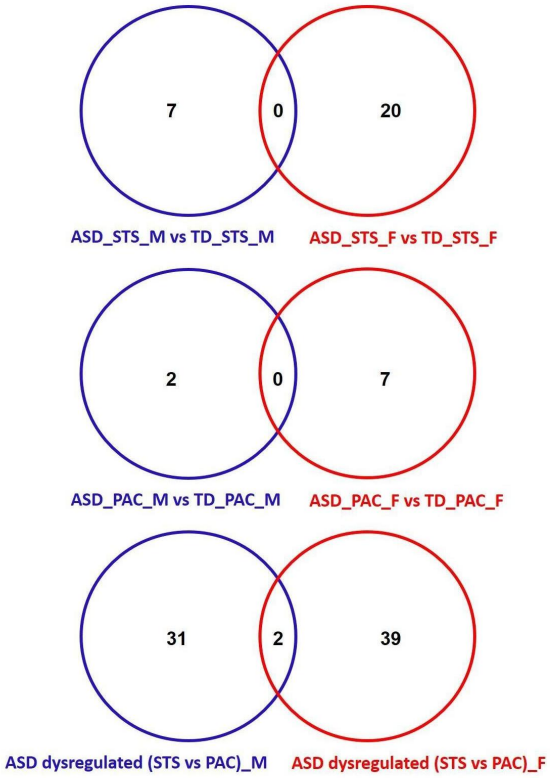
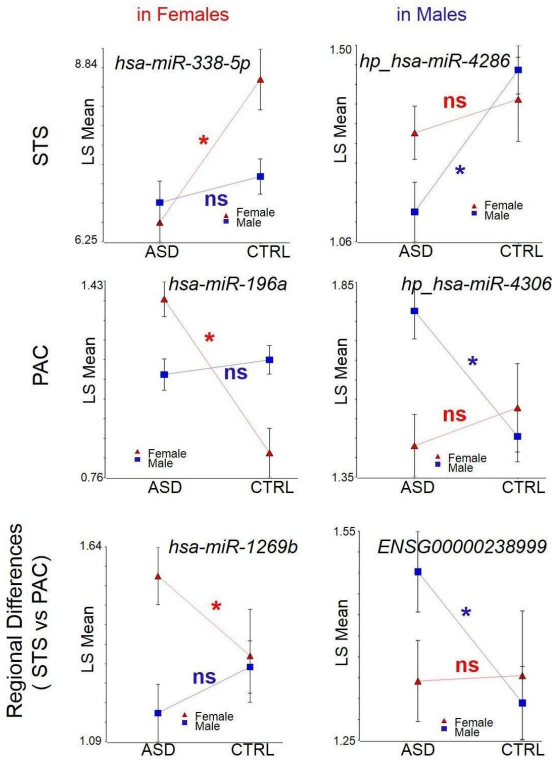


Figure 2. Examples of Sexually Dimorphic sncRNAs in ASD
*p<0.005; absolute fold change >1.2; ns = not significant



56 **144.056** Social Visual Engagement—a Putative Autism Endophenotype—Exhibits Marked Variation and Striking MZ Twin Concordance in Typical Infants

J. N. Constantino[1], *A. Klin*[2], *A. Glowinski*[3], *S. Kennon-McGill*[3], *C. Weichselbaum*[3] *and W. Jones*[2], *(1)Washington University School of Medicine, Saint Louis, MO, (2)Department of Pediatrics, Emory University School of Medicine, Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, GA, (3)Washington University in St. Louis, St. Louis, MO*

Background: Diminished eye contact has long been described as a classic symptom of autism spectrum disorder, and abnormalities in eye tracking measurements of social visual engagement (SVE) have been shown to predict autism spectrum disorders (ASD) among infants in ASD-affected families, by as early as 6 months of age (Jones and Klin, 2013). Because ASD is among the most heritable of all neuropsychiatric disorders (Geschwind and State, 2015), with most of its genetic risk attributable to common (polygenic) factors, and since a majority of polygenic influences on ASD overlap with those influencing normal variation in social competency in the general population (Robinson et al., 2011), it is additionally important to examine the genetic structure of candidate developmental endophenotypes of the disorder in the general population.
Objectives: This is the first attempt to explore specific SVE predictors of ASD in an epidemiologically-ascertained sample of infants, here encompassing 56 monozygotic (MZ) twins and 112 dizygotic (DZ) twins.
Methods: We capitalized upon the availability of a unique epidemiologically-ascertained infant twin cohort, which has been previously reported (Marrus et al., 2015), and acquired precisely the same eye tracking indices which predicted ASD among infants at risk in Jones and Klin (2013), in order to explore the distribution and genetic structure of these risk indices in the general population. Full description of the eye-tracking methods can be found in Jones and Klin, 2013.
Results: Quantitative SVE measurements exhibited striking MZ twin-twin concordance (on the order of 0.90) and only moderate DZ twin-twin concordance (on the order of 0.30,) indicating extremely high heritability, minimal measurement error, and wider-than-expected variation among typically-developing twins in the 18-24 month age range. This is shown in Figure 1 (attached). To address the fact that not every child is attentive to every section of every video clip presented, we repeated the analysis incorporating only those segments for which both members of a twin pair were visually engaged. The results were unchanged. Finally, we conducted detailed analyses of moment-to-moment twin-twin correlation, which revealed striking homology in tracking of eye movement in X and Y coordinate space between the members of MZ twin pairs, again in contrast to DZ twin pairs, as shown for representative twin pairs in the attached Figure (2) for gaze location in X-coordinate space over time.
Conclusions: SVE measurements in these epidemiologically-ascertained twins reflected remarkable MZ twin-twin concordance and robust biological/ecological validity for the measurement method. By comparison, substantially lower DZ concordance confirmed that familial influence on SVE—which has been proposed as an autism endophenotype—is largely genetic in origin. We commonly (i.e. in over one third of this normative sample) observed patterns of visual fixation which predicted the occurrence of autism among infants at high familial risk. How SVE interacts with other neurodevelopmental liabilities in the ontogeny of ASD warrants intensive subsequent study.

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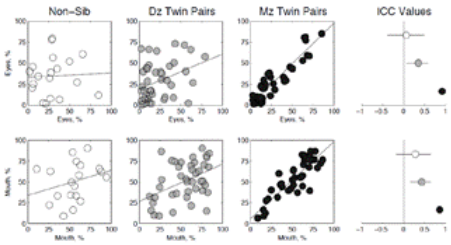

Figure 1. Scatter plots of Child 1 (x-axis) - Child 2 (y-axis) correlations for total proportion of time spent with eye gaze fixated on eyes (upper row) and mouths, for pairings of unrelated children (left column), dizygotic twins (middle column), and monozygotic twins (right column), followed by specification of intra class correlation coefficients. This depicts striking homology in fixation time for identical twins, and marked heritability of the trait, given successive erosion in ICC for DZ twins and unrelated children.

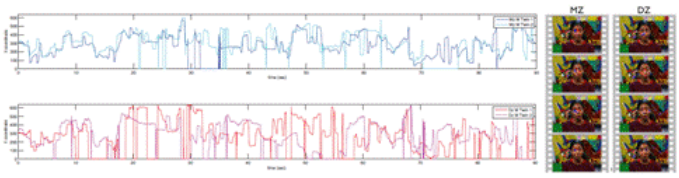

Figure 2. Representative tracing of eye gaze position in X-coordinate space plotted as a function of time for pairings of identical (MZ) twins (upper plot on the left) and non-identical (DZ) twins (lower plot on the left) during the viewing of a dynamic social scene.

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57 **144.057** Temporal Gene Expression Profiles and Behavioral Regression in Children with ASD with Postsynaptic Density Gene Disruptions

S. Trinh[1], *R. P. Goin-Kochel*[2] *and R. Bernier*[1], *(1)University of Washington, Seattle, WA, (2)Baylor College of Medicine, Houston, TX*

Background: Approximately one-third of children with an autism spectrum disorder (ASD) experience developmental regression within the first three years of life. However, the mechanisms underlying this behavioral phenotype remain unknown. Recently, disruptions in postsynaptic density (PSD) genes have been found to result in higher rates of developmental regression in language and social engagement skills (Goin-Kochel et al., under review). PSD genes play a role in regulating synaptic function in human neocortex (Bayés et al., 2011) and show differential timing in expression, with some genes preferentially expressed during synaptic formation and others during synaptic remodeling and differentiation (Swulius et al., 2010). Thus, disruptions in PSD genes preferentially expressed later in synaptic development may lead to normal initial behavioral development followed by onset of abnormal development and/or behavioral regression. Understanding the relationship between developmental gene expression timing and phenotypic ASD profiles may elucidate mechanisms of behavioral regression in ASD.
Objectives: To explore the following correlations in individuals with ASD who have PSD gene disruptions: 1) gene expression timing and presence of behavioral regression and 2) gene expression timing and age of ASD symptom onset.
Methods: Participants were 33 children from the Simons Simplex Collection with PSD gene disruptions (as defined by Iossifov et al., 2014) who meet strict criteria for ASD. Age of typical maximum expression for each PSD gene was extracted from the BrainSpan transcriptome exon microarray data (http://www.brainspan.org). Eight children with parentally reported history of developmental regression in language and social engagement skills were compared to 25 children without regression. First, groups were compared using independent samples t-test on the age of typical maximum expression of disrupted genes observed between the first prenatal trimester and third postnatal year. Second, age of typical maximum expression was used to predict regression groups using logistic regression. Finally, for all participants, using regression analysis, age of typical maximum gene expression was used to predict parentally reported age of ASD symptom onset.
Results: Age of maximum expression did not predict regression group (p=.46), and regression groups did not differ significantly in age of maximum expression ($t(37)$=.72, p=.48). However, age of maximum expression significantly predicted age of ASD symptom onset ($F(1, 37)$=5.02, p=.03, R^2=.119) such that the later the age of maximum expression, the later the age of reported onset of ASD symptoms. That is, participants with disruptions in PSD genes typically expressed later in development tended to have later reported ages of ASD symptom onset.
Conclusions: The observed relationship between age of ASD symptom onset and age of maximum gene expression in individuals with likely gene-disrupting mutations to PSD genes suggests the importance of gene expression timing in symptom expression timing. Previous mouse model studies demonstrate preferential expression of PSD genes in different phases of synaptic development (Swulius et al., 2010); these findings suggest that the differential phases of expression can impact symptom onset. Better understanding of the normal developmental timing of gene expression in genes disrupted in individuals with ASD may aid in explaining the phenotypic variability regarding symptom onset among children with ASD.

58 **144.058** The Autism-Associated Long Noncoding RNA MSNP1AS Regulates a Network of Genes Involved in Neuronal Process Stability

J. DeWitt[1], *N. A. Grepo*[2], *B. Wilkinson*[1], *K. Morris*[3], *J. A. Knowles*[1] *and D. B. Campbell*[1], *(1)University of Southern California, Los Angeles, CA, (2)USC, LOS ANGELES, CA, (3)The Scripps Research Institute, San Diego, CA*

Background: From genome-wide association studies (GWAS), a novel gene was discovered that has a highly significant association with autism spectrum disorder (ASD). The gene is a long non-coding RNA (lncRNA) designated *MSNP1AS* (moesin pseudogene 1, antisense). Expression of *MSNP1AS* was increased in the cerebral cortex of individuals with ASD and individuals with the ASD-associated genetic marker. Overexpression of *MSNP1AS* in human neuronal cells caused decreased expression of moesin (*MSN*) mRNA and moesin MSN protein, which is involved in neuronal process stability and immune response. These data indicate one aspect of the potential contribution of increased *MSNP1AS*expression in ASD. However, there are likely to be additional transcriptomic impacts of this lncRNA.
Objectives: To examine the transcriptomic impacts of the lncRNA, *MSNP1AS.*
Methods: To determine the effects of altered *MSNP1AS* expression on the neuronal transcriptome, we transfected human neuronal progenitor cells with constructs that overexpressed *MSNP1AS* or transcriptionally silenced *MSNP1AS*.
Results: RNA-Seq analysis indicated altered expression of multiple genes that contribute to altered neuronal process stability and immune response, including *MSN*.
Conclusions: Our data indicate several genes that are impacted by *MSNP1AS* dysregulation more significantly than *MSN*, suggesting a network of genes that contribute to ASD risk. Ongoing experiments seek to define the role of the *MSNP1AS* gene network in neuronal process stability.

59 **144.059** The Kaiser Permanente Autism Family Biobank: A Resource for Research on Autism Spectrum Disorders

M. L. Massolo, *C. K. Yoshida, Y. Qian, A. N. Anderson and L. A. Croen, Division of Research, Kaiser Permanente, Oakland, CA*

Background:
While specific causes of autism spectrum disorders (ASD) have not been identified, the genetic contribution to ASD etiology is strongly supported by twin and family studies. A growing body of evidence also supports the role of environmental factors, especially those occurring during the gestational or early postnatal period.
Objectives:
To collect biological specimens from 5,000 trios comprised of a child (minor or adult) with ASD, and his/her two biological parents, with the ultimate goal of creating a resource that will promote and facilitate research on genetic and environmental influences of ASD and response to treatment.
Methods:
To be eligible the affected child must be a Kaiser Permanente Northern California (KP) member with an ASD diagnosis recorded in the electronic medical record, while parents need not be KP members. Prior to launching recruitment, a focus group explored concerns regarding use of genetic information in clinical care, use of genetic information in research, and biospecimen collection. Recruitment involves sending by mail or email monthly batches of invitation letters, with intensive follow-up by phone, email, and/or mail. Adults with ASD receive an individual letter, independent of their parents. Parents and adult children consent online or by phone; parents consent for minor or incapable children. Upon consenting, participants choose to donate blood or saliva. Blood is drawn at KP facilities, and saliva kits are mailed to participants' homes. Two instruments will be collected online, the SRS-2 (from all three family members) and a Family History Questionnaire. Biospecimen and survey data will be combined with longitudinal clinical and phenotypic data stored in the electronic medical record. After one year of recruitment, qualitative interviews with parents of affected children will take place to find out barriers and facilitators to study participation, and recruitment materials will be modified as needed. Recruitment is scheduled to take place from 2015 to 2018.
Results:
At the start of recruitment in July 2015 we identified 17,370 KP members with an ASD diagnosis recorded in their medical record. In terms of age and sex, 8% were <4 years of age, 40% between 5-14 years, and the rest 15 years and older; 80% are male. Almost half are white, 21% Hispanic, 17% Asian, and 8% African American. By November 2015, 684 individuals consented to participate, representing 248 unique families (192 trios, 52 duos, and 4 singles). The majority of those who consented chose saliva over blood: 82% of children, 79% of fathers, 74% of mothers. A total of 323 biosamples have been collected to date - 108 from children, 111 from mothers, and 104 from fathers.
Conclusions:
The KP Autism Family Biobank will serve as a resource to promote and facilitate autism research and will be available to researchers around the world. An access review committee will be formed to vet proposals for use. In addition, genetic data generated from the specimens and selected phenotypic data will be shared without identifiers with the Simons Foundation and deposited in the National Database for Autism Research (NDAR).

60 **144.060** The Quantitative Autism Score (QAS): A Tool to Unravel Genetic Associations

S. Luzi[1], *M. L. Cuccaro*[1], *E. R. Martin*[2], *M. A. Pericak-Vance*[1], *A. J. Griswold*[3], *J. R. Gilbert*[1] *and J. P. Hussman*[4], *(1)John P. Hussman Institute for Human Genomics, University of Miami, Miami, FL, (2)John P Hussman Institute for Human Genomics, University of Miami, Miami, FL, (3)University of Miami, Miami, FL, (4)Hussman Institute for Autism, Inc., Catonsville, MD*

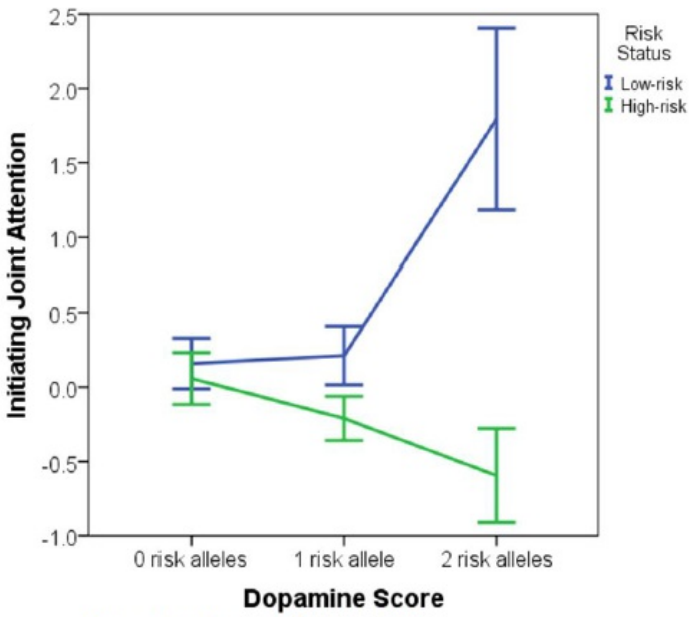
Background: The clinical diagnosis of ASD has changed considerably since its introduction into the formal nomenclature, reflecting conceptualization of ASD as a multi-dimensional phenotype. We hypothesize that genetic variants modify the expression of ASD symptomatology within subjects diagnosed with ASD, and specifically that variation in ASD candidate genes will lead to an increased number of core autism features. To evaluate this hypothesis, we developed a quantitative autism score (QAS) using variables on the ADI-R which reflect ASD features that have remained consistent throughout the changing diagnostic criteria (core ASD features).
Objectives: To identify genes that explain variation in the number of core ASD features.
Methods: The QAS was developed using the ADI-R, the semi-structured informant interview used to classify individuals for research studies in ASD. The QAS was defined using ADI-R algorithm items which consistently distinguish ASD from non-ASD or are present in early development and persist. The 25 QAS items are scored as present/absent and summed to yield a total score (0-25). Individuals with higher scores are those with more core features of ASD. The score was then calculated in 1118 ASD subjects from the Hussman Institute for Human Genomics (HIHG) and the Simons Simplex Collections. These individuals also had DNA sequence data available from a 17Mb custom capture covering 681 genes within regions identified by GWAS of ASD (Hussman et al 2013). SKAT-O (Li et al 2012) was used to conduct gene-based and single-variant tests for association with QAS as a quantitative trait. We examined combinations of synonymous, non-synonymous, missense, stop, loss-of-function and splice variants in different hypothesis tests. A Bonferroni correction for the number of genes tested was used as a significance threshold for each hypothesis with an experiment-wise significance level of 0.05.
Results: Values for the QAS in the 1118 subjects ranged from 4 to 25 with a mean value of 18.06 (sd=3.942). We found significant association for the gene *CDH4* (p= 9.20E-06) when all exonic variants were included in the gene-based test. This gene is a neuronal cell adhesion molecule known to play a role in brain segmentation and neuronal outgrowth and is a member of the cadherin family of genes, many of which have previously identified as ASD candidate genes and have been implicated by genetic association and sequencing for rare variants. We also found a significant association for the LGR5 gene when all exonic variants were included (p=3.59E-05) and when only missense variants were included (p=7.67-05). LGR5 is known to be implicated in neuronal specification in the nervous system. Single-variant tests within these two genes identified two synonymous variants in *CDH4* and two variants (1 synonymous and 1 missense) in *LGR5* associated (p<0.05) with QAS.
These results are in the process of being tested in three different replication samples.
Conclusions: Our study identified two genes, *CDH4* and *LGR5*, associated with the number of core ASD features. Our findings add support to the importance of genes involved in neurogenesis as well as to the role of phenotypic variations within ASDs.

61 **144.061** The Role of Dopaminergic Variants in Initiating Joint Attention in High- and Low-Risk Siblings

D. N. Gangi[1], *D. S. Messinger*[2], *E. R. Martin*[3] *and M. L. Cuccaro*[4], *(1)MIND Institute, University of California, Davis, Sacramento, CA, (2)Psychology, University of Miami, Coral Gables, FL, (3)John P Hussman Institute for Human Genomics, University of Miami, Miami, FL, (4)John P. Hussman Institute for Human Genomics, University of Miami, Miami, FL*

Background: The capacity to use gaze and gesture to share experiences or events with a social partner, initiating joint attention (IJA), typically emerges during the first year of life. Deficits in IJA are a core impairment in children with Autism Spectrum Disorder (ASD), and IJA may be a particularly important skill for infants at risk for ASD (high-risk siblings; younger siblings of children diagnosed with ASD). Levels of IJA at 8 months have predicted later ASD symptom severity at 30 months in high-risk siblings (Ibañez, Grantz, & Messinger, 2012). This suggests that the ability to share attention with a social partner before one year is particularly important for high-risk siblings in the development of ASD symptomatology. However, high-risk siblings exhibit substantial behavioral heterogeneity, both in early levels of IJA and in later ASD symptomatology.
Objectives: We aimed to explain variability in early levels of IJA by examining the role of common dopaminergic genes, *DRD4* and *DRD2*—variants that have been associated with attention problems in children.
Methods: High-risk siblings (n = 55, 35 male) and low-risk siblings (n = 38, 16 male) were genotyped for *DRD4* and *DRD2*. Each infant was assigned a dopamine gene score (ranging from 0-2) reflecting the number of genotypes associated with less efficient dopaminergic functioning (7-repeat allele of *DRD4* and A allele of *DRD2*) (Pearson-Fuhrhop, Minton, Acevedo, Shahbaba, & Cramer, 2013). Infants were administered the Early Social Communication Scales (ESCS) at 8, 10, and 12 months, a semi-structured interaction with an examiner during which a series of toys are presented and activated. Rates per minute of IJA were calculated for each assessment age; a mean was then calculated from the standardized values of each assessment age to provide a measure of IJA in the first year for analyses.
Results: A regression model indicated a dopamine score*status interaction effect, b = -0.81, t = -3.09, p = .003. Regression analyses by risk group indicated that in high-risk siblings, IJA levels decreased as dopamine scores increased (indicative of less efficient dopaminergic functioning), b = -0.31, t = -2.03, p = .047, while in low-risk siblings, IJA levels increased as dopamine scores increased, b = 0.50, t = 2.35, p = .03 (see Figure 1).
Conclusions: Higher dopamine scores, indicative of less efficient dopaminergic functioning, were associated with lower early levels of IJA in high-risk siblings. Low-risk siblings exhibited the opposite pattern, suggesting differential susceptibility. In the presence of familial risk for ASD, less efficient dopaminergic function was associated with lower IJA levels. Links between common genetic variants and behavioral phenotypes can aid in understanding developmental heterogeneity within high-risk siblings. Knowledge of genotypes in high-risk siblings associated with areas of difficulty relevant to ASD, such as IJA, may aid in assessing risk and identifying siblings at the greatest potential need for early interventions.

Figure 1. Mean levels of initiating joint attention (IJA) by group.



Note. Error bars reflect +/- 1 SE.

62 **144.062** Tissue-Specific Expression Quantitative Trait Loci (eQTL) in GI Symptomatic ASD Children

S. J. Walker[1], *A. Krigsman*[2] *and C. D. Langefeld*[3], *(1)Wake Forest Institute for Regenerative Medicine, Winston-Salem, NC, (2)Pediatric Gastroenterology Resources of New York and Texas, Far Rockaway, NY, (3)Center for Public Health Genomics and Department of Biostatistical Sciences, Winston Salem, NC*

Background:
Previously, we characterized, via whole transcriptome analysis of ileocolonic biopsy tissue, an IBD-like condition that occurs with high frequency in autism spectrum disorder (ASD) children. Using gene expression data from that study, together with whole genome single nucleotide polymorphism (SNP) data on DNA from the same individuals, we are exploring genome-wide expression quantitative trait loci (eQTL).
Objectives:
The immediate goal of this study is to test the hypothesis that SNPs that influence gene expression (eQTL) in the colon and terminal ileum identified in our ASD population are associated with Crohn's disease (CD), ulcerative colitis (UC) and inflammatory bowel disease (IBD).
Methods: Gene expression data (generated from Agilent whole genome microarrays) and SNP data (generated at 23&me on custom Illumina SNP chips) from 64 individuals were used for the eQTL analyses. Standard quality control was completed for association studies (e.g., SNP call rate, Hardy-Weinberg Equilibrium). Analyses were computed separately for colon and terminal illium samples and by ASD^{IC} (ASD with ileocolitis). For each transcript and tissue type, we computed a genome-wide association analysis using linear regression on single nucleotide polymorphism (SNP) *cis* (within 500kb) to the probe's gene. In this eQTL analysis, we regressed the SNP's genotype and the first principal components onto $\log_2$ expression for the transcript. Given the modest sample size, only the dominant genetic model was computed. A fixed effect meta-analysis and the corresponding test for heterogeneity of effects were computed across disease groups. Significance of an eQTL effect was measured as p-value <1x10E-6 and expression fold change of at least 1.5. We cross referenced these eQTLs (or SNPs in linkage disequilibrium (LD: r-squared>0.7) with lists of SNPs associated with CD, UC and IBD obtained from the UCSC Genome Browser GWAS catalog.
Results:
The number of children analyzed varies by tissue. There were 18 ASD^{IC+} with colon samples and 22 ASD^{IC+} terminal ileum samples. In total, 189 eQTL SNPs had p<1x10E-6. Comparing these eQTL SNPs or their proxies (SNPs in high LD) to known published GWAS results failed to identify any known loci associated with CD, UC and IBD. Previously we reported eQTLs on chr 7q11.23 with known links to Williams Beuren Syndrome and ASD, RYR2 (colon: rs10802598, and 1q43, $p=2.25x10^{-8}$) and EPHB1 (colon: rs10512944, 3q22, $p=1.88x10^{-12}$) related to ASD and/or ASD-phenotypes through other studies and approaches. Examination of the region about rs10512944 on 3q22 region appears to show high trans-mammalian species conservation and is in proximity to a region of high taxonomic class (Mammal, Aves, Pisces) conservation. The cause of this high trans-species conservation is not known, however, as there are limited known regulatory (DNase I Hypersensitivity Clusters, transcription factors) elements in the region.
Conclusions:
These data show no evidence that eQTL from the colon and terminal ileum, identified in our ASD population, are known CD, UC and IBD risk loci. However, eQTLs identified in this sample are associated with ASD and/or ASD-phenotype and are in areas of evolutionary high trans-species conservation.

63 **144.063** Using Whole Exome Sequencing to Investigate the Genetics of Sensory Processing Disorders

E. J. Marco[1], *G. Da Gente*[2], *S. Thomas*[3], *A. Brandes-aitken*[4] *and* ***E. Sherr***[4], *(1)University of California in San Francisco, San Francisco, CA, (2)Neurology, UCSF Brain Development Research Program, San Francisco, CA, (3)Epidemiology and Biostatistics, UCSF, San Francisco, CA, (4)Neurology, UCSF, San Francisco, CA*

Background:
While genetic causes of Autism Spectrum Disorders (ASD) have been extensively investigated, there has yet to be a focus on the genetics of Sensory Processing Disorders (SPD), either as a part of the ASD phenotype or in isolation. Heritability rates for sensory sensitivity have been estimated to be as high as 54% for tactile sensitivity and 38% for auditory sensitivity. In addition, there are several genetically mediated neurodevelopmental disorders with evidence of sensory sensitivity such as Fragile X and 16p11.2 deletion syndrome.
Objectives:
Firstly: to determine whether de novo pathogenic mutations are found in candidate neurodevelopmental genes in a small SPD cohort (N=11). Our second objective is to determine if in this SPD cohort there is a higher prevalence of rare potentially pathogenic variants in ASD associated genes than in the overall pool of genes interrogated by exome sequencing.
Methods:
We enrolled 11 children (ages 8-16 years) with SPD, but who do not meet clinical criteria for ASD, and their biological parents from the UCSF Sensory Neurodevelopment and Autism Program Registry. Probands and their biologic parents underwent sensory assessments and genetic testing using whole exome sequencing using the Agilent sure select platform and an in house analytic pipeline based on the current GATK best practices workflow (https://www.broadinstitute.org/gatk/guide/best-practices). Missense, nonsense, splice site, frameshift and indel mutations that were not present in dbSNP or the exome variant server (http://evs.gs.washington.edu/EVS/) were included in the downstream analysis of both de novo and inherited mutations. Mutations in ASD-linked genes were tested for association with the SPD phenotype through analysis of a bionomial distribution, accounting for gene length and correcting for multiple comparisons using Bonferroni.ASD linked genes were selected from the SFARI gene collection (genes.sfari.org).
Results:
First, our analysis identified a *de novo* premature stop codon mutation in the MBD5 gene of a single female child in our cohort. MBD5, located at 2q23.1 has previously been implicated in mental retardation autosomal dominant type 1. Affected individuals are reported to have microcephaly, intellectual disabilities, severe speech impairment, ASD and seizures but there is no mention of sensory processing differences. Second, inherited mutations in genes repeatedly linked to ASD are found in children with SPD more frequently than would be expected in a random model. However, given our small sample size, this finding only reached trend level (p=0.068).

Conclusions:
While further studies with a larger sample size are required, this preliminary study showing that both de novo and inherited ASD related mutations are found in an SPD only cohort suggests that SPD is mediated by similar deficits as ASD and that a similar clinical genetic investigation is warranted for children with SPD who may not meet other DSM based labels.

64 **144.064** Whole Exome Sequencing in Extended Families Identifies Shared and Unique Likely Gene-Disrupting Alterations

H. N. Cukier[1,2], *S. Luzi*[1], *L. Gomez*[1], *J. M. Lee*[1], *P. L. Whitehead*[1], *I. Konidari*[1], *W. Hulme*[1], *J. Haines*[3], *M. L. Cuccaro*[1,4], *J. R. Gilbert*[1,4] *and M. A. Pericak-Vance*[1,2,4], *(1)John P. Hussman Institute for Human Genomics, University of Miami, Miami, FL, (2)Neurology, University of Miami, Miami, FL, (3)Case Western Reserve University, Cleveland, OH, (4)Dr. John T. Macdonald Foundation Department of Human Genetics, University of Miami, Miami, FL*

Background: Autism spectrum disorders (ASDs) encompass a constellation of neurodevelopmental conditions and studies to date demonstrate that the underlying etiology is extremely heterogeneous. With the advent of whole exome sequencing (WES), studies have been implicating genes across many disorders. Thus far, autism exome studies have primarily focused either on simplex families to discover *de novo* alterations or consanguineous families that carry recessive mutations.
Objectives: Our study performs exome sequencing in extended, multiplex families with affected cousin pairs to identify potential ASD genetic factors. Our initial analysis focused on identifying identical by descent (IBD) variants that could contribute to ASD risk. This study extends these results and combines the results with also more severe alterations which may not be shared across families.
Methods: We performed WES on at least two affected cousins across 40 multiplex ASD families. A total of 164 individuals were captured with the Agilent SureSelect Human All Exon kit, sequenced on the Illumina HiSeq 2000, and the resulting data processed and annotated with BWA, GATK, and SeattleSeq. We have previously identified alterations that were inherited from a common ancestor and identical by descent. In this analysis, we focused on heterozygous alterations that were predicted to result in stop-gain or stop-loss mutation, or potentially interfere with splicing, collectively called “likely gene-disrupting” (LGD) variants. The LGD alterations that were both shared and unique within were evaluated families. We also determined whether any of these alterations fell within 142 ASD candidate genes; these included syndromic ASD genes and genes with relatively high confidence (as defined by the SFARI gene database).
Results: Following exome sequencing, each extended family was identified to carry approximately 90,000 variants. When we filtered each of the families for potential LGD alterations, we decreased the variants of interest to a few hundred per family. We then culled the data to determine if our variants intersected any previously reported ASD candidate genes; we identified a unique a stop-gain alteration in *NRXN3*, a gene already identified in ASD patients with copy number variants. Furthermore, potential splicing alterations were recognized, including in the ASD candidate genes *CC2D1A*, a gene also connected to intellectual disabilities, as well as *VPS13B*, a gene first reported to cause Cohen syndrome and since linked to ASDs, developmental disorders, epilepsy, and intellectual disabilities.
Conclusions: By studying these extended, multiplex families, we hope to reveal how inherited and unique alterations in may be acting in concert to result in ASDs.

65 **144.065** Whole Genome Sequencing and Identical By Descent Filtering of Autism Spectrum Disorder Extended Families Reveals Novel ASD Risk Variants

A. J. Griswold[1], *H. N. Cukier*[1], *D. Van Booven*[1], *P. L. Whitehead*[2], *N. K. Hofmann*[1], *J. M. Lee*[2], *E. R. Martin*[1], *M. L. Cuccaro*[2], *J. R. Gilbert*[2], *J. P. Hussman*[3] *and M. A. Pericak-Vance*[2], *(1)John P Hussman Institute for Human Genomics, University of Miami, Miami, FL, (2)John P. Hussman Institute for Human Genomics, University of Miami, Miami, FL, (3)Hussman Institute for Autism, Inc., Catonsville, MD*

Background: Massively parallel sequencing in autism spectrum disorder (ASD) has focused primarily on whole exome (WES) or whole genome sequencing (WGS) in trio cohorts for identification of *de novo* loss of function protein coding variants. These studies have only used simplex families and the available WGS analyses have reported largely only on protein coding portions of the genome.
Objectives: Our study applies WGS to extended, multiplex families with at least two affected cousins likely to carry rare, partially penetrant inherited alterations. We hypothesize that identical by descent (IBD) filtering in these large, multiplex pedigrees would define genomic regions of shared ASD risk and allow identification of coding variants missed by exome sequencing, functional variants in the 98% of the genome that is noncoding, as well as structural variation, to identify potential new ASD loci.
Methods: We performed WGS on at least two affected cousins across six ASD extended families (15 individuals). Sequencing was performed on the Illumina HiSeq2500 and analyzed through pipelines including BWA-MEM alignment, quality recalibration by GATK, and variant calling with the GATK HaplotypeCaller. Structural variants (SVs) were called with the SWAN algorithm. Annotations were applied with ANNOVAR including functional predictions for noncoding variants (GWAVA, CADD, FATHMM-MKL). We determined IBD regions using whole genome genotyping data and the MERLIN package and used these regions to filter variations for each family. Variants were prioritized by sharing in all affected individuals per family, rarity of the variant in the population (< 1%), and evidence of functionality from computational predictions.
Results: We sequenced each genome to ~40X coverage and identified more than four million single nucleotide variants (SNVs) and small indels and more than 100 SVs per individual. IBD and sharing filtering within each family limited the total number of SNVs for analysis to 289-655,355, depending on family structure. Among coding SNVs, ~94% concordance was found with existing WES (Cukier, et al, 2014), however WGS identified ~10% more coding variant calls. These include a family with a rare missense mutation in the neurogenesis growth factor *GDF11* and another with a frameshift in the axonal development gene *SLAIN1*. Impact of noncoding variation is continuing to be evaluated, and has identified two shared likely functional variants in the putative promoter of the ASD candidate gene *CNTN4* in one family and a two others upstream of potassium channel *KCTD1* in another. Finally, rare copy number variants disrupting the promoter of the neurodevelopmental *WWOX* gene as well as deleting an exon of the lincRNA *FIRRE* involved in chromosomal organization were found in single families.
Conclusions: By studying these unique pedigrees, applying cutting edge sequencing and analysis methods, and employing using IBD filtering we establish that WGS in extended families can be used to identify ASD risk alterations. Such methods extend the scope of ASD genetic risk beyond *de novo* protein coding variants to functional noncoding SNVs, SNVs not captured by WES, and SVs that might be conferring ASD Taken together, WGS identifies new ASD candidate genes and pathways.

Poster Session
145 - Interventions Non-Pharmacologic - School Age, Adolescent, Adult
11:30 AM - 1:30 PM - Hall A

66 **145.066** A Brief Behavioral Sleep Intervention Improves Sleep Onset Delay and Sleep Efficiency in Adolescents with Autism Spectrum Disorders

W. A. Loring[1], *R. Johnston*[1], *L. Gray*[2], *S. E. Goldman*[3] *and B. A. Malow*[1], *(1)Vanderbilt University, Nashville, TN, (2)Neurology, Vanderbilt University Medical School, Nashville, TN, (3)Vanderbilt University, franklin, TN*

Background: Sleep problems affect many individuals with autism spectrum disorders (ASD). Many studies of sleep problems in ASD have focused on young children, with less understood about the treatment of sleep problems in adolescents with ASD. Treatment of sleep problems with medications is not always successful and often has negative side effects. Behavioral treatment of sleep concerns for adolescents with ASD is an understudied area with many potential benefits regarding its use. In this study, we are assessing the impact of an education-based program on nighttime sleep and daytime functioning for adolescents with ASD.
Objectives: Objectives of this study are to: 1) develop a manualized education program for adolescents with ASD and their parents and 2) assess the impact of this program on nighttime sleep and daytime functioning for adolescents with ASD.
Methods: We delivered a brief sleep intervention to 20 adolescents, ages 11-18 years, and their parents. Adolescents had sleep onset delay and/or night wakings as measured by actigraphy. The program consisted of 2 education sessions with a psychologist, the adolescent, and his/her parent, followed by 2 follow-up phone calls. These sessions focus on previously researched components of successful sleep, including daytime habits, bedtime routines, sleep timing, and sleep environment as well as the addition of strategies related to relaxation and distraction. Actigraphy provided objective data concerning the adolescent’s pre- and post-program sleep. The parent and adolescent also completed pre- and post-program self-report measures. Final study results are presented here from actigraphy, parent and adolescent sleep measures, and satisfaction measures. The sleep measures include parent and adolescent report of the Adolescent Sleep Wake Scale (ASWS), Adolescent Sleep Hygiene Scale (ASHS), and Modified Epworth Sleepiness Scale (M-ESS).
Results: Of those enrolled, 63% were male and 22.2% were female. The average age was 14.77 years (SD=1.769), the average full scale cognitive score was 102.48 (SD=14.65), and the average ADOS-2 calibrated severity score was 7.33 (SD=2.176). Through actigraphy, significant improvement was observed in sleep latency ($p=0.007$) and sleep efficiency following treatment ($p=0.030$). In both parent and adolescent report of the ASWS, a significant improvement was seen with treatment in total score ($p<0.001$ and $p=0.006$) and all subscales. In both parent and adolescent report of the ASHS, a significant improvement was seen in total score ($p<0.001$) and 4 of 5 subscales. A significant improvement in total score was seen in adolescent report of the M-ESS ($p=0.002$), but not parent report. 50% of the sample was able to be contacted 3 months following completion of the study and gains were maintained for all contacted based on parent and/or adolescent report. Parents reported high satisfaction and were able to implement session recommendations at a high rate of understanding and comfort level.
Conclusions: Through this brief format of behavioral sleep education, significant improvements were detected in reported overall sleep behaviors and objectives measures of sleep latency and efficiency. These findings offer promising results in improving sleep for adolescents with ASD through a brief intervention.

67 **145.067** A Manualized Program to Support Transitions within Classroom Routines for Students with ASD: Child and Teacher Outcomes

S. Iadarola[1], *T. Smith*[2], *W. I. Shih*[3] *and T. AIR-B Network*[4], *(1)University of Rochester Medical Center, Rochester, NY, (2)Division of Neurodevelopmental and Behavioral*

Pediatrics, University of Rochester Medical Center, Rochester, NY, (3)UCLA, Monrovia, CA, (4)AIR-B Network, Los Angeles, CA

Background: Over the past decade, children with autism spectrum disorder (ASD) have been included in public education settings at swiftly increasing rates (National Center for Education Statistics, n.d.). Students in these settings frequently experience difficulties with transitions that occur during their daily routines. Transition-related difficulties often result in challenging behavior, including disruption, noncompliance, tantrums, aggression, and self-injury (Schreibman, Whalen, & Stahmer, 2000). Specific behavioral techniques to support transitions have been identified through single-subject research studies, but this research should be extended to include packaged interventions that are easily implemented in school settings and that are associated with more global child and teacher outcomes.
Objectives: This project aimed to develop and evaluate the Schedules, Tools, and Activities for Transitions (STAT) program, a short-term, manualized package intervention of behavioral supports relevant to facilitating successful transitions within the daily routine for students with ASD (K-5) in self-contained educational settings.
Methods: Across three sites (UCLA, University of Pennsylvania, University of Rochester), a cluster-randomized group comparison design with matched pairs was used to assign self-contained classrooms to treatment (STAT program) or waitlist control. STAT involved a 12-16 session, collaborative, coaching model between research staff and school staff that encouraged educators to use 9 steps to facilitate successful classroom transitions, thereby resulting in a teacher-mediated intervention program. Intervention components included antecedent-based strategies (e.g., warnings, visual supports), teaching strategies (e.g., prompt hierarchies), and reinforcement. Student outcomes included academic engagement, independence (ABAS self-direction domain) and problem behavior (School Situations Questionnaire) during school routines, and teacher-nominated target problems. Teacher outcomes included fidelity and generalization. Data on intervention implementation and buy-in were also collected.
Results: n total, 153 students and 76 educators participated. No group differences were noted for academic engagement, as baseline academic engagement was quite high (.80%) at baseline across sites. For teacher-nominated target problems, STAT showed a significant positive effect over waitlist, with a larger proportion of classrooms indicating improvements in the identified behaviors (χ^2=13.996, p=0.003). Positive effects of the STAT program were also found on the SSQ (SSQ; $M_{control}$ = .67; $M_{treatment}$ = .72), but not on the ABAS (ABAS; $M_{control}$ = 4.51; $M_{treatment}$ = 4.32).
Conclusions: The use of a teacher-mediated, behavioral intervention program was successfully implemented in self-contained classrooms across three under-resourced school districts. The results preliminarily suggest the utility of implementing a behavioral intervention package that can be beneficial for aspects of student behavior, feasible for educators to implement with high fidelity, and perceived as sustainable in real-world settings.

68 **145.068** A Pilot Investigation of Classroom-Based Music Therapy for Individuals with ASD and Other Disabilities

J. Mendelson[1], *Y. White*[2], *L. Hans*[3], *R. Adebari*[3], *J. Riggsbee*[4], *A. Goldsmith*[3], *K. Buehne*[3], *S. Jones*[3] *and G. Dawson*[5], *(1)Marcus Autism Center, Children's Healthcare of Atlanta and Emory University School of Medicine, Greensboro, NC, (2)Voices Together, Durham, NC, (3)Duke University, Durham, NC, (4)Education, Duke University, Durham, NC, (5)Duke Center for Autism and Brain Development, Duke University School of Medicine, Durham, NC*

Background: Research supports the efficacy of music therapy for improving communication skills in children with autism and related disabilities (Gold, Wigram, & Elefant, 2010 Srinivasan & Bhat, 2013). Neuroscience research suggests that music as a treatment modality may be uniquely well-suited to the information processing strategies employed by individuals with ASD (Stanutz, Wapnick, & Burack, 2014). Given early findings suggesting its efficacy (Braithewaite & Sigafoos, 1999; Brownell, 2002; Buday, 1995), classroom-based music therapy may be an especially time and cost efficient means of treatment delivery for children with various developmental disabilities. However, little is known about the efficacy of music therapy delivered in a classroom
Objectives: This was an initial pilot investigation of the efficacy of a classroom-based music-based intervention, Voices Together®, for improving communication skills in children with autism and developmental disabilities.
Methods: Four local public elementary school special education classrooms serving 5 children with a classification of autistic disorder and 32 children with intellectual disability without autism were randomly selected to receive one of two levels of exposure to *Voices Together®* music therapy "Long-Term" (15 weeks beginning in January 2105 (Time 1), n=14) or "Short-Term" (7 weeks beginning 7 weeks later in February (Time 2), n=17). Using observational ratings, Duke University researchers reliably scored participants live in terms of their level of verbal responsiveness to prompts during three songs (Hello, Feel, and Topic) featured each week of the program. Data were collected at three time points: baseline (T1), then in 7-week increments (T2 and T3).
Results: Independent *t*-tests investigating between-group (short vs. long term) differences in verbal responses at Times 2 and 3 were not significant. Both groups demonstrated increases in verbal responses over time, however, only the long-term group demonstrated significant within-group increases. Repeated measures ANOVA from Time 1 to Time 3, indicated improvement in mean verbal response during the *Feelings song* $F(2, 28)= 3.32$, $p<.05$ Significant change was found between Time 1 and Time 2 ($t(14)= 2.63$, $p<.05$). There were also significant improvements in verbal responses to *All Songs* between Time 1 and Time 2, $t(14)=2.47$, $p<.05$, and between Time 1 and Time 3, $t(14)=2.46$, $p<.05$ (Figure 1). Results showed a shift, on average, from 'one word' to 'partial sentence' responses to the prompts from the therapist.
Conclusions: Findings from this initial pilot investigation suggest that music therapy delivered in a classroom can result in improvements in verbal abilities among individuals with autism and other developmental disabilities. The finding that improvements were achieved during 45-minute weekly sessions in a classroom-based, public school setting suggests that structured music therapy programs such as *Voices Together®* may be a time efficient and cost effective modality of treatment. These preliminary findings warrant conducting a randomized controlled trial to further investigate the efficacy of classroom-based music therapy for improving speech development in children with autism and other disabilities.

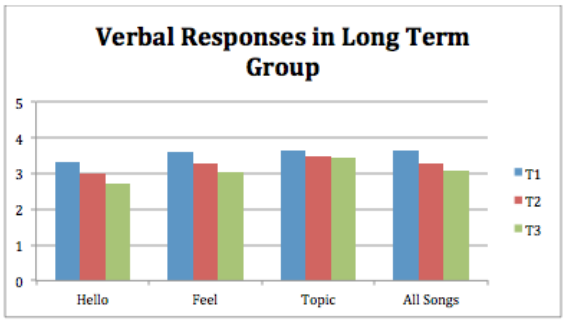


Figure 1. Mean verbal responses to three songs over time in the Long Term Therapy Group. Lower scores reflect more advanced verbal responses.

69 **145.069** A Pilot Test of Adult Social Knowledge (ASK) Workshop: An Intervention to Improve Outcomes in Young Adults with ASD

T. Oswald[1], *L. Gilhooly*[2], *J. B. McCauley*[3], *L. Libero*[4], *R. Hansen*[5], *P. C. Mundy*[6], *A. M. Iosif*[7], *S. J. Rogers*[4], *A. C. Stahmer*[3], *P. Schetter*[8], *S. Ruder*[8], *R. May*[9] *and M. Solomon*[10], *(1)2825 50th Street, University of California at Davis MIND Institute, Sacramento, CA, (2)UC Davis MIND Institute, Davis, CA, (3)University of California at Davis MIND Institute, Sacramento, CA, (4)University of California at Davis, Sacramento, CA, (5)Pediatrics and the MIND Institute, University of California Davis, Davis, CA, (6)Education and Psychiatry, University of California at Davis, Sacramento, CA, (7)Public Health Sciences, University of California Davis, Davis, CA, (8)MIND Institute, UC Davis, Sacramento, CA, (9)Alta California Regional Center, Sacramento, CA, (10)MIND Institute, Sacramento, CA*

Background:
Adult outcomes are alarmingly poor for people with Autism Spectrum Disorder (ASD). Over 50% of these individuals were not pursuing post-secondary education or gainfully employed in the 2 years after high school (Shattuck et al., 2012). Adults with ASD, compared to other disability groups, have the worst social and vocational outcomes, experience a higher burden of health and mental health issues and report low levels of life satisfaction (Howlin et al., 2004; Taylor & Mailick, 2014). Half a million children with ASD will enter adulthood in the coming decade (CDC, 2014). Services for adults with ASD that assist with this life transition are urgently needed.
Objectives:
To develop and pilot test the curriculum for Adult Social Knowledge (ASK) Workshop—a 19-week, 1 ½ hours/week intervention to improve functional outcomes for young adults with ASD (18-24 years of age). The ASK curriculum was adapted from the Functional Adaptive Skills Training (FAST; Patterson et al., 2006) and the Social Adjustment Enhancement intervention (Solomon et al., 2004), using Android technology, to target three pivotal areas of adult functioning: (1) Planning & Organization, (2) Social Skills & Interpersonal Communication, and (3) Communication in the Work Place & Community Engagement. Parents attended a concurrent support group that also provided information about community resources

Methods:
Analyses are for nine (2 female) adults with community diagnoses of ASD without intellectual disability. Pre-test and Post-test assessments were conducted using the ASEBA Adult Self-Report (ASR; Achenbach & Rescorla, 2003) subscales of "Attention Problems" (measuring planning and organization problems) and "Depression", as well as the WHO Quality of Life BREF Self-Report "Social Relationships" subscale (WHOQOL-BREF; WHOQOL Group, 1997). Univariate statistical tests were used.
Results:
A paired samples t-test revealed a statistically significant reduction in planning and organization problems from pre-test (M = 70.13; SD = 12.65) to post-test (M = 65.25; SD = 7.70), based on the ASR Attention Problems subscale, $t(7)$ 2.41, $p < .05$, with a large effect size (Cohen's d = .85). Though not statistically significant, a medium effect size (Cohen's d = *.72)* was found for the reduction in ASR depression levels from pre-test (M = 66.75; SD = 11.76) to post-test (M = 62.38; SD = 7.96), $t(7)$ 2.05, $p = .08$. Additionally, a medium effect size (Cohen's d = .56) for improvements in social relationships as measured by the WHOQOL-BREF were found for pre-test (M = 53.13; SD = 35.06) to post-test (M = 61.46; SD = 28.50), although this was not statistically significant, $t(7) = -1.60$, $p = .15$. High levels of satisfaction also were reported by young adults and their parents during a focus group at the conclusion of the trial.
Conclusions:
Given that participants in the ASK Workshop reported fewer planning/organization problems and depressive symptoms and greater social relationships after the intervention and expressed high satisfaction with the program, we are refining the curriculum in preparation for a wait list controlled experimental therapeutics trial, that will test improvements in cognitive control as a mechanism of therapeutic change, to begin shortly.

70 **145.070** A Simulated Driving Intervention for Young Adults with Autism Spectrum Disorder: Attention, Perceptual, and Motor Considerations

L. E. Mash[1,2]*, M. Samano*[2]*, N. Suarez*[2]*, S. Yu*[2]*, J. Townsend*[2] *and L. Chukoskie*[3]*, (1)SDSU/UC San Diego Joint Doctoral Program in Clinical Psychology, San Diego, CA, (2)Department of Neurosciences, University of California, San Diego, La Jolla, CA, (3)The Institute for Neural Computation, University of California, San Diego, La Jolla, CA*

Background: Obtaining a driver's license is an important milestone for most teenagers. In many parts of the United States, driving is critical for adults to function independently; the inability to drive can be an obstacle to education, employment, and routine errands such as grocery shopping. Although many high-functioning individuals with autism spectrum disorder (ASD) plan to drive, research has shown that many in this population experience deficits in attention, motor, and perceptual skills that are crucial for safe driving (Miller, Chukoskie, Zinni, Townsend, & Trauner, 2014; Townsend, Keehn, & Westerfield, 2011). Prior driving simulation research suggests that these features may, in fact, impact the ability of teens with ASD to drive (Reimer et al., 2013). However, the extent of the relationship between these basic functions and driving ability in ASD remains unclear. Furthermore, it is unknown whether teenagers on the autism spectrum may benefit from training on a driving simulator, and how individual differences in basic processing affect driving outcomes. By allowing teenagers with ASD to practice in a low-risk environment, we expect that both their overall confidence and driving proficiency will improve.
Objectives: Our goal was to assess the effectiveness of driving simulation training, and to relate basic perceptual, attention, and motor skills to driving ability in individuals with ASD.
Methods: 18 teenagers and young adults with ASD trained on a driving simulator for 45-60 minutes each week, for six weeks. Simulations included 1) simple drives, 2) divided attention drives that required responses to visually peripheral stimuli while driving, and 3) "challenge" drives that included unexpected obstacles. Divided attention and challenge drive performance was compared pre- and post-intervention. Our personalized six-week training program allowed participants to master progressively more complex driving environments at their own paces. Additional pre- and post-training assessments included a visual-motor integration task, an attention-orienting task, a general motor assessment, and a balance test. Participants' parents also completed the Social Responsiveness Scale-2. Changes in driving, attention, and sensorimotor function over the course of the intervention were assessed, as well as the role of pre-training basic processing skills as predictors of intervention success.
Results: Overall, driving skills improved over the course of the six-week intervention. Of the 18 participants, two have since become fully-licensed drivers; follow-up of the remaining participants is pending. Analysis of supplementary tasks is under way to determine whether and how driving ability and improvement with training is related to basic attention, perceptual and motor function.
Conclusions: Our six-week training appears to have been effective in improving performance on specific driving simulation tasks. Pending data analysis will shed light on the mechanistic involvement of perceptual, motor, and attention functions in moderating this change. These data will inform future research on the added benefit of training these general skills as part of a driving intervention; developing the best possible training resources for potential drivers with ASD will help to ensure optimal independence and quality of life as these individuals transition to adulthood.

71 **145.071** A Summer Intervention Targeting the Acquisition of Fundamental Movement Skills Among Children with ASD

K. Staples*, A. Bellerive, K. Collins and S. Lautenslager, University of Regina, Regina, SK, Canada*

Background: Having the confidence and competence to perform fundamental movement skills plays a critical role in development, providing the foundation for participation in physical activity and sport. Many children with ASD have difficulty performing the fundamental movement skills needed to participate successfully in what are often group-based activities. These movement skill difficulties become more obvious with increasing age and more children with ASD are left on the sidelines. During the summer months, opportunities to practice and improve these skills are further constrained because children with ASD are not receiving regular physical education.
Objectives: Over the summer months, Sports Camps are offered on many university campuses, yet very few have the structure and support for children with ASD to participate successfully. The purpose of this research was to examine the effectiveness of an intervention for children with ASD that followed the format of a summer Sports Camp. Following best practice guidelines (Smith et al., 2007), the intervention was based on 4 hours of instruction per day for a total of 20 hours per week; athletes participated in at least 4 of the 8 weeks of instruction. The delivery of the intervention was based on the 8 key components of pivotal response teaching (PRT) that are grouped into antecedent and consequence strategies. The coaches were undergraduate students in kinesiology who were trained to deliver quality instruction using PRT strategies to their teams of 1 to 3 children.
Methods: 10 children (7 boys, 3 girls) with ASD (7 to 10 years; FSIQ = 45 to 117) participated in the intervention targeting the acquisition of fundamental movement skills. The curriculum was based on the 13 skills included in the *Test of Gross Motor Development* (*TGMD-3*) a criterion referenced assessment that examines the performance of both locomotor and object control skills. Multiple performance criteria allow children to receive credit for any aspect of the movement they are able to perform and scoring is based on 46 and 54 possible performance criteria for the locomotor and object control subtests, respectively. The effectiveness of the intervention was determined by examining the change in the number of criteria met during the performance of the locomotor and object control subtests before and after participation.
Results: Following 4 to 8 weeks of participation in the intervention, children with ASD improved their performance on the locomotor subtest from a mean score of 17.2 to 27.10 (p = .008) and on the object control subtest from 20.9 to 31.3 (p = .001). These improvements reflect an increase of 24% and 22% in the number of performance criteria met for locomotor and object control skills.
Conclusions: This research demonstrates the effectiveness of PRT strategies in the acquisition of movement skill for children with ASD. The mastery of fundamental movement skills is integral to promoting active participation among children with ASD and the summer months are an opportune time when intensive instruction can occur.

72 **145.072** A Synthesis Review of Employment Support Interventions in ASD

D. B. Nicholas*, University of Calgary, Edmonton, AB, Canada*

Background: Evidence suggests that adults with ASD are at risk for poor employment outcomes. Of those who obtain employment, underemployed or being employed in positions that are not meaningful or rewarding may limit employment engagement. These challenges can negatively impact individual quality of life and self-esteem, and potentially impose gaps in labor market productivity. A relatively small body of literature explores employment support interventions for individuals with developmental and/or intellectual disabilities. While some models and interventions show promise, little is known about their use and effectiveness with the ASD population.
Objectives: This synthesis review explored employment support interventions applied in ASD, along with respective outcomes.
Methods: A synthesis review of ASD employment support interventions was implemented. The peer-reviewed literature on vocational interventions in ASD was reviewed. A librarian trained in Cochrane collaboration synthesis/systematic review methods conducted the search, exploring Cochrane, Scholar's Portal, CINAHL, EMBASE, ERIC, Medline and PsycINFO databases, and the gray literature. Studies were included if they identified a vocational intervention in ASD and outcome data.
Results:
This search yielded 501 articles targeted to adults with ASD (18 years of age or older); however, only 10 studies were included due to meeting inclusion criteria of evaluating an ASD employment support intervention. Two broad categories of interventions were identified: supported employment (community placement and job coaching) and technology-based applications (media and online use). It is important to note that the literature disproportionately reported on the cognitively-able ASD population, with less consideration of diversities relative to variability across the ASD spectrum, gender or other social determinants of health.
Supported employment literature in ASD tended to favor positive outcomes from interventions when protracted, commenced earlier in life, and tailored to the needs of the individual. Supported employment was identified as potentially offering positive impacts on cognitive performance. A community placement model was shown to offer better outcomes than a sheltered work approach. Job coaching was often viewed as integral to employment access. Interventions that utilized technology were perceived to yield positive outcomes, as was video-modeling which was posited to teach modeled skills, with some participants replicating these in work settings. The use of personal digital assistants (PDAs) was also shown to nurture work-related behaviors.
It is important to note that the reviewed studies were generally limited by methodology limitations including design, small sample size and imprecise outcome measurement, leading to concerns over the generalizability of this literature.

Conclusions: There is a need for research with stronger empirical designs as well as inclusion of diversities in ASD and the social determinants of health. Addressing both access *and* retention of employment is critical in evaluation and practice, as is building employer engagement and community capacity.

73 **145.073** A Systematic Review of Employment Outcomes for Adults with ASD

B. M. Di Rezze[1], *H. Viveiros*[2], *R. I. Pop*[3] *and G. Rampton*[3], *(1)School of Rehabilitation Science, McMaster University, Hamilton, ON, Canada, (2)CanChild Centre for Childhood Disability Research, McMaster University, Hamilton, ON, Canada, (3)McMaster University, Hamilton, ON, Canada*

Background:
Employment services or interventions for individuals with neurodevelopmental disabilities (NDD), including ASD, have been described in the literature to include counseling, job skill training, coaching and training of supports. In the employment disability literature, outcomes are often measured based on dichotomous approaches (e.g., whether an individual is employed), as well as continuous metrics (e.g., tenure and compensation over time). These outcomes are unable to evaluate what is specifically going well/poorly in multi-service employment interventions for individuals with ASD. To identify the outcomes measured in employment and ASD research, a comprehensive search across NDDs could identify measures that better evaluate existing or novel interventions.
Objectives:
To review studies describing standardized employment-focused measures and assessment procedures in ASD.
Methods:
The review targeted employment outcomes using standardized measures or procedures for adults with neurodevelopmental disabilities, based on DSM-5 criteria. One reviewer (HV) conducted the search of ERIC, MEDLINE, CINAHL, HaPI, and PsycINFO databases. Our search generated 2,151 citations, and after duplicate removal we screening in two stages. Reviewers used a predetermined list of eligibility criteria, with a key focus on finding articles that looked at employment outcomes beyond typical metrics (i.e., employed/unemployed, wages, and hours). For the first stage, two reviewers (HV and RP) conducted independently title and abstract screening of 2,075 articles, with all disagreements adjudicated by the senior advisor (BDR). For the second stage both reviewers conducted full text screening and eliminated all but 54 articles. Both reviewers conducted data extraction using a standardized form for population, recruitment setting, standardized measures, and employment outcomes. A descriptive examination of the studies was conducted to identify the population characteristics, construct of outcome measures, and measurement properties.
Results:
Among the 54 articles included, the majority focus on persons with intellectual disability (ID) (35 papers), and the next largest focus is on persons with ASD (14 papers). From the ASD studies, seven focused exclusively on individuals with ASD; four included both individuals with ASD and others with NDD; and three examined individuals with a combined diagnosis of ASD and ID or other NDD. ASD studies included standardized measures and job skill evaluation procedures. Two ASD-specific measures included the Autism Work Skills Questionnaire and the Vocational Index for Adults with ASD. Measurement constructs in ASD involved mainly six person-focused outcomes such as job satisfaction, preference, performance, as well as, work personality, motivation and readiness. Three constructs were represented by measures related to the work environment, such as workplace culture, supports (e.g., co-worker involvement) and social integration.
Conclusions: This review demonstrates the breadth of research measuring a variety of employment outcomes for adults with ASD - detailing both person and work environment-focused measures. ASD measures could serve as potential examples of new directions for research across other NDDs and conversely, constructs of measures identified in NDD could be areas of consideration in future ASD research.

74 **145.074** Adapting an Evidence Based Intervention Using an Implementation Science Framework

A. D. Rodgers[1], *L. A. Ruble*[1], *M. W. Jackson*[2], *C. Snell-Rood*[3], *W. H. Wong*[1], *Y. Yu*[4], *J. ". A. Odom*[1] *and J. H. McGrew*[5], *(1)University of Kentucky, Lexington, KY, (2)Educational, School, and Counseling Psychology, University of Kentucky, Lexington, KY, (3)Behavioral Sciences, University of Kentucky, Lexington, KY, (4)Indiana University-Purdue University, Indianapolis, IN, (5)Indiana University - Purdue University Indianapolis, Indianapolis, IN*

Background: This pilot research responds to the 2012 Interagency Autism Coordinating Committee for studies that utilize “implementation science to test methods to improve implementation of evidence-based treatments.” Applying the Consolidated Framework for Implementation Science (Damschroder, et al., 2009), we collected stakeholder perspectives on the experience of students with autism spectrum disorder (ASD) transitioning out of school and stakeholder recommendations for improvement. Findings were employed to adapt an evidence-based implementation strategy for schools called the Collaborative Model for Promoting Competence and Success (COMPASS). COMPASS, a teacher-parent consultation intervention based on a transactional framework (Ruble, Dalrymple, & McGrew, 2012), has been tested in two randomized controlled trials for young children with ASD.
Objectives: To use an implementation science framework to identify the critical factors impacting quality implementation and intervention effectiveness in COMPASS with the long-term goal of applying this information to understand, adapt, refine, and pilot the parent-teacher consultation.
Methods: Ten focus groups were conducted with 42 participants including individuals with ASD, parents, school service providers, school administrators, adult service providers, and state policy makers from the Kentucky offices of Vocational Rehabilitation, Special Education, Medicaid, and Developmental Disabilities. Each hour-long session was recorded and transcribed. The research team performed qualitative content analysis through composing a codebook of themes derived from the literature on transition and cross-checked all codes with themes appearing in a preliminary reading of all transcripts. Codes were discussed and refined within the team to finalize the codebook. Team members worked in pairs to test and apply codes; all codes were tested until reaching 80% agreement in inter-rater reliability. Then, each pair of coders applied codes line by line to all transcripts. Researchers reviewed coded content code-by-code to identify specific aspects of COMPASS to be adapted and revised to meet the needs of transition-age youth.
Results: Stakeholders identified several crucial points of intervention to improve transition for young adults with ASD including (a) adding or developing new measures of quality of life, self-determination, activation, and social support; (b) incorporating student goals for vocational and independent living skills and parent goals for obtaining services; (c) developing psychoeducational handouts on the transition process, state services, and a transition planning timeline with descriptions of different roles; (d) assessing parent perception of openness of IEP team to curricular changes; (e) involving student in completion of COMPASS forms and in the consultation; (f) inviting certain players, such as the vocational rehabilitation counselor, to consultation and coaching sessions, and offering different methods for involvement (e.g., in person, phone), (g) assessing current services prior to the consultation and assessing student interests, strengths, and skills; and (h) adapting interests questionnaires based on student abilities, such as use of visuals, and adapting COMPASS questions for age appropriateness.
Conclusions: Focus group data were used to adapt and revise the COMPASS model for transition age youth by improving assessment, communication between key players, and involvement of students and key players in planning. Our qualitative, stakeholder-centered process may be helpful for other implementation science studies adapting autism interventions to fit specific contexts.

75 **145.075** Adaptive Changes in Anxiety and Arousal Following a Randomized Control Trial of a Theatre-Based Intervention for Youth with Autism Spectrum Disorder

B. A. Corbett[1], *S. D. Blain*[1], *S. Ioannou*[2] *and M. Balser*[3], *(1)Vanderbilt University, Nashville, TN, (2)Psychology and Counseling, Lipscomb University, Nashville, TN, (3)Wake Forest University, Winston-Salem, NC*

Background: Increased anxiety and stress are frequently found in children with autism spectrum disorder (ASD) and often associated with social challenges. Following a randomized control trial of a peer-mediated, theatre-based intervention, significant treatment effects were shown across several areas of social competence including increased group play with novel peers.
Objectives: Elevated anxiety and physiological arousal are often associated with peer interaction in youth with ASD. Peer-mediation has been shown to facilitate positive social effects. Furthermore, participation in theatre games and social play in the treatment setting may generalize to other settings, leading to higher quality, less distressing interactions during social play. Thus, the purpose of the current study was to examine the impact of the intervention on reducing anxiety and stress.
Methods: Participants included 30 high-functioning (IQ >70) youth with ASD (8-to-14-years of age) randomly assigned to the Experimental (EXP, N = 17) or Wait-list control (WLC, N = 13) group. Participants were exposed to the Peer Interaction Paradigm (PIP) before and after the treatment to assess duration of play with novel peers, self-reported anxiety, and cortisol levels. A series of Analysis of Covariance (ANCOVA) models were used to test the between-group differences for the anxiety and stress variables. Specifically, the variables included the STAIC anxiety scale (Trait and State), as well as baseline and social stress cortisol collected during group play with peers. Pearson product moment correlations were conducted between anxiety, cortisol, and Group Play.
Results: Significant pre-test-adjusted between-group differences at posttest were observed on Trait-anxiety ($F(1, 27)=9.16$, $p=0.005$) showing lower Trait-anxiety in the experimental group. However, no group differences were observed for State-anxiety ($F(1, 27)=0.03$, $p=0.86$). Additionally, there were no between group differences on the diurnal or stress based cortisol values. There was a significant negative correlation between Group Play and Trait-anxiety ($r=-.362$, $p=0.05$) showing a self reported reduction in anxiety following the intervention for the EXP group. Playground cortisol was positively correlated with Group Play, for the experimental group ($r=0.55$, $p=0.03$) showing higher arousal for more engagement with peers.
Conclusions: The theatre-based, peer-mediated intervention not only results in improvement in social competence in youth with ASD, but also contributes to reductions in trait-anxiety associated with more social interaction with peers. In SENSE Theatre, peers serve as models for reciprocal social exchange. It is feasible that social engagement during the intervention may facilitate positive appraisals of peer interaction thereby reducing perceived anxiety during subsequent social exchange. Positive correlations between cortisol and Group Play in the EXP group suggest that increased physiological arousal may facilitate social engagement with peers. Optimal performance on demanding tasks requires greater arousal and for children with ASD, engaging with peers may be conceived of as challenging. Therefore, some degree of

physiological arousal is essential for social interaction and may be adaptive for individuals with ASD.

76 **145.076** An Examination of Predictors of Social Intervention Response for Elementary Aged Children with Autism

K. O'Connor[1], *M. Herzog*[2] *and J. P. Stichter*[3], *(1)University of Missouri, Columbia, MO, (2)Special Education, University of MIssouri, Columbia, MO, (3)Department of Special Education, University of Missouri, Columbia, MO*

Background:
The autism spectrum is unique due to the significant heterogeneity in both onset as well as presentation observed in diagnosed individuals. Interventions, especially those that target social skills, are not universally effective across the autism spectrum due in part to the heterogeneity of symptom severity. Although previous research has identified several characteristics that may be predictive of improved treatment outcomes, this research does not distinguish phenotypically distinct subtypes and may not inform treatment decisions. Given the limited information on targeting social competency interventions for autism, the purpose of this study was to examine behavioral phenotypes present in the subtype of individuals with high functioning autism within the context of an established social program (Social Competency Intervention for Elementary Aged Children: SCI-E).
Objectives:
The objectives of this study were to examine the extent to which characteristics of elementary aged participants with autism predict treatment responsivity as well as to identify possible distinct behavioral phenotypes present in the study sample that can support intervention responsivity and treatment needs.
The following research questions were investigated:

1. To what extent do pre-intervention characteristics predict treatment responsivity?
2. What are the specific characteristics associated with children with autism who demonstrate differing levels of responsiveness?
3. To what extent do pre-intervention behavioral phenotypes predict treatment responsivity?

Methods:
This quasi-experimental study investigated the characteristics of a group of children with autism that may be predictive of treatment responsivity within the context of the SCI-E program. Participants included 13 males and 5 females (n=18) with an autism spectrum diagnosis between the ages of 6 and 11 years (*M*= 8 years 9 months) with estimated full scale IQ's ranging from 77 to 132 (*M*= 99). The program consisted of a ten-week program with hour-long sessions twice per week targeting conversation, emotion regulation and problem solving skills.
Behavioral phenotypes were identified through analyses of participant profiles based on pre-intervention characteristics as well as following intervention based on treatment responsivity. Intervention outcomes were determined through the use of pre/post assessments including both direct participant performance measures and parent report measures.
Results:
The results of this study indicate that low pre-treatment ASD specific impairments (symptom severity scores) and Theory of Mind abilities were predictive of intervention outcomes. An initial exploration into behavioral phenotypes within the context of the SCI-E program yielded four distinct groups of participants that significantly differed based on overall level of intelligence as well as on measures of symptom severity.
Conclusions:
This study identified a complex and varied profile of characteristics and responsivity within the sample of children with autism that will inform researchers as to the efficacy of the SCI-E program as well as assist with treatment decisions for participants. The use of specific research examining responsivity and behavioral phenotypes throughout the stages of efficacy research has the potential to increase the specificity of social intervention research and improve outcomes for individuals on the autism spectrum.

77 **145.077** Building a Summer Transition Program for Autistic College Students That Has Replicable Benefits: A Participatory-Action Model

C. Shane-Simpson[1], *R. Obeid*[2], *D. DeNigris*[3], *M. Siller*[4], *E. R. Hotez*[5], *J. Pickens*[6], *M. Alicea*[6], *A. Massa*[7] *and K. Gillespie-Lynch*[8], *(1)The Graduate Center & College of Staten Island, New York, NY, (2)CUNY Graduate Center, New York, NY, (3)The Graduate Center & College of Staten Island, CUNY, New York, NY, (4)Hunter College of the City University of New York, New York, NY, (5)The Graduate Center of the City University of New York, New York, NY, (6)CUNY, Staten Island, NY, (7)CSI; CUNY, Staten Island, NY, (8)CUNY Graduate Center, Brooklyn, NY*

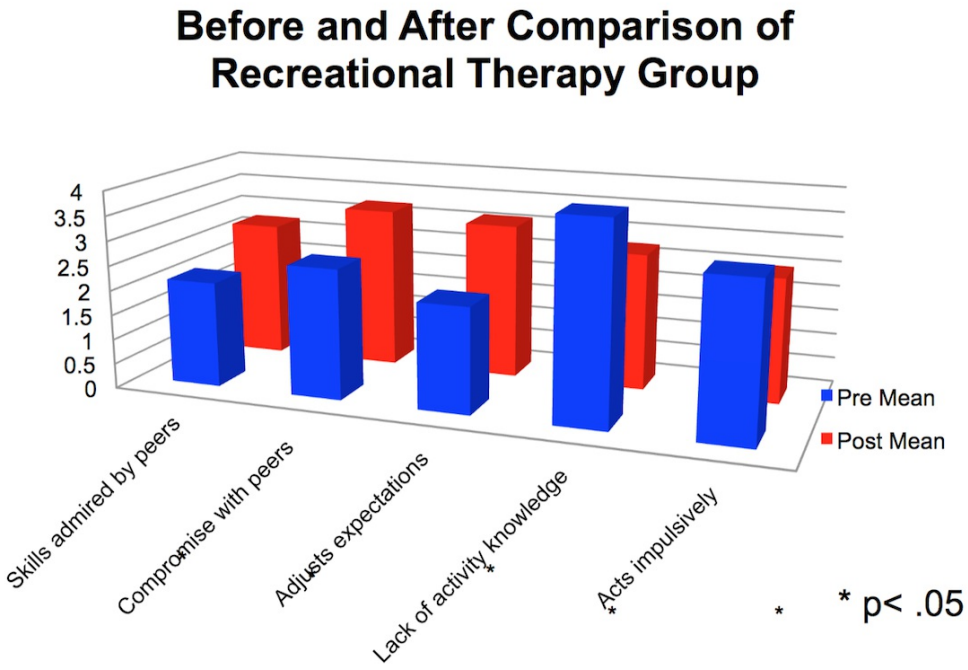
Background:
As more autistic students enter college, many face difficulties with self-advocacy, social interaction, and self-regulation (Gelbar et al., 2014; Van Hees et al., 2014). Few specialized supports are available for autistic college students (Barnhill, 2014). We used a participatory-action design to develop a summer transition program for incoming autistic college students. Participation in our first week-long program was associated with improvements in self-reported autism symptoms and anxiety (Oral presentation; IMFAR 2014). After adapting the curriculum using feedback from autistic and non-autistic students, we ran a second transition program in 2015 to determine if findings from the first program replicated.
Objectives:
1. Determine if autistic symptoms are more closely related to other challenges than intelligence (as they were in the first program);
2. Compare self-reported and parent-reported symptoms;
3. Evaluate benefits of participating in our second program.
Methods:
We developed a curriculum manual by revising materials from our first program to increase multimodal learning opportunities and assess fidelity more effectively. Through focus groups and individualized meetings, autistic and non-autistic students from our mentorship program helped adapt the curriculum.
Ten students (2 women) enrolled in a free week-long transition program (3 were in high school). All students self-identified as autistic, exceeded the parent-reported SRS cut-off for autism, and provided IEP documentation of disability (2 IEPs did not specify a diagnosis). Doctoral students led programming while undergraduate mentors (2 with a documented ASD and 4 without) helped model effective behaviors.
Pre-/Post-tests assessed autism symptoms (SRS-2; Constantino & Gruber, 2012), anxiety (Spielberger et al., 1983), autism knowledge (Gillespie-Lynch et al., 2014), disability identity (Darling, & Heckert, 2010), and academic self-efficacy (Hoover-Dempsey & Sandler, 2005), and included interviews and role-plays. Nonverbal intelligence was assessed with the TONI (Brown et al., 1997).
Results:
Autism symptoms positively correlated with orientation towards the social model (p=.008), but were unrelated to other measures. Nonverbal intelligence negatively correlated with trait anxiety (p=.025) and perceived support from friends (p=.033). Parental reports of participants' autism symptoms (M=95.3, SD=23.0) were higher than participants' self-reports (M=67.0, SD=28.1, p=.024).
Participation in the program was associated with decreased self-reported autism symptoms (p=.05) and increased autism knowledge (p=.012). Participants reported that they enjoyed meeting people, practicing social and self-advocacy skills, and learning college-related skills. One said, "it made me aware about other people with disabilities have a voice." Another said, "I really liked how I got to learn things that will prepare me for the future in college." Autistic mentors enjoyed meeting participants and sharing their self-knowledge with them.
Conclusions: Associations between symptoms, intelligence, and challenges were different in the current sample (which had higher average intelligence) relative to our first program. Improvements in symptoms replicated from the first program (wherein a trend was observed) to the second. Reduced anxiety did not replicate in the current program, but improvements in autism knowledge, which is essential for self-advocacy, were apparent during this program. Findings suggest that programming has replicable benefits that should be evaluated in larger samples.

78 **145.078** Comparative Effectiveness of Two Non-Pharmacological Approaches to Self-Efficacy and Social Skills

E. Kemeny *and D. A. Hutchins, Recreational Therapy, Slippery Rock University, Slippery Rock, PA*

Background: Adolescents with autism spectrum disorders (ASD) need effective non-pharmacological approaches that impact self-efficacy and social skills (Dattilo & Rusch, 2012; Obrusnikova & Miccinello, 2012). Garcia-Villmaser et al. (2010) found that preliminary evidence that recreation improves quality of life. However, no research compares the impact of goal-directed individualized recreational therapy and non-goal directed recreation for youth with ASD.
Objectives: This research concerns the question: Which intervention is the most effective in improving the social skills and self-efficacy?
Methods: A convenience sample of 24 participants, ages 13-19, with ASD were divided into equal groups (age and gender) to participate in a 4-week repeated measures design that compared two conditions (goal-directed individualized with non-goal directed recreation). Three outcomes were measured before and after the weekly 2 hour sessions in both conditions: parent-report of Home Community-based Social Scale (HCSBS), Self-efficacy Scale (Dishmann et al., 2005), and researcher observation (OARS smart tablet application) of six social skills. The same recreational activities (such as social games and horseback riding) were used in both conditions. Only participants in condition A received an individualized assessment and treatment plan.
A series of paired sample t-tests were used on each dependent variable to determine if there were significant differences within each group before and after the programs. Next, a factorial ANOVA with repeated measures was used to compare the differences between the conditions (goal-directed vs. non-goal directed recreation participation).

Results: The t-test revealed a difference pre to post (p <. 05) in the goal-directed condition on the parent-reported HCSBS, the self-efficacy scale, and OARS in eight different areas: a decrease in impulsive behavior, an improvement in admiration by peers, compromise with peers, adjusting to expectations, overall social competence score, knowledge of recreational options, and responsiveness to mentor. A descriptive analysis revealed that social games were more effective in promoting responsiveness to mentor/peer and the outdoor equine-assisted activities were more effective in supporting initiating conversation. Based on the repeated measures ANOVA, the areas of significant difference (p<. 05) between the individualized-goal and non-goal directed were found in the self-report of self-efficacy: 1) perceiving physical activity as fun and enjoyable, 2) knowledge of activity, and 3) increased positive mood regarding activity.
Conclusions: Individualized goal-directed recreational therapy appears to be more effective in targeting self-efficacy for community participation than general recreation programs. Participants in both groups received an opportunity to participate in the same recreational interventions over the same time period with the same frequency. Therefore, the main difference in the groups was that the recreational therapy (RT) condition had a goal-directed intervention based upon the assessment and goal planning. The individuals in the RT condition had input into their goals and intentionally worked toward improving their own social and physical skills while participants in the other condition only received the recreational program itself. Just providing a recreational program is not enough. For more effective community integration, intentional targeting and inclusion of the adolescent with ASD in goal planning may have a greater impact on self-efficacy for social recreational and leisure participation.



79 **145.079** Current Inclusion Practices for Students with ASD in Under-Resourced Schools

L. Huynh[1], *M. Dean*[2], *S. Iadarola*[3] *and T. AIR-B Network*[4], *(1)UCLA, Los Angeles, CA, (2)California State University, Channel Islands, Camarillo, CA, (3)University of Rochester Medical Center, Rochester, NY, (4)AIR-B Network, Los Angeles, CA*

Background: In response to federal mandates, children with ASD are included in general education classrooms at increasing rates(Smith 2012), and many school districts have identified “best practices” for teachers to support inclusion of children with ASD. However, little is known about teachers’ views on the feasibility, acceptability, and utility of these inclusive practices. Teachers’ views are important because they could exert a significant influence over whether and how new interventions are adopted and implemented. Furthermore, evidence suggests that empirically supported inclusion practices are often implemented inconsistently and without fidelity (Hunt, Soto, Maier, & Goetz, 2002).
Research in these areas is timely, given the emphasis in ASD research on developing interventions and practices that can be successfully adopted in real-world settings. Factors related to the implementation of services, such as capacity, buy-in, and “barriers to the ‘fit’ between social context and intervention” (Dingfelder & Mandell, 2011) can significantly affect how new interventions are adopted and carried out.
Objectives: The purpose of the study is to use qualitative research methodology to examine the barriers and facilitators to inclusive practices and perceived child outcomes in three socio-economically disadvantaged schools in a large urban school district.
Methods: Using a purposive sample of 3 schools, we facilitated 9 focus groups with teachers (4), paraprofessionals (3), and parents (2) of children with ASD, and 7 key informant interviews with administrators (3), parents (1), and related service providers (3). Under a phenomenology framework, transcripts were analyzed using thematic analysis.
Results:
Two themes permeated the school and neighboring community climate. Financial hardships and perceived discrimination created daily stressors that hindered interpersonal relations within and across community and school settings. The extent to which these stressors caused communication breakdowns directly related to perceived child outcomes. Financial burdens affected the hiring of support staff, caseload management, training opportunities for teachers, parents, and paraprofessionals, and a general lack of access to instructional materials and resources. Children were often placed in ASD programs at schools outside of their neighborhood, and a lack of transportation or childcare, or the inability to take off work made parent involvement difficult.
Perceived discrimination was reported by educators and parents. Special education teachers were perceived as being a lower priority than general education teachers, and children with ASD often received little support in inclusive environments. The extent to which adults facilitated a climate of inclusion was positively related to the perceived acceptance of a child with ASD. Parents reported being rejected because of their child with ASD, leading to feelings of isolation. There was a relationship between level of school and community support for parents, and the perceived quality of inclusion programs.
Conclusions:
Our findings suggest that there is a tension between federal mandates and school policy, and actual school practices. Financial hardships and perceived discrimination reveal a lack of infrastructure to support the implementation of best practices for inclusion in socioeconomically disadvantaged communities. Interpersonal communications related to the barriers had a direct effect on perceived child outcomes, such that healthier communication was associated with greater acceptance.

80 **145.080** Deconstructing the Literature on the Treatment of Anxiety in Youth with ASD

B. M. Marro[1], *R. J. Weber*[1], *L. Bungert*[1], *S. Sommer*[1], *C. M. Kerns*[2], *L. J. Moskowitz*[3], *E. Cohn*[4] *and M. D. Lerner*[1], *(1)Stony Brook University, Stony Brook, NY, (2)A.J. Drexel Autism Institute, Philadelphia, PA, (3)Psychology, St. John's University, Queens, NY, (4)Center for Health Innovation, Adelphi University, Garden City, NY*

Background: Anxiety symptoms in Autism Spectrum Disorders (ASD) are highly prevalent (Simonoff et al., 2008). Interventions aimed at treating ASD and anxiety include different elements, each defined as a "discrete clinical technique or strategy" (Chorpita et al., 2005). Characterizing interventions by their base elements streamlines terminology, and illuminates variation and overlap amongst interventions, which may be particularly diverse when targeting comorbid syndromes. No study has reviewed discrete elements in the literature on treating anxiety in ASD. Doing so provides a uniquely informative bird's-eye view of current evidence-based treatment in this literature. Further, as only two treatment approaches, Cognitive Behavioral Therapy (CBT) and Applied Behavioral Analysis (ABA), are considered "empirically supported" for anxiety in ASD, it is useful to see whether patterns of their use can be discerned by examining distributions of their discrete components.
Objectives: (1) To explore which elements are used most commonly in the empirical literature treating anxiety in ASD youth. (2) To categorize those elements that are best characterized as CBT or ABA strategies. (3) To examine how participant age and gender relate to element distribution.
Methods: Researchers reviewed PubMed, PsycINFO, and Web of Science. This process yielded excellent agreement (ICC(1,2)=.957), and N = 40 articles. They were coded for elements compiled by a research consortium as representing common evidence-based practices in the field, and for participant age/gender. Inter-rater reliability for these codes was excellent (ICC(2,5)=.792). In order to classify elements as CBT or ABA, we grouped elements based on the published definitions (Gosch et al., 2006; National Autism Center, 2015), then employed an iterative backwards stepwise inclusion strategy to achieve acceptable internal consistency. We examined frequencies of individual elements in the literature, as well the presence of ABA and CBT strategies; paired-sample *t*-tests and χ^2 tests were used to compare strategy frequency and associations with age & gender.
Results: The most common elements, appearing in ≥40% of articles, were Graduated Exposure, Cognitive Restructuring, and Homework; conversely, Meditation, Prompt Fading, and Time Out were not present (Figure 1). CBT was comprised of Cognitive Restructuring, Homework, Relaxation/Deep Breathing, and Self-Awareness Bodily Response (Cronbach's α=.661). ABA was comprised of Prompting, Priming, Games and Activities Involving Social Interaction, Shaping, Stimulus Control, and Video/Audio Modeling (Cronbach's α=.688). The number of CBT elements used was significantly greater than the number of ABA elements (*t*=2.06, *p*=.046; CBT: *M*=1.4, *SD*=1.37; ABA: *M*=0.7, *SD*=0.46). No significant association was found between gender or age and the presence of CBT or ABA elements (all *p*>.190).
Conclusions: That Graduated Exposure is the most commonly implemented element suggests that the research literature strongly relies on well-supported approaches to anxiety in ASD. The use of more CBT strategies in this review may reflect a differential preference for representing internal (i.e. cognitive aspects of anxiety) symptoms in CBT, relative to purely external (i.e. visible behavior) symptoms in ABA. Future work is warranted to similarly characterize interventions implemented in the community and to explore variation in treatment techniques on that larger scale as a function of age, gender, or other characteristics.

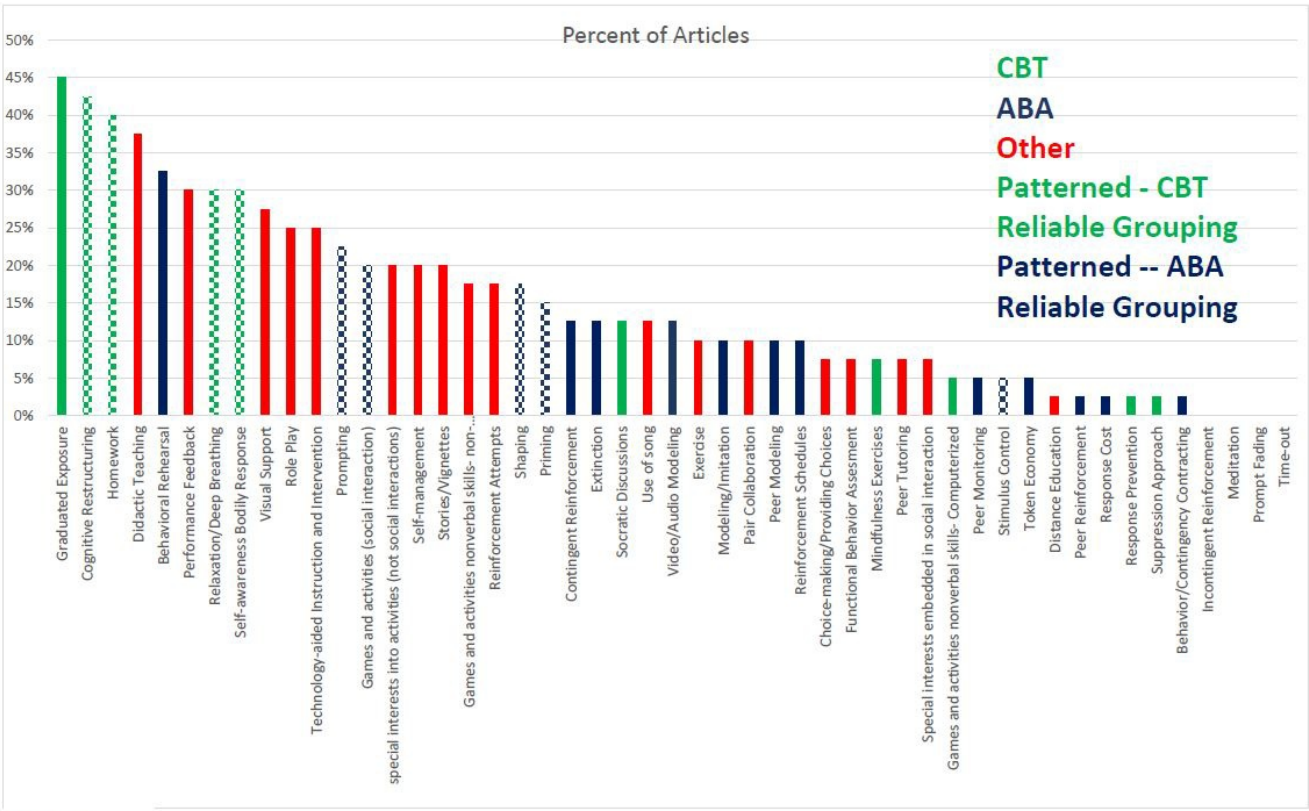


Figure 1

81 **145.081** Effectiveness of a Novel Outdoor Behavioral Health Treatment Intervention for ASD: A Single Subject Design

*M. E. Villalobos[1], **S. Semcho**[2], D. Schuler[3] and S. Lewis[3], (1)TEACCH Autism Program University of North Carolina Chapel Hill, NC, Asheville, NC, (2)Psychiatry, TEACCH UNC Chapel Hill Autism Program, Asheville, NC, (3)CReATE: Center for Research, Assessment, and Treatment Efficacy, Asheville, NC*

Background: Recent estimates have indicated that autism spectrum disorder (ASD) affects approximately 1 in 68 children (Baio, 2014); epidemiological data suggests that this figure represents a marked increase in prevalence rates observed over the past decades (Duchan, & Patel, 2012). Social behavior deficits, a core diagnostic criterion of ASD, negatively impact youth's functioning in many ways. Struggles to develop relationships, rigid behavioral routines, affective dysregulation, and hyperactivity reduce social learning opportunities and compound functional difficulties (Bauminger, Shulman, & Agam, 2003). Thus, there has been a renewed interest in the development of comprehensive, psychosocial treatment for youth with ASD. The current feasibility study explored the effectiveness of a multi-modal, intensive, residential treatment program, delivered in a naturalistic wilderness setting, for adolescents with ASD. Quasi-experimental data has supported the use of similar programming for adolescents with psychiatric disorders (e.g., Russell, 2002; Lewis, 2013); however, this is the first study of its kind to examine the effectiveness of such programming for youth with ASD.
Objectives: The purpose of the current research was to conduct a feasibility study, investigating the therapeutic response of a single subject to a novel treatment intervention for youth with ASD. It was hypothesized that the participant would evidence improvements in overall psychological functioning and social skills, as well as associated behavioral excesses and deficits during 8-weeks of intensive residential treatment.
Methods: A 15-year-old male with diagnoses of ASD and ADHD was enrolled in a residential treatment program, delivered in the naturalistic setting of the NC national forest. Data were collected pre- and post-treatment, as well as weekly throughout the duration of the program; data included standardized, normative instruments completed by therapist and youth (i.e., Treatment Outcome Package [TOP; Kraus et al., 2005] and Social Skills Improvement System [SSIS; Gresham and Elliot, 2008]), behavioral documentation conducted by trained staff, and partial-interval behavioral recording, conducted weekly by staff trained in behavior analysis.
Results: Results supported primary hypotheses. Clinically meaningful reductions in externalizing behaviors, ADHD symptoms, internalizing problems, and overall ASD-related behavioral symptoms were observed, from baseline to discharge. Comparisons of pre- to post-treatment therapist ratings indicate that the participant demonstrated significant, clinically meaningful improvements in adaptive social skills (13th percentile, baseline; 55th percentile discharge) and significant reductions in problem behaviors (99th percentile, baseline; 77th percentile, discharge). Specifically, improvements were noted in communication, responsibility, empathy, social engagement, and self-control. Further, behavioral observation data indicated greater frequency of positive social behaviors (e.g., contributing to group discussion, helping peers, starting/joining a conversation) and decreased frequency of negative social behaviors (e.g., verbal impulsivity) over 8-weeks of treatment.
Conclusions: The results indicate that in the current single-subject feasibility study, the participant evidenced significant improvements in functioning broadly— including psychological symptomatology, social skills, prosocial behavior, peer relatedness— from baseline to post-treatment. These results offer encouraging preliminary evidence for the effectiveness of a novel, multi-modal, intensive treatment for adolescents with ASD and comorbid behavioral and mental health disorders.

82 **145.082** Effects of Therapeutic Horseback Riding for Youth with Autism Spectrum Disorder

Z. Pan[1], *D. A. Granger*[2], *J. Lucas*[3], *B. Dechant*[4] *and R. Gabriels*[5], *(1)Pediatrics, University of Colorado Denver school of medicine, Aurora, CO, (2)Institute for Interdisciplinary Salivary Bioscience Research, Arizona State University, (3) Johns Hopkins University School of Nursing, Bloomberg School of Public Health, and School of Medicine, Phoenix, AZ, (3)Psychiatry, University of Colorado, Aurora, CO, (4)University of Colorado - Denver, Aurora, CO, (5)Children's Hospital Colorado, Aurora, CO*

Background:
In a randomized clinical trial, (Gabriels et al., 2015; NIH/NINR 1R01NR012736) demonstrated that therapeutic horseback riding (THR), as compared to a no horse activity control, benefitted children with autism spectrum disorder (ASD) on measures of irritability, hyperactivity, social cognition and social communication, along with the total number of words and new words spoken during a standardized language sample.–
Objectives: To examine whether results reported by Gabriels and colleagues (2015) can be replicated,, determine the feasibility of collecting saliva samples from children with ASD, and explore the effect of THR on individual differences in children's cortisol levels
Methods: Sixteen participants, 6-16 years old with a diagnosis of ASD were randomized with 1:1 ratio into either THR or no-horse barn activity control group (BA). Other inclusion criteria include a combined score of 11 points or higher on the Irritability and Stereotypic Behavior subscales of the ABC-C and nonverbal IQ ≥ 40. Exclusion criteria included physical or behavioral issues that would prevent participation, a history of animal abuse or phobia to horses, more than two hours of EAAT experience within the past six months, or taking steroid medications. Pre- and post-intervention evaluation of Systematic Analysis of Language Transcripts (SALT) were conducted by a speech therapist blinded to intervention condition. A designated caregiver for each participant completed the ABC-C and Social Responsiveness Scale (SRS). Salivary samples were collected pre- and 20 minutes post- THR group sessions and later assayed for cortisol
Results:
THR-related behavior response patterns are presented in Figure 1 and Table 1. The effect of THR, as compared to BA control, was significant on hyperactivity ($p<0.05$) and marginally significant ($ps<0.1$) on irritability and social communication. Pre- and post-intervention saliva cortisol were successfully collected in 90% and 40% of the interventions sessions respectively for THR and Barn groups] Linear mixed effects model analysis indicated that greater irritability was associated with greater post-intervention reduction in cortisol in the THR group ($p=0.05$) and in the Barn group (each $p=0.10$); Greater hyperactivity is associated with greater cortisol reduction in THR group ($p<0.05$) but not in the barn group.
Conclusions:
The effects observed in the prior THR RCT were partially replicated. It was feasible to collect saliva from children with ASD at the riding center. Although this preliminary study did not have sufficient statistical power to evaluate effects on salivary cortisol as outcome for assessing immediate effects of the THR intervention on HPA activity, results suggest that salivary cortisol may be a promising measure for future investigations to explore the mechanisms of THR as having a sensory/calming effect on children with ASD.

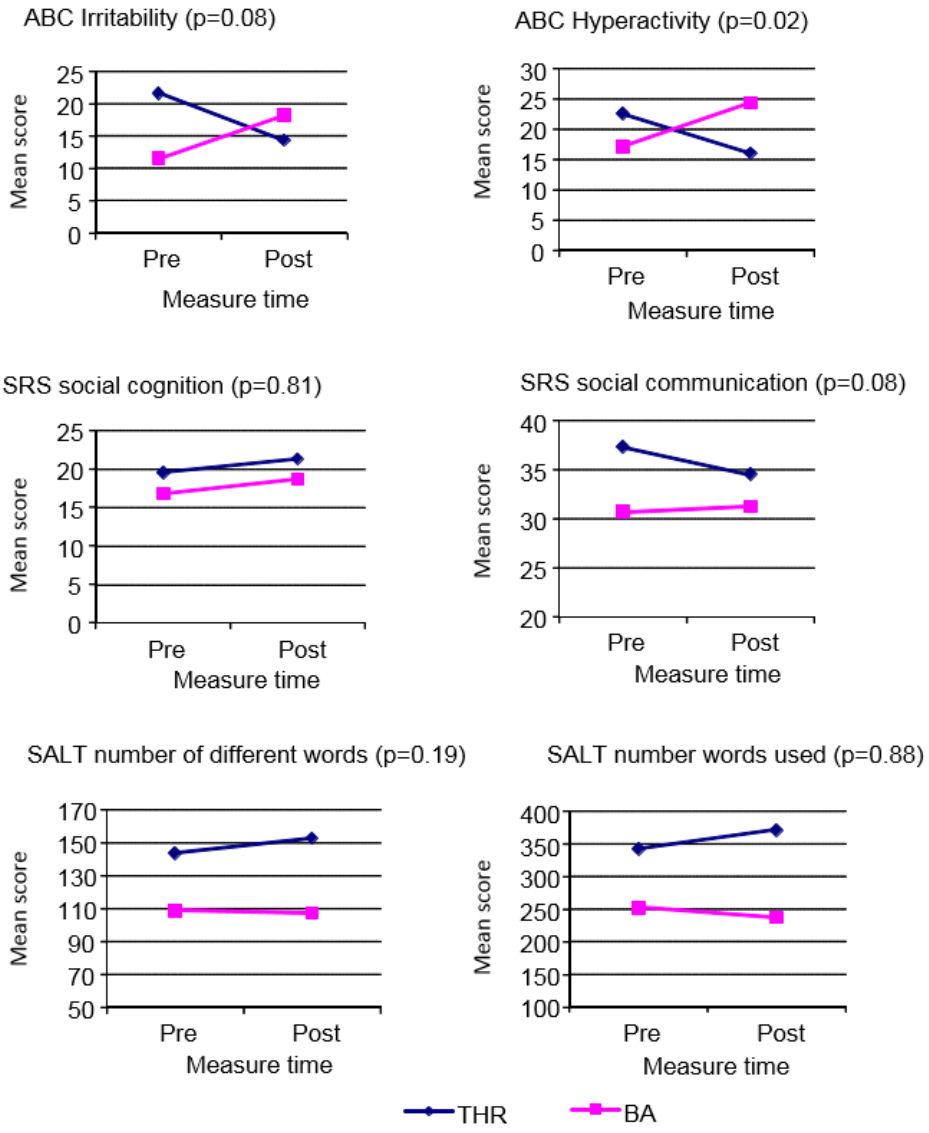


Figure 1 : Results replicated 5 out of 6 outcomes observed between two groups in a previously published, larger RCT (n=127).

83 **145.083** Electrophysiological Assays of Multisensory Integration and Sensory Processing in Autism Spectrum Disorders

S. Molholm*, Neuroscience and Pediatrics, Albert Einstein College of Medicine, Bronx, NY*

Background:
The development of ordered interactions among inputs to the different sensory systems is a necessary component of normal functioning and plays a fundamental role in our ability to successfully navigate the environment. Examples of multisensory influences on normal perception are manifold. For example, seeing someone speak can have

profound effects on what is heard, and the perceived location of a sound is affected by the location of a co-occurring visual event. It has been proposed that failure to develop normal integration of sensory inputs is at the root of some childhood neuro-behavioral disorders, a notion that has been especially applied to autism. This notion led to the formulation of the Sensory Integration Theory in the late 70's, a theory that has attracted a large following over the intervening years.
Psychometric tests and questionnaires indicate profound differences in sensory processing in individuals with autism. However, the neural underpinnings of these sensory processing differences remain elusive. One promising line of research suggests that differences in connectivity may be involved. It has been argued that in autism, perhaps as a consequence of reduced long-range connectivity, typical perception and cognition are disrupted when information must be integrated across sensory and cognitive domains. A breakdown in long-range connectivity would of course lead to impoverished integration of sensory information across modalities.
Objectives:
1) To use objective neural and behavioral metrics of sensory processing and multisensory integration (MSI), in order to probe the integrity of multisensory integration processes in ASD.
2) To develop biomarkers that can be used to assay normalization of function due to treatment.
Methods:
High-density electrophysiological scalp recordings served to measure the brains response to unisensory and multisensory stimuli (basic visual, auditory, and somatosensory stimuli presented alone or simultaneously). Parallel behavioral reaction-time measures assessed perceptual enhancement due to multisensory stimulation. In an additional, purely behavioral paradigm, the consequence of impaired MSI for speech processing was examined. Here participants identified spoken words-in-noise that were sometimes accompanied by videos of the speaker saying the word. Improved performance on the auditory-plus-video condition compared to the auditory-alone condition indexed MSI.
Results:
Basic unisensory processing was relatively intact in ASD, especially for somatosensory and visual stimulation. In contrast, integration of audiovisual multisensory inputs was significantly impaired in this group, as evinced by both neurophysiological and behavioral measures. The audiovisual speech-in-noise task further revealed profound MSI deficits in children with autism that impacted their ability to discern words in a noisy environment.
Conclusions:
The ability to integrate multiple sensory cues incurs major advantage to decoding the social and communicative milieu. The impaired MSI that we observe in children with an ASD puts them at significant disadvantage in such complex situations where a fine weighting of multisensory cues is required. The protracted development of MSI offers a window of opportunity for intervention to remediate MSI. Here we present measures of MSI that can be used to assess the impact of interventions on these fundamental processes.

84 **145.084** Enhancing Joint Attention Skills in Children with Autism Spectrum Disorder through an Augmented Reality Technology-Based Intervention

P. Perez Fuster[1], *G. Herrera*[1], *A. Ferrer*[2], *M. Mademtzi*[3] *and F. Shic*[3], *(1)Autism Research Group. Robotics Institute, University of Valencia, Valencia, Spain, (2)Educational and Developmental Psychology, School of Psychology, University of Valencia, Valencia, Spain, (3)Yale Child Study Center, Yale University School of Medicine, New Haven, CT*

Background: Joint attention (JA), defined as the ability to coordinate attention with an interactive social partner to share awareness of an object or event, has been identified as a key deficit among children with ASD (Mundy et al., 1986). In particular, children with ASD do not engage in responding to JA (RJA) behaviors, such as gaze following and pointing, in the same way as typically developing individuals (Mundy, 2003). Because these skills are crucial for child development and learning (Charman, 2003), previous behavioral interventions have been implemented (Kasari et al., 2006). Also several studies have used technology as a mediating tool to improve RJA skills, leading to significant overall improvements in some children (Cheng & Huang, 2012).
Objectives: The objective of this study was to enhance the RJA skills of gaze following and pointing in children with ASD through an intervention based on the use of *Pictogram Room*. This technology is a Kinect-based Augmented Reality (AR) system comprised of multiple educational video games designed for enhancing a variety of skills including RJA in children (Herrera et al., 2012).
Methods: Two males and one female of 3, 5 and 8 years old with ASD participated in the study. ADOS-2 (Lord et al., 2012) and ESCS (Mundy et al., 2003) standardized tools were used to assess participants' RJA skills. A single-subject multiple-baseline design was used over twelve weeks. The intervention consisted of six sessions of 30 minutes: 15 minutes for the intervention (i.e. participants used *Pictogram Room* to learn how follow the gaze of a virtual dummy and touch the object of shared attention in an AR environment) and 15 minutes for the assessment (i.e. the dependent variable was measured as the number of times that participants gaze followed a real dummy by pointing out the object of shared attention in the physical world). Maintenance was evaluated through follow up assessments. Another assessment in which the students had to respond to a person's gaze was used to evaluate generalization.
Results: ADOS-2 and ESCS assessments identified students' difficulties for RJA, which made them to be eligible for participating in the study. For measuring the dependent variable, two blind raters independently coded the videos and an inter-observer reliability of >90 was reached. The *Percentage of All Non-Overlapping Data* was 96% and Pearson *Phi* statistic analysis showed an effect size of 0.92 ($p < .01$), which indicated that the intervention was highly effective for improving the RJA skills of gaze following and pointing of the three students. Improvements were maintained after one month and generalized to a person's gaze.
Conclusions: This study suggests that a novel AR technology-based intervention can be effective for the improvement of RJA skills in children with ASD. Although the intervention has been implemented for only three children, the findings are significant and promising. Therefore, it would be desirable as future work to evaluate the impact of this intervention on a larger sample. Also a randomized controlled trial would help to explore its full efficacy.

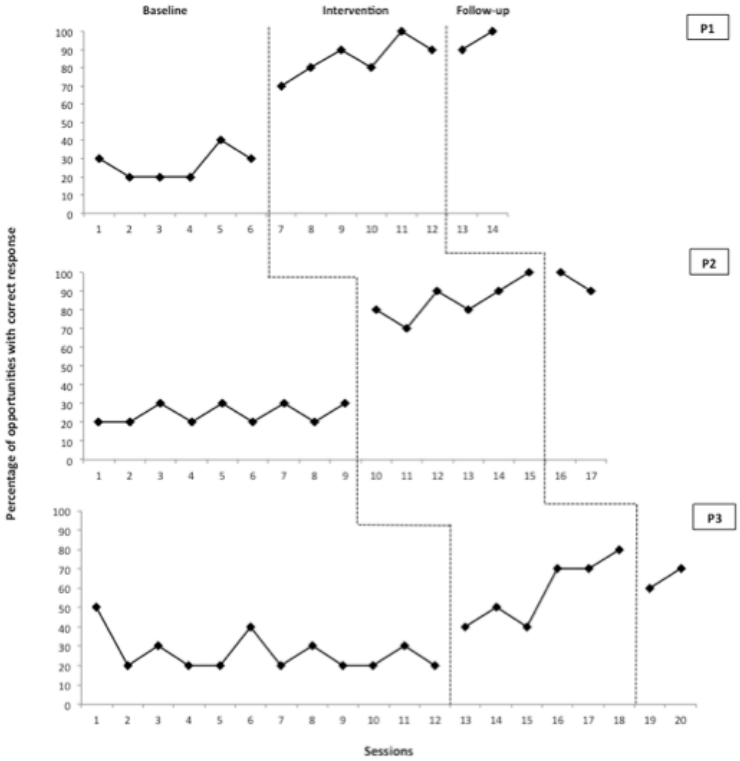


Fig. 1 Percentage of opportunities in which the participant correctly gaze followed and pointed the target object of shared attention

85 **145.085** Evaluating the Summer Treatment Program for Children with Autism Spectrum Disorders

B. Aaronson[1,2], *D. Campa*[1,2], *A. Compton*[1,2], *E. Baumler*[1] *and A. M. Estes*[1,3], *(1)University of Washington Autism Center, Seattle, WA, (2)Department of Educational Psychology, University of Washington, Seattle, WA, (3)Department of Speech and Hearing Sciences, University of Washington, Seattle, WA*

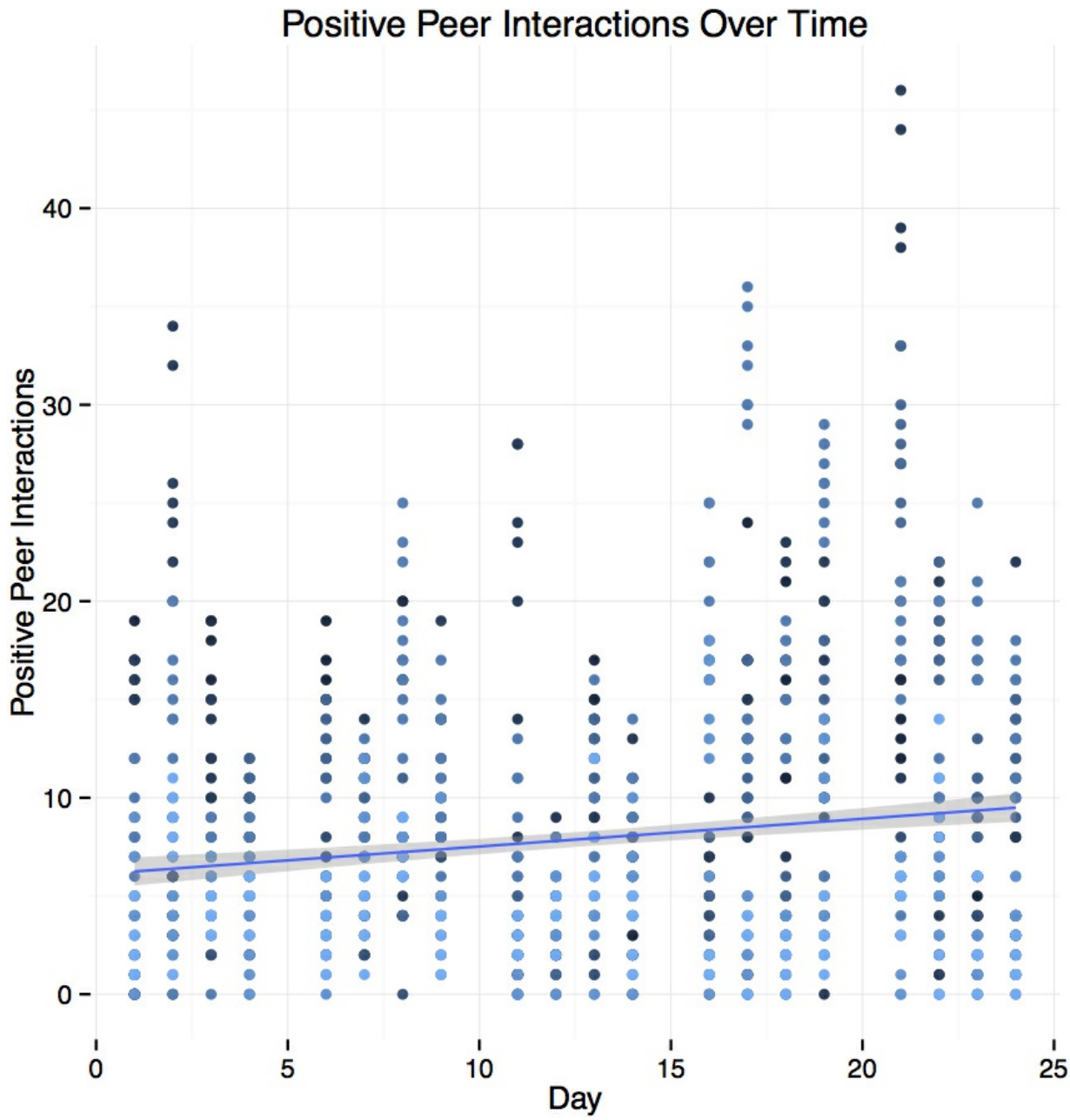
Background: The Summer Treatment Program (STP) was developed by Pelham and colleagues to provide behavioral and social skills intervention for children with attention-deficit hyperactivity disorder (Pelham, Greiner, Gnagy, 1985; 2014). Children participate in structured recreational activities, while a detailed token economy promotes adaptive behaviors. Behavior management is a prominent program objective, along with a detailed social skills curriculum. There are around a dozen programs in the United States that use the STP methodology. It is becoming increasingly common for children with autism spectrum disorder (ASD) to enroll in these summer programs due to their explicit structure, focus on social skills, and limited alternative summer options. To our knowledge, there has been no report of the effectiveness of the STP in promoting social skills for children with ASD.

Objectives: To evaluate the effectiveness of the Summer Treatment Program in increasing positive peer interactions for children with autism spectrum disorder.

Methods: The UW Autism Center adopted the Summer Treatment Program to provide children with ASD an opportunity for structured development of behavioral and social skills during the summer. Minor modifications to the program for children with ASD are described, including a modified time-out procedure. Graduate and undergraduate students were recruited to implement the program, completing 2 weeks of training in the STP model, including intervention techniques and behavioral coding. Behavioral data were collected continuously during the program, including measures of attention, compliance, and positive peer interactions. The frequency of positive peer interactions over time was reviewed for 59 participants of the 5-week program during the summer of 2015 with a documented diagnosis of autism spectrum disorder.

Results: Preliminary analysis of 59 participants with ASD included calculating a simple linear regression to examine the relationship between days of participation in the Summer Treatment Program and the number of positive peer interactions. A significant regression equation was found $F(1, 1178) = 27.19$, $p < .001$, with an $R^2$of 0.022. Positive peer interactions increased 0.14 for each day of attending the program.

Conclusions: For children with ASD who participated in the Summer Treatment Program, an increase was observed over time in the number of positive peer interactions, which includes helping others, sharing with others, and ignoring provocation. The Summer Treatment Program methodology may be an effective tool for increasing social skills in children with ASD. Future research might examine the program's impact on other specific behavior and autism symptomology.



86 **145.086** Evaluation of the Client-Therapist Relationship in an Emotion Regulation Intervention for Children with Autism Spectrum Disorder

P. Burnham Riosa *and J. A. Weiss, York University, Toronto, ON, Canada*

Background:
Evidence-based practice (EBP) involves integrating the current best available research literature with clinical expertise and client characteristics, values, and preferences (American Psychological Association, 2005). An understudied yet important facet of EBP is the therapeutic alliance (TA), or collaborative therapist-client working relationship. Across treatment modalities, TA is a predictor of treatment success in both child and adult populations (Horvath & Symonds, 1991; Martin et al., 2000; Wampold et al., 1997). Researchers have described the need to evaluate TA in interventions for children and youth with ASD (Brown et al., 2014). Empirically supported treatments designed to address co-occurring emotional and behavioral problems of children with ASD are emerging; however, relatively little work has been done to examine TA in interventions for this population.
Objectives:
The objective of the current study was to examine the therapist-client relationship and its relation to client satisfaction ratings and child treatment outcomes in a cognitive behavior therapy (CBT) intervention, the *Secret Agent Society: Operation Regulation* (Beaumont, 2013).
Methods:
As part of an ongoing randomized waitlist controlled trial, 20 children (19 males) ages 8 to 12 years (M = 9.8; SD = 1.29) with ASD and their parents completed the 10-session CBT intervention and detailed measures of therapeutic alliance. Parents and children completed child ER (*Emotion Regulation Checklist* (Shields & Cicchetti, 1997; *Children's Emotion Management Scale*, Zeman et al., 2010) and psychopathology (*Behavior Assessment System for Children, 2nd Edition*, Reynolds & Kamphaus, 2004) measures pre- and post-intervention. Two trained coders rated early (Session 2), middle (Session 5), and late (Session 9) therapy sessions using the *Therapy Process Observational Coding System–Alliance Scale*(McLeod, 2005; McLeod & Weisz, 2005). Coders established excellent reliability (ICC = .95). Parents and children completed post-intervention program satisfaction measures.
Results:
Forty-nine unique video-recorded sessions were coded across 20 participants for child-therapist and parent-therapist alliance (ICC = .95). Observational ratings of these alliances were correlated (r = .48, p= .04), with ratings of child-therapist alliance and parent-therapist alliance high across early, middle, and late sessions.
Early session child-therapist alliance was not related to child psychopathology, ER, or satisfaction ratings; however, high early parent-therapist alliance was related to low parent-reported internalizing problems post-intervention (r = -.69, p =.002). High middle session child-therapist alliance was correlated with low externalizing symptoms (r = -.68, p =.004) and emotional lability/negativity (r = -.73, p =.001). High middle session parent-therapist alliance was also correlated with low in externalizing problems (r = -.51, p =.05) and higher child-reported overall coping (r = .61, p =.02). Finally, high late session child-therapist alliance was correlated with child-reported satisfaction with the program (r = .80, p =.001) and child-reported coping (r = .69, p =.003) post-intervention. Late parent-therapist alliance was not correlated with any post-intervention measures (p> .05).
Conclusions:
Our study highlights the importance of examining therapeutic relational processes to understand client satisfaction and treatment outcomes of children with ASD. The implications of understanding relational processes on the delivery of empirically supported treatments in this population will be discussed.

87 **145.087** Examining the Effectiveness of the PEERS Program on Social Skills and Anxiety in Adolescents with Autism Spectrum Disorder

T. L. Hill[1], *S. Gray*[1], *K. Boggs*[2], *C. Johnson*[2], *E. J. Carey*[2], *C. N. Baker*[1] *and R. E. Varela*[3], *(1)Psychology, Tulane University, New Orleans, LA, (2)Children's Hospital, New Orleans, New Orleans, LA, (3)Loyola University New Orleans, New Orleans, LA*

Background: Poor social functioning is a hallmark feature of Autism Spectrum Disorder (ASD). As such, recent research has focused on developing social skills interventions for individuals with ASD. Research indicates that the Program for the Enhancement and Enrichment of Relational Skills (PEERS), a manualized social skills intervention for high functioning adolescents with ASD, is efficacious. However, to date, no studies have examined the effectiveness of the PEERS program in community settings. Moreover, high functioning youth with ASD often present with comorbid anxiety. Social skills interventions may increase participants' self-efficacy in social interactions, thereby reducing the anxiety that participants may feel in social interactions, yet only one study (Schohl et al., 2014) has sought to extend the current findings linked to PEERS by examining the program's effects on participants' anxiety.
Objectives: This small-scale pilot study aimed to evaluate the effectiveness of the PEERS program not only on improving social skills but also on reducing anxiety.
Methods: Participants included 5 high functioning adolescents ages 13 to 15 with ASD and their parents. The intervention consisted of 90-minute, weekly parent and teen sessions over the course of 14 weeks. Pre and post measures were completed by the parents and adolescents and included the Social Skills Improvement System (SSiS), the Social Responsiveness Scale (SRS-2), the Test of Adolescent Social Skills Knowledge (TASSK), the Quality of Play Questionnaire (QPQ), and the Screen for Child Anxiety Related Disorders (SCARED). Pre- to post-intervention improvement was examined using paired samples t-tests.
Results: Results from the paired samples t-tests are presented in Table 1. There was significant improvement in adolescents' knowledge of the specific social skills taught during the intervention. Autism symptomatology and internalizing symptoms (measured by the SSiS Internalizing scale) showed a significant decrease from pre- to post-intervention. While the paired-samples t-test failed to reveal a significant decrease in pre- to post- anxiety as measured by the SCARED, SCARED Total scores generally decreased for most participants (Fig. 1). Furthermore, the two participants with clinical levels of anxiety (SCARED Total score > 25) prior to intervention reported non-clinical levels of anxiety at post-test. For the variables of interest, the strength of the effect sizes for the mean change scores on the outcome variables in this study were small to large, and most were comparable to the effect sizes for the mean change scores calculated from the published PEERS efficacy studies (see Table 1).
Conclusions: This independent and community-based small-scale pilot study supports the effectiveness of the PEERS program in community-based care for improving the social functioning of high functioning adolescents with ASD. Although reducing anxiety is not a direct target of the PEERS program, our findings are consistent with the findings of Schohl et al. (2014), which indicate that participation in the PEERS program also leads to reductions in anxiety.

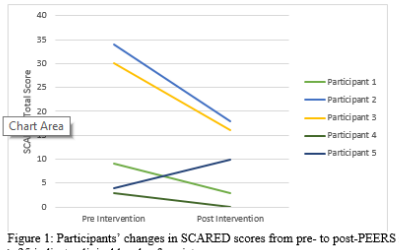


Figure 1: Participants' changes in SCARED scores from pre- to post-PEERS intervention; scores > 25 indicate clinical levels of anxiety.

Mean pre- and post-intervention scores, standard deviations, and effect sizes for outcome variables (N = 5)

	Pretest	Posttest		Cohen's d		
Outcome	Mean (SD)	Mean (SD)	*t*	Current Study	Laugenson et al. (2009)	Schohl et al. (2014)
SSiS Social Skills	77.8 (13.4)	85.2 (20.7)	1.89	0.42	0.89	0.71
SSiS Problem Behaviors	123.8 (14.0)	113.8 (10.3)	-1.77	0.82		0.47
SSiS Communication	11.4 (2.3)	13 (3.5)	1.97	0.54		
SSiS Cooperation	11 (2.3)	12.4 (2.6)	1.36	0.57		
SSiS Assertion	10.2 (7.1)	12 (6.0)	1.23	0.27		
SSiS Responsibility	11(1.9)	11(4.5)	0	0		
SSiS Empathy	9 (2.6)	12 (4.5)	2.12	0.81		
SSiS Engagement	7 (3.9)	10.4 (4.9)	2.92*	0.77		
SSiS Self-Control	11.4 (1.1)	9.8 (3.3)	-0.85	0.65		
SSiS Externalizing	9.8 (4.3)	8.6 (2.1)	-0.53	0.36		
SSiS Bullying	2.2 (1.9)	1.4 (1.7)	-0.75	0.44		
SSiS Hyperactivity/Inattention	10 (5.0)	7.6 (2.6)	-1.31	0.61		
SSiS Internalizing	12 (4.1)	8.2 (4.8)	-2.73*	0.85		
SSiS Autism Spectrum	22.6 (5.1)	16.4 (7.0)	-4.84**	1.01		
SRS-2 Total	79.8 (11.9)	66.2 (12.4)	-5.87**	1.12		1.38
SRS-2 Social Awareness	68.2 (10.5)	64 (6.6)	-1.36	0.48		
SRS-2 Social Cognition	73.2 (11.8)	61.6 (11.5)	-3.02*	0.99		1.09
SRS-2 Social Communication	80.4 (9.4)	64.6 (12.8)	-6.18**	1.41		0.81
SRS-2 Social Motivation	73.8 (12.7)	63.6 (12.3)	-4.05*	0.82		0.72
SRS-2 Restricted Interests/Behaviors	78.2 (16.0)	68.8 (14.3)	-2.39	0.62		2.25
SCARED Total	16 (14.8)	9.4 (7.9)	-1.66	0.56		
TASSK	11.4 (6.3)	20.2 (1.3)	3.64*	1.92	3.21	2.96
QPQ-P: Hosted Get-Togethers	0.5 (1.0)	2.75 (2.2)	2.64	1.31		0.91
QPQ-A: Hosted Get-Togethers	0.4 (0.9)	3 (2.9)	2.15	1.21	1.14	0.69

Note: On the SRS-2, higher scores indicate greater autism symptomatology.
*$p \leq .05$, **$p < .01$

88 **145.088** Examining the Efficacy of Teacher Training Models for Pivotal Response Treatment: A Comparison of in-Person Coaching and Video-Feedback

J. K. Randolph[1], *K. O'Connor*[2] *and S. M. Kanne*[3], *(1)Thompson Center, Columbia, MO, (2)Thompson Center for Autism and Neurodevelopmental Disorders, University of Missouri, Columbia, MO, (3)Thompson Center for Autism & Neurodevelopmental Disorders, Columbia, MO*

Background: Pivotal Response Treatment (PRT) is an evidenced-based practice of naturalistic behavioral principles that enhances social-communication and engagement behaviors of children with autism spectrum disorders (ASD). Traditionally delivered in-person, access to PRT training remains a challenge for regions without immediate access to an expert coach. The use of video-feedback may provide access to high-quality training to meet the needs present in rural areas and regions that traditionally have difficulties with access to care.
Objectives: This presentation will review initial data from a nonequivalent quasi-experimental between-group design on the comparison of an in-person training model and video-feedback training model for teachers and paraprofessionals of children with autism and emergent social-communication skills.
Methods: This study is a nonequivalent quasi-experiment between-group examination of PRT training models comparing an in-person training model group and a video-feedback training model group. Both treatment groups were provided an in-person dyadic initial overview training of PRT principles. The in-person treatment group was then provided weekly 25-minute in-person sessions of independent implementation, coached practice, and feedback, while the video-feedback treatment group was provided weekly typed feedback after reviewing videos of independent implementation. Both treatment groups were considered at fidelity when the teacher achieved at least 80% fidelity of implementation across 3 consecutive feedback sessions. Collection of maintenance and generalization data is on-going. Participants included children with ASD and significant language delays, ages 3-10 years who are eligible for special services in public school settings. Dependent measures include structured behavior observations of teachers' fidelity of implementation and children's social-communication and engagement behaviors.
Results: To date, 40 teacher-child pairs have completed. Data collection is ongoing with an estimated n=76 (41 in-person feedback and 35 video feedback) to be completed by March 2016. Preliminary data has been analyzed for 18 participants (n=9 per training group). There were no statistically significant differences between the two training groups in regard to teachers' baseline ability or children's characteristics. Initial data analysis indicates there is no statistically significant difference between the average number of sessions to obtain fidelity whether the training was conducted in-person or via video feedback. Children in both treatment groups acquired similar levels of increases in social-communication and engagement skills as fidelity of PRT implementation was achieved by teachers. No statistically significant differences were observed between training groups in regard to their maintenance levels of PRT fidelity.
Additional analyses will be conducted to examine the potential relationship between teacher fidelity, child response to intervention and child characteristics in the domains of: cognition, communication, social engagement, toy play, self-stimulatory behavior, avoidant behavior and maladaptive behavior. Analysis regarding social validity for both training models will also be included.
Conclusions: These preliminary data suggests promise in reaching remote sites with high quality training through the use of video feedback. Potential benefits and challenges of video-based feedback training models and areas in need of future research will be discussed.

89 **145.089** Examining the Efficacy of a Family Peer Advocate Model in Reducing Caregiver Stress in Black and Hispanic Caregivers of Children with Autism Spectrum Disorder

E. Fourie[1], *J. M. Jamison*[2], *P. M. Siper*[3], *P. Trelles*[4], *M. Gorenstein*[4], *J. Krata*[5], *E. Holl*[5], *D. Halpern*[4], *A. Kolevzon*[2], *J. D. Buxbaum*[6], *B. Hernandez*[5], *L. Mitchell*[5] *and J. Shaoul*[5], *(1)Seaver Autism Center for Research and Treatment at the Icahn School of Medicine at Mount Sinai, New York, NY, (2)Psychiatry, Seaver Autism Center for Research and Treatment at the Icahn School of Medicine at Mount Sinai, New York, NY, (3)Seaver Autism Center, New York, NY, (4)Icahn School of Medicine at Mount Sinai, New York, NY, (5)YAI, New York, NY, (6)Psychiatry, Seaver Autism Center at Mount Sinai, New York, NY*

Background: Studies show that caregivers of children with developmental disabilities, and especially those with autism spectrum disorder (ASD), experience higher levels of caregiver strain than caregivers of typically developing children. Family peer advocates (FPA; often referred to as parent advocates) have been utilized across child service delivery systems to facilitate engagement in care and minimize the challenges that caregivers face. Peer-delivered advocacy services have been found to reduce isolation, normalize distress, and de-stigmatize child and family needs. Because the majority of research to date has examined caregiver strain in a largely Caucasian sample, there is a need to examine the FPA model within a more ethnically diverse population. Black and Hispanic children are experiencing disproportionately increasing rates of ASD diagnoses and are a frequently underserved population.
Objectives: To examine the impact of focused contact with an FPA on family stress and caregiver strain.
Methods: Sixty-seven children of Black or Hispanic descent, between the ages of 5 and 12, were screened for this study. Thirty-nine children met research eligibility criteria for ASD using the DSM-5, the Autism Diagnostic Observation Schedule (ADOS-2) and the Autism Diagnostic Interview-Revised (ADI-R) and were included in the analysis. This study used a single-blind randomized controlled design, in which caregivers were randomized to a Family Peer Advocate (FPA) group or a community care control group (control group). Caregivers in the FPA group had phone contact with a trained FPA at least twelve times over a six-month time period. Caregivers in the control group received treatment as usual within the community. All caregivers completed the Parenting Stress Index (PSI)—Short Form and Caregiver Strain Questionnaire (CSQ), both validated in autism populations, at three time points (baseline, month 3, and month 6).
Results: There was a significant two-way time x group interaction on the PSI for total score (p<.001), as well as each subscale. The FPA group showed significant improvement in parental stress over time on PSI total scores and all subscales, while the control group did not significantly improve on any PSI subscale. There was also a significant two-way time x group interaction on the CSQ (p<.001), indicating that the FPA group showed significantly less caregiver strain over time as compared to the control group.
Conclusions: Our results demonstrate that caregivers who were paired with an FPA over a six month time period were more likely than the caregivers in the control group to report decreased stress and strain on two separate measures. This evidence supports the efficacy of this FPA model in alleviating stress levels for Black and Hispanic families of children with ASD. Future studies should include larger samples, an active treatment comparator, and a follow-up time point to see if contact with an FPA had sustained effects on parental stress levels.

90 **145.090** Examining the Impact of the PEERS® Social Skills Intervention on Females with ASD

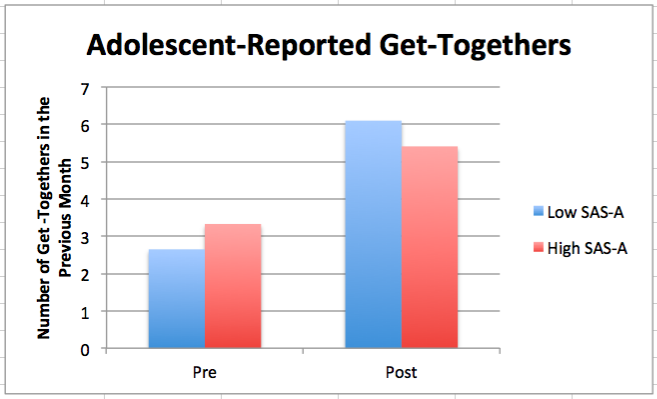
A. McVey[1], *B. Dolan*[1], *A. G. Meyer*[1], *J. S. Karst*[2], *S. Stevens*[3], *K. A. Schohl*[1], *C. Caiozzo*[1], *E. Vogt*[1], *S. Potts*[1] *and A. V. Van Hecke*[1], *(1)Marquette University, Milwaukee, WI, (2)Children's Hospital of Wisconsin, Wauwatosa, WI, (3)University of Minnesota, Minneapolis, MN*

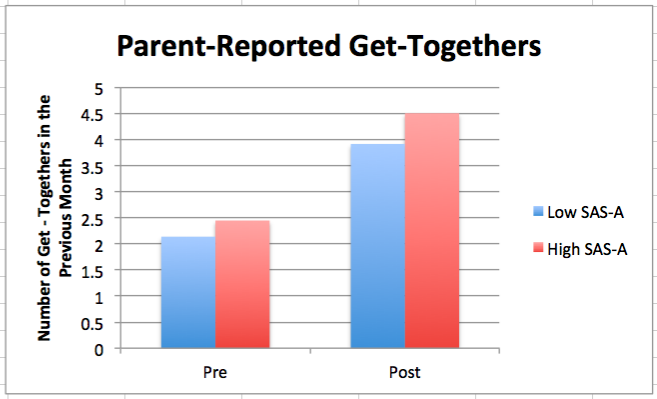
Background: A paucity of research has been conducted to examine the effect of social skills interventions on females with autism spectrum disorder (ASD). Broadly, literature on social skills interventions for this population has focused on males alone or males and females in aggregate (Chan et al., 2009).
Objectives: The primary objectives of this study were to examine if changes in social skills knowledge and social responsiveness among female adolescents and young adults with ASD differed from males who underwent the same social skills intervention.
Methods: One hundred and eleven adolescents (n = 111; 15 female) between the ages of 11 and 16, and 48 young adults (n = 48; 9 female) between the ages of 18 and 28 with ASD participated in this study. Two comparable social skills interventions, specifically the Program for the Education and Enrichment of Relational Skills (PEERS®) for adolescents and PEERS® for Young Adults, were conducted based on age. Both PEERS® interventions focus on improving friendship quality and social skills among young adults with higher-functioning ASD (Laugeson, Frankel, Gantman, Dillon, & Mogil, 2012; Gantman, Kapp, Orenski, & Laugeson, 2012). Participants were high-functioning individuals with ASD, who comprised the Experimental Treatment Group (n = 56 adolescents, n = 23 young adults) and the Waitlist Control Group (n = 55 adolescents, n = 25 young adults). Pre- and post-intervention measures included the *Test of Adolescent Social Skills Knowledge* (Laugeson and Frankel, 2010) for adolescents, the *Test of Young Adult Social Skills Knowledge* (Gantman et al., 2012) for young adults, which are self-report measures, and the *Social Responsiveness Scale* (Constantino et al., 2003), a parent-report measure.
Results: Preliminary results include available data from males and females from the experimental treatment and waitlist control groups; ongoing analyses will include additional participants for both groups. When analyzed by group, males and females do not differ significantly on their improvement within these areas, as measured by the TASSK/TYASSK (F = .748, p = .388) and SRS (F = .494, p = .483). Both groups demonstrate significant improvement on both the TASSK/TYASSK (F = 121.2, p < .01) and SRS (F = 10.8, p < .01) from pre- to post-intervention.
Conclusions: Our results suggest that the PEERS® intervention is as effective for females with ASD as males with the disorder. Research shows that males and females often demonstrate differing presentations of the disorder (Dean, 2013), and females may be thought to be more “socialized” than males (Goldman, 2013; Solomon et al., 2012). Our findings indicate that, despite these differences in presentation, females show similar patterns of improvement in social skills to males. This has important implications for understanding how females with ASD respond to social skills intervention.

91 **145.091** Examining the Relation Between Social Anxiety and Social Engagement Outcomes Among Adolescents with Autism Spectrum Disorder Following the UCLA PEERS® Intervention

A. V. Dahiya[1,2], *E. Veytsman*[3], *R. Ellingsen*[4] *and E. A. Laugeson*[3], *(1)UCLA PEERS Clinic, Los Angeles, CA, (2)UCLA Semel Institute for Neuroscience and Behavior, Los Angeles, CA, (3)Psychiatry and Biobehavioral Sciences, UCLA Semel Institute for Neuroscience and Human Behavior, Los Angeles, CA, (4)University of California Los Angeles, Los Angeles, CA*

Background:
Deficits in social skills, including impaired social-emotional reciprocity, poor nonverbal communicative behaviors used for social interaction, are common hallmarks for those with autism spectrum disorder (ASD) (Otero et al. 2015). As a result, adolescents with ASD often have difficulty understanding their peers and establishing social reciprocity with others (Volkmar 2011). These social skill deficits, in combination with elevated physiological arousal, can lead to the development of social anxiety, which is significantly associated with increased social avoidance (Bellini 2006). Previous research on the UCLA Program for the Education and Enrichment of Relational Skills (PEERS®), an evidence-based social skills intervention for adolescents with ASD, demonstrates increases in social engagement following treatment (Laugeson et al. 2012). While research suggests that social anxiety is associated with social avoidance, the extent to which social anxiety is related to frequency of social engagement in adolescents with ASD following PEERS®has yet to be examined.
Objectives:
The present study examines the relationship between social anxiety at baseline and social engagement in adolescents with ASD following the completion of a 14-week parent-assisted social skills intervention.
Methods:
One hundred adolescents (males=84; females=16) with ASD ranging from 11-18 years of age (M=14.02; SD=1.81) and their parents participated in the study. Adolescents and their parents attended an evidence-based, parent-assisted social skills intervention, PEERS®. They attended 90-minute group treatment sessions over a period of 14-weeks to learn guidelines of social behavior related to the development and maintenance of social relationships. In order to assess social anxiety and social avoidance at baseline, adolescents and parents completed the Social Anxiety Scale (SAS; La Greca, 1999) pre-intervention. To assess change in frequency of social engagement, adolescents and parents completed the Quality of Socialization Questionnaire (QSQ; Frankel & Mintz 2008) which assesses the frequency of hosted and invited get-togethers with peers in the previous month at baseline and post-intervention. Pearson correlations were calculated to examine the relationship between social anxiety at baseline and change in social engagement from pre- to post-treatment.
Results:
Results reveal that 49 percent of participants (n=49) reported social anxiety in the clinical range at baseline, as measured by the SAS total score (≥50). While social engagement increased over the course of treatment for the full sample, as measured by adolescent and parent-reported hosted (p<.001) and invited (p<.05) get-togethers on the QSQ, overall social anxiety at baseline on the SAS was not associated with improvement in social engagement following intervention. However, higher scores on the SAS subscale of General Social Avoidance and Distress were significantly correlated with an increase in parent-reported hosted get-togethers (p<.05) following treatment.
Conclusions: Although there was no significant relationship between adolescents' overall social anxiety at baseline and change in social engagement following PEERS®, there was a significant treatment effect for adolescent and parent-reported hosted and invited get-togethers. Greater general social avoidance and distress prior to treatment may be related to better treatment outcomes through improved social engagement. These findings suggest that social anxiety may not influence treatment outcomes related to social engagement for adolescents following the PEERS® intervention.





92 **145.092** Examining the Role of Social-Communication in Explaining Treatment Gains for Adolescents with ASD Following the PEERS® Social Skills Intervention

C. C. Bolton[1], *E. Veytsman*[1], *Y. Bolourian*[2] *and E. A. Laugeson*[1], *(1)Psychiatry and Biobehavioral Sciences, UCLA Semel Institute for Neuroscience and Human Behavior, Los Angeles, CA, (2)University of California - Riverside, Riverside, CA*

Background: Social communication skills, including social interaction, social competence, speech style and language pragmatics, are strongly associated with long-term outcomes for youth with autism spectrum disorder (ASD) (Howlin et al. 2004; Ingersoll, 2011). Deficits in social communication are often the earliest identifiable indicators of ASD, and several early intervention models target this domain (Ingersoll, 2013; Kasari, 2015). However, research has not previously examined the influence of social communication on the development of social skills in adolescence.
Objectives: This study examines the role of social communication in predicting social skills ratings following the implementation of the UCLA Program for the Education and Enrichment of Relational Skills (PEERS®), an evidence-based social skills curriculum in both school-based and outpatient mental health settings.
Methods: Participants included 186 adolescents with ASD referred for social skills training in outpatient and school settings. Among the outpatient sample, participants included 80 adolescents (males=68; females=12) 11-18 years of age (*M*=13.8, *SD*=2.25) School based participants included students (*n* = 80 males; *n* = 26 females) in 6th – 12thgrades attending a non-public school for students with ASD. Adolescents, parents, and teachers completed pre and post-test measures, including the Social Skills Improvement System (SSIS; Gresham & Elliot, 2008) and the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005). Following the completion of baseline measures, adolescents participated in a 14-week manualized teacher-facilitated intervention then completed post-test measures. A linear regression analysis was conducted to examine the relation between baseline measures of social-communication (SRS) and the SSIS post-treatment.
Results: Data analysis shows that social communication (SRS) at baseline is significant in explaining the variance in social skill acquisition (SSIS) following intervention. Adolescent social communication scores (SRS) both significantly predicted b = -.61, t(70) = -6.92 *p*<.000 and explained a significant proportion of variance in social skills as rated by parents R^2 = .41, *F*(1,70) = 47.92, *p*£.000 in the school-based sample. In the same sample, social communication both significantly predicted b = -.82, t(104) = -6.89, *p*<.000 and explained a significant proportion of variance in social skills R^2 = .32, *F*(1,104) = 47.34, *p*£.000 as rated by teachers following intervention. Social communication also significantly predicted social skills scores as rated by parents in the clinic sample, b = -.37, t(80) = -3.51, *p*<.001 and also explained a significant proportion of the variance R^2 = .14, *F*(1,78) = 12.32, *p*<001. However, social communication was better able to account for outcomes in the school-based sample than the clinic sample.
Conclusions: Data analysis revealed that social communication significantly predicted social skills scores and also explained a significant proportion of variance in social skills scores following intervention in both school-based and outpatient settings. This research demonstrates the importance of social communication in the acquisition of social skills following intervention and should be further evaluated. These results may provide additional support for early intervention targeting the domain of social communication to support social skills intervention and boost treatment outcomes for social skills acquisition.

Table 1

Summary of Simple Regression Analyses of Social Communication on the SRS in Predicting Post-Treatment Results on the SSIS

	School-based Participants				Outpatient Participants			
Outcome Variables	*B*	*SE B*	*β*	R^2	*B*	*SE B*	*β*	R^2
SSIS-Parent *(N = 70)*	-.61	.09	-.64***	.41	--	--	--	--
SSIS-Teacher *(N = 104)*	-.82	.12	-.56***	.32	--	--	--	--
SSIS-Parent *(N = 80)*	--	--	--	--	-.37	.12	-3.51	.14

Note. p<.05, **p<.01, ***p<.001; Listwise deletion was used in the regressions resulting in small decreases for the sample sizes across the measures included in this analysis. SSIS = Social Skills Improvement System (Gresham & Elliot, 2008); SRS = Social Responsiveness Scale (Constantino & Gruber, 2005).

93 **145.093** Examining the Treatment Efficacy of the PEERS in Japan: Towards Improving Social Skills of Children with Autism Spectrum Disorder

T. Yamada[1], *Y. Miura*[2] *and M. Oi*[3], *(1)Osaka University, Osaka, Japan, (2)Kanazawa University, Kanazawa, Japan, (3)Kanazawa University, United Graduate School of Child Dev., Kanazawa, Japan*

Background: Children with autism spectrum disorder (ASD) are characterized by social communication and interpersonal disabilities, repetitive behaviors, and restricted interests. These characteristics affect important aspects of their lives, like making friends and maintaining good relationships. As a result, these individuals experience difficulties in social adjustments, especially because adolescents focus more on themselves and social relationship with others.
Objectives: The need for social skill training programs to support social adjustment is increasing, but many of these programs are targeted at young children. PEERS (Program for the Education and Enrichment of Relational Skills) is parent-assisted social skills training organized as a group session. PEERS utilizes the principles of cognitive behavior therapy to improve social functioning for teens with ASD. For both teens and parents, each session (once a week) lasts 90 min and continues for 14 weeks. Although PEERS has been shown to improve the social skills of adolescents with ASD in North America, cross-cultural trials have only just started. The objective of

this research was thus to examine the treatment efficacy of PEERS in Japan for improving social skills.
Methods: The PEERS treatment manual was translated into Japanese, and the curriculum contents necessary for cultural adjustments were modified with the permission of the developer of PEERS. Modifications included examples of peer groups, places where teens can find new friends, humorous material that could be understood in terms of Japanese culture, and activities teens enjoy together. Participants included 28 teens between 6th and 9th grade diagnosed with ASD and a verbal intelligence score >70 on WISC-IV. Eligible teens were assigned to a treatment group (TG) or a delayed control group (CG). Primary outcome measures included questionnaires quantifying social ability and communication skills and behaviors related to ASD. Secondary outcome measures included depressive symptoms and behavioral problems. All participants including their mothers and teachers completed these outcome measures three (pre-treatment, post-treatment, follow-up) or four times (a baseline assessment was added for the delayed control group).
Results: Comparison of pre- and post-intervention questionnaires indicated that teens receiving PEERS showed improved social skill knowledge according to the Test of Adolescent Social Skills Knowledge (TASSK) and social skills in the area of social communication. The measures parents reported suggested that teens showed decreased ASD symptoms relating social responsiveness by the end of the 14-week intervention, according to the Social Responsiveness Scale. Also, in the social skills area of Vineland II, interpersonal relationship, play/leisure time, and coping skills scores differed significantly before and after treatment. According to Vineland II, scores in the area of maladaptive behaviors also decreased. Besides these scores, high levels of parent, child, and staff satisfaction were reported, in addition to high attendance rates.
Conclusions: Teens receiving the PEERS treatment showed increased social skills knowledge and improved interpersonal relationship skills. The PEERS intervention appears effective for teens with ASD in Japan after small cultural adjustments.

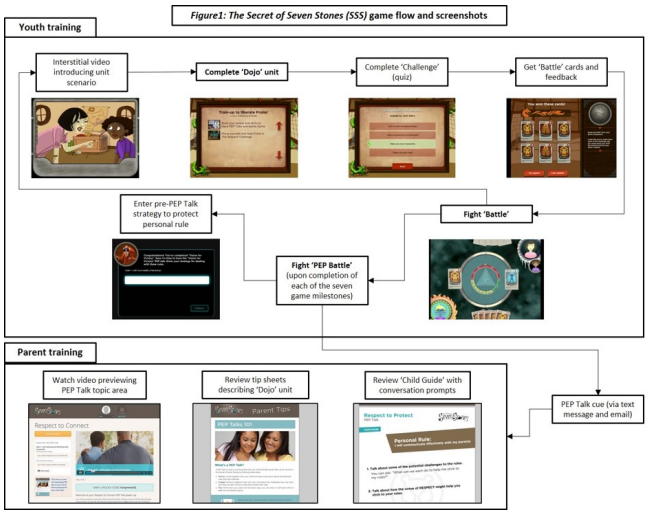
94 **145.094** Exploring the Feasibility of an Innovative Inter-Generational Computer Game for Sexual Health Education in Youth with Autism Spectrum Disorder and Other Neurodevelopmental Disabilities: A Mixed-Method Case Study

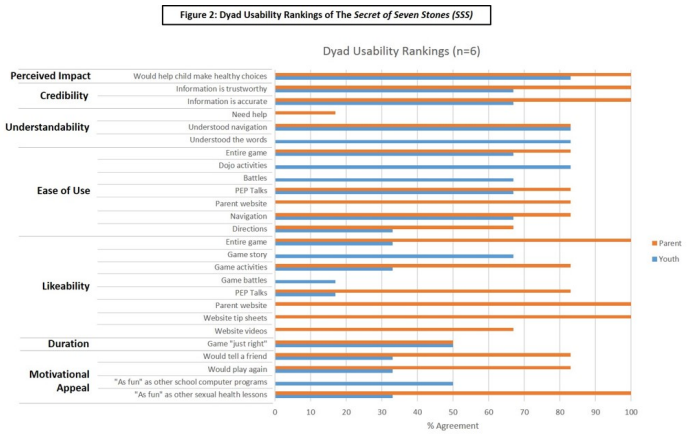
P. Chaudhary[1], *S. M. Dube*[2], *L. N. Ceglio*[2], *D. A. Pearson*[3], *H. Y. Song*[4], *A. M. Spencer*[5], *C. Markham*[2], *M. Peskin*[6], *D. Santa Maria*[7], *J. McLaughlin*[8], *J. M. Wilkerson*[5], *R. Addy*[5] *and R. Shegog*[2], *(1)Health Promotion and Behavioral Sciences, University of Texas School of Public Health, Houston, TX, (2)Center for Health Promotion and Prevention Research, University of Texas School of Public Health, Houston, TX, (3)Psychiatry & Behavioral Sciences, University of Texas Medical School at Houston, Houston, TX, (4)University of Texas School of BioInformatics, Houston, TX, (5)University of Texas School of Public Health, Houston, TX, (6)Center for Health Promotion and Prevention Research, Houston, TX, (7)Nursing Systems, University of Texas School of Nursing, Houston, TX, (8)Radiant Creative Group, LLC, Houston, TX*

Background: Although youth with Autism Spectrum Disorder (ASD) and other Neurodevelopmental Disabilities (NDD) experience deficits in communication and social skills, the onset of puberty and sexual development is not equally delayed. Yet, their sexual and relationship needs are often neglected. Moreover, barriers to effective peer and parental communication experienced by these individuals, limit the educational impact of traditional sexual health interventions. As the individuals with ASD/NDD are often visual learners, technology based serious intergenerational games represent a salient strategy to fulfil this gap. Hence, this study aims to explore the potential of an innovative, home-based intergenerational computer game, *The Secret of Seven Stones (SSS)*,to promote sexual education and parent-youth communication in this population.
Objectives:

1. To explore the usability of SSS for sexual health education in ASD/NDD youth.
2. To explore the feasibility of using SSS in the home setting.
3. To explore the feasibility of SSS to promote parent-youth communication.

Methods: This study is a mixed methods multiple case study of six parent-youth dyads (11-14 years) in a large metropolitan area in Texas. This study is a subset of a larger, randomized control efficacy trial, to evaluate the 18-level home-based SSS computer game and parent website (Figure 1). A stepped development framework, Intervention Mapping, informed the theoretical and empirical foundation of SSS. Parent and youth self-reported data were collected via Questionnaire Development System (QDS™) survey assessing pre-sexual and sexual behaviors, intentions towards sex and parent-youth communication about sex, and gaming behaviors at baseline and 3-month follow-up. Game progress and time-on-task data were collected from the SSS data base. Usability rating surveys and in-depth semi-structured exit interviews were conducted with parents and youth at 3-month follow-up.
Results: The youth sample (n=6) was male (50%), Caucasian, of mean age 13.04 ± 1.49 years, and with diagnosis of Autism Spectrum Disorder (ASD) (33%) and/or had other Neurodevelopmental Disabilities (NDD) (67%). Youth were sexually inexperienced (100%) but engaged in some pre-sexual behavior (50%) and intending to have sex in next year (33%). Some had ever talked to their parent about sexual topics such as birth control (50%), condoms (33%), HIV/AIDS (50%), and STIs (33%). Parents were female, 46.1 ± 2.43 years old, and Caucasian. By 3-month follow-up most youth had either completed SSS (57%) or completed over half of SSS (14%). Youth and parents rated the game as captivating (67-100%), easy to use (67-83%), understandable (50-100%), credible (67-100%), and helpful for making future healthy choices (83-100%) (Figure 2). SSS rated lower on uniqueness, attractiveness, and motivational appeal (33-67%). Youth reported length and technical difficulties as barriers to game play. Qualitative findings highlighted higher acceptability of the game and website among parent-youth dyads, particularly for ease of navigation, website resources, and parental involvement. Parents indicated benefits of SSS in mediating parent-youth communication regarding sexual health.
Conclusions: Our exploratory analysis indicated that an intergenerational game offers an acceptable and feasible strategy to address the socio-sexual needs of youth with ASD/NDD. These exploratory results suggest that further research with larger samples is indicated.





95 **145.095** Family Support Interventions for Young Adults with ASD

L. E. Smith[1], *J. S. Greenberg*[1] *and M. R. Mailick*[2], *(1)University of Wisconsin-Madison, Madison, WI, (2)Waisman Center, University of Wisconsin-Madison, Madison, WI*

Background: Autism spectrum disorders (ASDs) are developmental disabilities that affect approximately 1 in 68 children in the US. Although there is evidence of some abatement of autism symptoms and behavior problems over time (Esbensen et al., 2008; Seltzer et al., 2004; Shattuck et al., 2007; Woodman et al., 2015), ASD is a chronic disability which presents multiple challenges for individuals and their families at each stage of the life course. Further, improvements in behavioral functioning slow down following high school exit (Taylor & Seltzer, 2010) and there is a significant loss of services for individuals with ASD upon exiting the school system (Howlin et al., 2005). Given the dearth of *formal* services for young adults with ASD, it may be all the more imperative to offer interventions that increase a family's capacity to find and create *informal* supports and activities. Thus, interventions that help adults with ASD and their family members learn new skills and enhance the effectiveness of their advocacy are necessary. However, currently there are no empirically-based interventions designed for the family (Schultz et al., 2011; Taylor, Dove et al., 2012). To address this gap we have developed a multi-family psychoeducation model, *Working Together*, designed for disengaged young adults with ASD and their families. The *Working Together* model adapts an approach commonly used in research and practice with individuals with varying mental health conditions (e.g., schizophrenia, bipolar disorder) and applies it to families of individuals with ASD. This model is unique with its emphasis on supporting the family system to increase engagement of individuals with ASD in employment and educational activities.
Objectives: We will report on the process of development of a family-centered intervention model, including data from focus groups and a feasibility pilot.

Methods:
A comprehensive review of the literature was conducted to develop intervention content. Three focus groups were completed to gain feedback on the proposed model from key stakeholders including young adults with ASD, family members, and service providers. The model and curriculum content were further refined based on this input. Finally, a feasibility pilot study was conducted with 4 families. Feedback from the feasibility pilot was used to create the final model to be evaluated in a 12-month randomized control trial.
Results:
Based on a comprehensive literature review, a model was developed that involved 8 weekly group sessions, 2 individual family sessions, and a method for ongoing resources and referrals. Focus group data confirmed the need for family-centered supports for individuals with ASD during adulthood and suggested that the curriculum should also include an emphasis on coping strategies and safety. Results from the feasibility pilot suggested a need for the model to include additional opportunities for individualized support and a high family interest in ongoing booster sessions.
Conclusions: The finalized *Working Together* model is currently being evaluated in randomized control trial with 54 families.

96 **145.096** Functional Score Changes in a Group of Patients with Autistic Spectrum Disorders (ASD) with Interdisciplinary Treatment

***S. L. Baetti**, Pediatrics Mental Health, Hospital Italiano de Buenos Aires, Buenos Aires, Argentina*

Background:
In the Italian Hospital of Buenos Aires there is an interdisciplinary team (ASD team) that provides treatment to patients with developmental disorder. It works with clinicians, music therapists, psychologists, speech therapists, occupational therapists, physical therapists and pedagogical professionals The team uses the IDEA (Inventory autistic spectrum) as a qualitative tool for evaluating the severity and responses to treatment of the patients. The IDEA is a behavioral observation scale that evaluates 12 aspects of development. It also estimates the severity of autistic characteristics, and provides targets for intervention, and gives tips for monitoring the evolution. No studies have been found in Argentina to validate this tool in monitoring patients with ASD. Population: pediatric patients between 2 and 17 years old, diagnosed with ASD who have at least 2 assessments of IDEA in a minimum interval of time of 6 months between each other. (Inclusion criteria)
Objectives: To make a description about the progress and give a score to this progress of patients who are in treatment with an ASD Team.
Methods: It is a retrospective and descriptive study. We include all patients founded in the ASD team treatment between 2008 and 2014. The description of the patients' evolution was done through the analysis of the IDEA score. Items evaluated were: age, sex, result of the first IDEA scores (IDEA 1) and the second IDEA score measured after 6 months of evolution (IDEA 2). Also an IDEA partial score of each dimension evaluated. The IDEA scale measures disorder or dysfunction. Each dimension of IDEA presents a range of 8 points, from 0 to 8. 8 correspond to a maximum level of involvement in each dimension and 0 as skill without disorder. The total score is the result of the sum of the 12 dimensions (range 0 to 96). The score decline implies improvement in patients' functionality. The cutoff points below 50 are considered with good prognosis and below 25, with high functionality.
Results: From a total of 50 patients, 39 met the inclusion criteria. 85% were male and the median age was 5 years (IQR 4-6). After two evaluations made with IDEA The results shows a score decrease in 31 patients (79%).
Conclusions: A statistic significant difference is observed between the initial IDEA (median 36 RIC 28-50) and final IDEA (median 31, IQR 25-40).An statistical analysis is done in two groups of patients: better prognosis n: 29 (With initial scores: less than 50) and worse prognosis n: 10 (with initial scores : higher than 50) and it is observed that the difference between scores of groups 1 and 2 was statistically significant test result. (p less than 0.005)

97 **145.097** Identification of Sensitive Outcome Measures of Functional Skills

***E. Ridgway**, Rose F. Kennedy Children's Evaluation and Rehab Center (CERC) at Montefiore, Albert Einstein College of Medicine, Bronx, NY*

Background: Clinicians and researchers have an obligation to evaluate the effectiveness of the interventions they provide. Patient-reported outcome measures are an important component of outcome measurement and effectiveness research and these have gained increase recognition and status with the advent of the Patient-Centered Outcomes Research Institute and initiative (PCORI, 2014); however, they may be subject to response bias. In regard to occupational therapy using sensory integration, a frequently requested and utilized intervention for children with ASD, there is now pilot data showing that this intervention improves the child's participation in functional activities and that the children show increased independence in activities of daily living and socialization via parent-report measures. To further explore the evidence for this intervention and others that target these outcomes, valid, reliable, performance-based outcome measures are needed to supplement parent-rated measures.
Objectives:
The objective of this presentation is to present the findings from a study funded to identify psychometrically sound, suitable, performance-based outcome instruments to measure functional skills and socialization in children with ASD that could be used in future studies.
Methods:
This study used mixed methods to identify performance-based measures of daily living skills and socialization, test their feasibility when applied to children with ASD ages 6-9, and explore their discriminant validity. Systematic review of the literature was completed to identify currently available performance-based assessments of activities of daily living and socialization for children with ASD. Inclusion criteria included that the measure 1) evaluates daily living skills and/or socialization; 2) is appropriate for use with children with ASD ages 6-9 years of age; 3) is performance-based; 4) and is norm referenced for use with ASD. A panel of experts in Autism and/or outcome measurement rated measures using a quality indicator scale that rates psychometric rigor, sensitivity, and appropriateness for ASD. Top-rated measures were then subject to a modified Delphi Process. In the next stage of this research a feasibility trial of the top-rated measures with 20 ethnically diverse children with ASD will be conducted at an urban clinic.
Results: Eight performance-based outcome measures of Activities of Daily Living or Socialization were identified from the literature review. Quality indicator ratings showed that the top-rated instruments that met most criteria were The Assessment of Motor and Process Skills (AMPS – Fisher & Jones, 2012) and the Evaluation of Social Interaction (ESI - Fisher and Griwold, 2010). These assessments will be used in the feasibility trial that will be conducted during January and February 2016.
Conclusions:
The AMPS is a performance-based, standardized assessment of daily living skills that has strong reliability and validity as an outcome measure and has norms for use with ASD. The ESI is a reliable, valid, performance-based assessment that shows strong promise as an outcome measure of social interaction for children with ASD. Discriminative validity and feasibility data will also be presented. This final phase will determine their discriminative validity and utility for use as an outcome measure in a comparative effectiveness trial.

98 **145.098** Implementation Outcomes of a Coach-Based Transition Program for Students with ASD in Urban Educational Settings

***C. Aponte**[1], K. Zanibbi[1], T. Smith[2], J. J. Locke[3] and T. AIR-B Network[4], (1)University of Rochester Medical Center, Rochester, NY, (2)Division of Neurodevelopmental and Behavioral Pediatrics, University of Rochester Medical Center, Rochester, NY, (3)University of Washington Autism Center, Seattle, WA, (4)AIR-B Network, Los Angeles, CA*

Background: There is a gap between behavioral interventions developed within a university-based laboratory and the settings within which the interventions are likely to be executed. Barriers in school systems may impede the consistency and quality with which an evidence-based intervention can be executed. Engaging in community-partnered research to develop interventions addresses the needs and goals of the key community stakeholders with consideration to barriers that are present in the community setting. In addition to the content and outcomes of treatments, an important aspect of this type of intervention development is the evaluation of the degree to which implementers in community settings accept the intervention, and the degree to which they adhere to the components of the intervention.
Objectives: We aimed to: a) evaluate the fidelity with which teachers executed the components of the Schedules, Tools, and Activities for Transitions (STAT) program; and b) determine the acceptability and feasibility of the STAT program in under-resourced public schools.
Methods:
Along with our community partners, we developed the STAT program to address transition-related problem behavior commonly observed in students with ASD in self-contained classrooms. STAT was implemented in three urban school districts in Rochester NY, Los Angeles, and Philadelphia. Participating classrooms were randomized to immediate treatment (n = 73) or waitlist control (n = 77). Blind observers collected teacher Fidelity at baseline, exit, and 3-month follow-up. Teachers who received immediate treatment also completed the Implementation Climate Survey, and a Buy-in Measure at post-treatment and follow-up.
For the Buy-In Measure, teachers rated the degree to which they agreed with 21statements about the importance of the intervention on a Likert scale (1 = strongly agree; 7 = strongly disagree).
For Implementation Climate, teachers used a Likert scale (1 = not true; 5 = true) on 17 items designed to assess program quality, school support, and global perceptions of climate.
Results:
Although preliminary results indicated that, at baseline, teachers assigned to either group were already implementing STAT components with high (88%) fidelity, there was a slight post-treatment advantage for the experimental condition. Teachers in immediate treatment improved their average fidelity score to 93% (exit), and 97% (follow-up); fidelity scores for teachers in waitlist control maintained at 89% (post) and 87% (follow-up). Teachers' average buy-in scores were 1.73 at exit and 1.71 at follow-up, indicating high levels of intervention acceptability. For the Implementation Climate Questionnaire, teachers indicated that the STAT program was important and a priority in their schools.
Conclusions: Given the time and resource barriers in many urban schools, implementing evidence-based interventions poses significant challenges. Preliminary results from

this study suggest that, although many teachers already implement components of behavioral interventions, their performance can be enhanced through additional intervention. These effects were maintained over time, with participants continuing to adhere to the transition program. Additionally, teachers found the intervention valuable, and generally reported feeling supported by supervisors and classroom teams. This information supports the ongoing use of coach-based, packaged behavioral intervention and suggests that this model can be sustainable in public school settings.

99 **145.099** Implementation of Interventions in Under-Resourced Public Schools: Teacher and Administrator Perceptions of Programs for Students with ASD

E. Reisinger Blanch[1], *J. J. Locke*[2], *D. S. Mandell*[3] *and T. AIR-B Network*[4], *(1)University of Pennsylvania, Philadelphia, PA, (2)University of Washington Autism Center, Seattle, WA, (3)University of Pennsylvania School of Medicine, Philadelphia, PA, (4)AIR-B Network, Los Angeles, CA*

Background: Moving evidence-based practice from research clinics into under-resourced community settings requires considerable effort and resources. ASD interventions rarely are developed with the skills and resources of end user in mind, and rarely take into account the organizational context that will support (or not support) intervention implementation. Working in partnership with community practitioners and the organizations in which they work could enhance the effectiveness and sustainability of autism interventions (Locke, Kratz, Reisinger, & Mandell, 2014).
Objectives: To determine, after one year of implementation without outside support, if administrators and implementers (teachers & aides) feelings change regarding a) whether the intervention sustained, b) how school staff feelings change regarding the acceptability of the intervention and c) whether staff identify new barriers to implementation.
Methods:
The programs of interest are the Schedules, Tools, and Activities for Transitions (STAT) program, a behaviorally based classroom intervention for children with ASD, and the Remaking Recess (RR) intervention, a social engagement intervention for included children with ASD. The STAT and RR interventions were implemented in three urban school districts in Philadelphia, Rochester, and Los Angeles. Including all sites, 78 teachers and 157 students were enrolled in STAT and 106 teachers/aides and 95 students were enrolled in RR. Participating schools were randomized to immediate treatment or a waitlist control. Study staff collected program fidelity by rating staff adherence to program components throughout treatment. Measures of implementation climate and buy-in were collected at post-treatment and follow-up.
One year after support ended, 7 school administrators and 35 program implementers (classroom aides or teachers) were interviewed using a semi-structured interview protocol. One interview protocol was developed per intervention. Separate forms were developed to target the experience of implementers or supervisors. Each protocol contained between 14- 23 questions and each interview was audio recorded and later transcribed for analysis. Each interview averaged between 30- 60 minutes and was conducted at the participating school or by phone.
For the buy-in measure, teachers rated the degree to which they agreed with statements about the importance of the intervention on a Likert scale (1 = strongly agree; 7 = strongly disagree). For implementation climate, teachers used a Likert scale (1 = not true; 5 = true) on items designed to assess program quality, school support, and global perceptions of climate. Qualitative data are analyzed using NVivo. Codebook was created through consensus across members of the study team. Quantitative analysis included descriptive stats of measures of buy-in and implementation climate.
Results: Data analyses are ongoing. Teachers report that intervention fidelity and buy-in continue to be relatively high after one year. Qualitative responses suggest ongoing and new barriers that emerge in the course of the year.
Conclusions: Study results suggest that targeted modular interventions for children with ASD can be implemented and sustained in under resourced public schools. The data also suggest that barriers to implementation must be taken into account when looking to improve community practice.

100 **145.100** Improvement in Reciprocal Conversation Skills and Maladaptive Behaviors in Young Adults with ASD

C. A. Paisley[1], *A. Dutton*[1], *D. R. Oosting*[1], *R. Doggett*[2], *R. Tillman*[3] *and P. E. Ventola*[1], *(1)Yale Child Study Center, Yale School of Medicine, New Haven, CT, (2)Department of Child and Adolescent Psychiatry, The Child Study Center at NYU Langone Medical Center, New York, NY, (3)University of Maryland, College Park, MD*

Background: Many young adults with ASD are under- or unemployed and struggle with social relationships. Despite these difficulties and the significant challenges faced during the transition into adulthood, there are few evidence-based treatment options for young adults with ASD. Pivotal Response Treatment (PRT) is a naturalistic behavioral treatment that focuses on increasing skills in pivotal areas. PRT has been adapted for use in adolescents with a focus on self-monitoring (Doggett et al., 2013), but no study, to date, has used this model with young adults.
Objectives: Using a multiple baseline design, we sought to determine if a four-month treatment based on principles of PRT could improve reciprocal conversation skills and decrease maladaptive behaviors (e.g. skin picking, odd vocalizations) in young adults with ASD.
Methods: Three young adults between the ages of 18 and 21 years (Mean IQ = 106.67, S.D. = 11.93) participated in four months of treatment targeting reciprocal conversation skills and maladaptive behaviors. The sessions were 90 minutes, twice a week. The treatment followed principles of PRT, adapted for use with young adults (Doggett et al., 2013). Using a multiple baseline design, participants were randomized into a baseline condition (between 3 and 7 probes spanning 6 to 14 weeks). Specific targets included number of conversational turns and maladaptive behaviors. During the treatment phase, data on targeted behaviors was collected every two weeks. Additionally, to provide a measure of day-to-day functioning following treatment, the parents of the participants completed a Vineland Adaptive Behavior Scale-Second Edition (Vineland-II) before and after treatment.
Results: Following the start of intervention, participants rapidly increased their reciprocal conversation skills and the frequency of their maladaptive behaviors decreased. These improvements were maintained over time. Furthermore, the participants made notable gains in adaptive communication and social skills based on parent report. Specifically, participants made the equivalent of at least one year of gains in expressive and receptive communication skills and two years of gains in interpersonal relationship skills over the course of the 4-month intervention.
Conclusions: Young adults with ASD are a vastly underserved group with few options for evidence-based treatment and often limited access to care. Young adults can, though, dramatically benefit from behavioral treatment targeting reciprocal conversation skills and maladaptive behaviors following a short-term behavioral treatment based on principles of PRT adapted for young adults. Improvements are evidenced in the context of a clinical setting but also within their daily lives.

101 **145.101** Improving Autism Outcome Measures: An Integrated Home and Clinic Protocol with Novel Technologies

R. M. Jones[1], *C. Carberry*[1], *A. Hamo*[1], *H. Rao*[2], *U. Gupta*[2], *A. Albin*[2], *R. Pawar*[2], *I. Kleckner*[3], *O. O. Wilder-Smith*[4], *M. S. Goodwin*[4], *M. Clements*[2] *and C. Lord*[1], *(1)Weill Cornell Medical College, White Plains, NY, (2)Georgia Institute of Technology, Atlanta, GA, (3)University of Rochester Medical Center, Rochester, NY, (4)Northeastern University, Boston, MA*

Background: Sensitive, standardized, reliable outcomes for clinical trials attempting to change behavior in children and adults with Autism Spectrum Disorder (ASD) have been limited to date. Previous clinical trials often rely on a single behavior to quantify change (Findling et al., 2014) or determine change in one context (i.e. solely parent report or assessments only in the clinic) or use a measure with limited capability for replication (Bolte & Diehl, 2013), thus reducing the scope of the research. Outcomes in clinical trials that combine multiple domains to measure behavior and use multiple contexts to collect data offer the greatest success of capturing change in individuals with ASD.
Objectives: 1) To identify and evaluate social communication and physiological arousal measures that may be sensitive to change; 2) To determine an integrated clinic, smartphone/online and home protocol that is cost effective, unobtrusive and maximizes participant retention. No treatment intervention is part of this study, as the aim is to test the scalability of measurements that track behavior over time.
Methods: 16 children and adolescents with ASD (5-17 years of age), with at least 2-3 word phrases, completed a 1-week protocol. Data collection is ongoing in 20 children and adolescents in an 8-week protocol measuring behavior in both the clinic and the home. In both settings, electrodermal activity (EDA) data were collected via wrist sensors (Q sensors) and natural language data were recorded via LENA digital language processors. Caregivers completed momentary questions about their child's behavior on a smartphone.
Results: All families completed the protocol, including answering daily smartphone questionnaires and using the LENA devices and Q sensors in their home. As we predicted, there is substantial variation across children in behavior across contexts in amount of language produced and occurrence of problem behaviors. Novel voice detection procedures correctly identified the child's voice at approximately 90% accuracy as well as affective vocalizations (laughing), providing an automated alternative for time intensive transcriptions and replacing current LENA supported algorithms not suited for children above 5 years of age. As predicted, EDA data from the clinic visit demonstrates increased physiological arousal during mildly frustrating tasks in 63% of the participants. Home EDA data are considerably more variable and changes in EDA do not consistently correspond to increased screaming detected from the LENA recordings, confirming established findings that EDA is complicated to interpret without additional contextual information. Parent momentary reporting demonstrates some consistency with standardized questionnaires (negative mood PANAS) and events identified on the LENA, but are also variable across time and parents.
Conclusions: Caregivers of children and adolescents with autism are motivated to use novel technologies in a daily home and clinic protocol to measure their child's behavior. Children's behavior does vary across contexts and there is variability in parental styles in reporting their child's behavior. The research provides an important foundation to inform future outcome protocols that measure caregiver-reported, behavioral, and physiological changes in children undergoing medical and behavioral interventions.

102 **145.102** Improving Impressions of Social Competence: Results from an RCT of the START Social Skills Program for Adolescents with ASD

J. Ko, *A. Miller, S. Solomon and T. Vernon, University of California, Santa Barbara, Santa Barbara, CA*

Background: There has been a growing interest in targeting the social vulnerabilities of adolescents with ASD. Outcomes of these efforts have primarily consisted of a variety of parent and self-report measures (Miller, Vernon, Wu, & Russo, 2014). These measures, while serving as useful indicators of improvement, have notable limitations related to social desirability and other reporting biases (McMahon et al., 2013; Moskowitz, 2006). There is a need to determine if purported social improvements endorsed on parent and self-rating scales are also reflected in impression ratings of social competence made by one's peers. Blind peer ratings of social competence (made after watching conversation probes of each participant) present a novel method for understanding if everyday observers are able to discern noticeable improvements in social aptitude.
Objectives: The current study measures social skills improvement using social impression ratings following participation in a randomized controlled trial (RCT) of a social intervention for adolescents with ASD.
Methods: Participants consisted of 35 adolescents with ASD (ages 12-17; 31% female) who were enrolled in an RCT of the Social Tools And Rules for Teens (START) program. Adolescents were randomized to either a treatment group or a waitlist control group. The treatment group completed the 20-week curriculum; each 2-hour session consisted of an individual therapeutic check-in, unstructured socialization with typically developing high school and undergraduate facilitators, structured social activity, discussion of a weekly social topic, and a check-out session with the parents. Two 5-minute video conversations with two unfamiliar similar-aged students (one male and one female who were unaffiliated with the study) were recorded in naturalistic settings at both intake and 20-week time points. Undergraduates unfamiliar with the aims of the project or the disability status of the individuals (total n=131) were recruited to watch these videos and provide social ratings along numerous dimensions, including social skills, comfort, awkwardness, perceived quality of existing relationships. The same undergraduate completed a rating for a given participant at both intake and 20-week time points. Videos were counterbalanced among raters, so a rater was not always viewing videos in the same order. Every participant video was rated five times by different raters to ensure consistency of ratings.
Results: A series of dependent t-tests were performed for both the treatment and waitlist control groups. Pre- and post-intervention ratings demonstrated meaningful change in the treatment group (p=.001), but no significant improvement was noted in the control group. While participants varied in their total change scores over the course of their START program enrollment, 97% of the immediate treatment participants experienced improvement in overall ratings from their pre-intervention to post-intervention (20-week) time point.
Conclusions: Overall, observer ratings of social impressions provide favorable evidence regarding the social validity and significance of the START program. This method offers a real world indication of improved social competence that is not adequately captured by survey measures alone. The START model appears to positively impact the use of pivotal conversation strategies, which in turn creates more favorable social impression ratings among one's peers.

103 **145.103** Kids Love Musicals!: Social and Emotional Learning Outcomes in Special Education Environments

O. Zyga[1], *H. Meeker*[2], *J. Kirk*[2] *and S. W. Russ*[1], *(1)Psychological Sciences, Case Western Reserve University, CLEVELAND, OH, (2)The Musical Theater Project, Cleveland, OH*

Background: Children with autism spectrum disorders (ASD) show deficits in ability to process and express appropriate emotions and interact in social situations. Previous research has shown that the use of theater and music in the context of therapy have been beneficial in producing gains in socio-emotional functioning for individuals with ASD (Corbett et al., 2015). In the present study, the researchers examined the effects of the *Kids Love Musicals!* (KLM) residency program on children who either had a diagnosis of ASD or some type of learning or developmental disorder. The KLM program employs musical theater as a way to teach children skills relating to expressing emotions, engaging in cooperative learning, and imagination development through performing the "Wizard of OZ." Within this study, students engaged in a 4-week intervention, delivered once a week for 30 minute sessions.
Objectives: The main aim of this study was to provide empirical support for the KLM musical theater program. The authors wanted to better understand if students were able to make gains in socio-emotional skill development during the program. A secondary aim of the project was to understand if the intervention program could be tailored to various ages and ability levels.
Methods: The KLM residency program was delivered to 5 schools across the greater Cleveland area to children ranging from 1^{st}-12^{th} grade. The intervention sessions were video recorded and student's ability on variables of Eye Contact, Turn Taking, Sharing & Cooperative Learning, Engagement, Social Awareness & Self-Confidence, Symbolic Flexibility, and Emotional Understanding were coded by trained research assistants and interrater reliability was establish. Each variable was assigned a score on a likert scale based on a coding scheme adapted from previous research. Qualitative notes were also taken of student functioning. In total, 52 students were coded for the variables listed above. All students had previous diagnoses of either ASD or other developmental or learning disorders or delays.
Results: Results showed that across all schools and ability levels, students made gains in Eye Contact ($p < .001$, $t = -4.156$), Turn taking & Cooperative Learning ($p < .001$, $t = -5.020$), Engagement ($p < .001$, $t = -5.054$), Social Awareness & Self-Confidence ($p = .003$, $t = -3.188$), Symbolic Flexibility ($p = .001$, $t = -3.609$), and Emotional Understanding ($p = .009$, $t = -2.710$) from session one to the end of the residency program. Further analysis also showed a significant main effect of school setting on variables of Turn taking & Cooperative learning, Social Awareness & Self-Confidence, and Emotional understanding, suggesting that ability level may play a role in gains possible during the intervention.
Conclusions: Overall, these findings suggest that engagement in a musical theater program does support the building of socio-emotional skills in children with ASD and other developmental disorders. Next steps include independent pre and post-assessments of measures of interest and delayed follow-up to understand the stability of these gains and their generalizability outside of the musical theater intervention.

104 **145.104** Let's Move Your Body! Physical Activity to Treat Anxiety in Adults with Autism Spectrum Disorders

N. Brondino[1], *L. Fusar-Poli*[1], *E. Codrons*[2], *L. Correale*[2], *C. Panisi*[1], *P. Politi*[1] *and M. Vandoni*[2], *(1)Department of Brain and Behavioral Sciences, University of Pavia, Pavia, Italy, (2)Laboratory of Adapted Motor Activity, Department of Public Health, Experimental and Forensic Medicine, University of Pavia, Pavia, Italy*

Background: Anxiety is a common comorbidity in autism spectrum disorders (ASD). Particularly, during adolescence and adulthood, people with ASD may experience a worsening in anxiety symptoms as a result of entering more complex social situations and of becoming more aware of their interpersonal difficulties. To date, pharmacological treatments (such as antidepressants) have showed preliminary efficacy, but data are still sparse and medications can be burdened by side effects. On the other hand, cognitive-behavioral therapy seems promising, but, presently, there are no empirically supported treatments for anxiety in ASD. It is well-known that physical activity is associated with a wide range of health benefits. In particular, aerobic exercise seems to exert an anxiolytic effect on healthy controls as well as on patients with generalized anxiety disorder or panic disorder.
Objectives: the present randomized study aimed to evaluate the effect of physical activity on anxiety levels in a sample of adults with ASD
Methods: Our study planned to recruit 20 participants who were randomly assigned to treatment or waiting list. Treatment consisted in one and a half hour per week of aerobic physical workout. Exercise sessions lasted for three months and subjects were required to attend at least 10 sessions. Heart rate and activity counts have been recorded during treatment sessions. Anxiety was evaluated using self-report questionnaires (i.e. Zung Self-Rating Anxiety Scale) as well as clinician-rated instruments (i.e. Hamilton Anxiety Scale). Additionally, cortisol diurnal variation was measured before and after treatment.
Results: all patients in the treatment arm experienced improvement in symptoms and there was a significant decrease in self-report anxiety ($p<0.05$).
Conclusions: physical activity may represent an alternative effective treatment for anxiety in this patient group.

105 **145.105** Measuring the Generalization of Skills in Response to Treatment in Minimally Verbal Children with ASD

R. Grzadzinski[1], *C. Dick*[2], *N. Hong*[3] *and C. Lord*[4], *(1)Center for Autism and the Developing Brain, New York, NY, (2)Center for Autism and the Developing Brain, White Plains, NY, (3)Psychiatry, Center for Autism and the Developing Brain, White Plains, NY, (4)Weill Cornell Medical College, White Plains, NY*

Background: Measuring the generalization of skill acquisition and treatment response is crucial for the maintenance of learned behavior. For children with Autism Spectrum Disorder (ASD), generalizing specific skills across contexts can be particularly challenging (Klinger & Dawson, 2001). Given this challenge, researchers and clinicians often rely on a clinical judgment of improvement because there are few standard measures that capture changes seen outside of the intervention setting. Using the Brief Observation of Social Communication Change (BOSCC) may be one way to assess generalization of skills acquired during the clinician-child interactions to a broader context, such as parent-child interactions.
Objectives: This study aims to explore the relationship between clinicians' ratings of behavioral improvements observed during treatment of a child with ASD and blind raters' observations of behavioral improvements during play sessions with a parent. The BOSCC, a novel, objective measure, is used to assess whether children with ASD are generalizing improvements made in intervention to interactions with a parent.
Methods: Data from 150 families participating in adaptive interventions for minimally verbal children with ASD will be presented. Children have a diagnosis of ASD, are between 4.5 and 8.5 years old, and used fewer than 20 spontaneous words during a 20-minute naturalistic language sample. The BOSCC is applied to 10-minute parent-child semi-structured play videos gathered across three time points (baseline, mid-intervention, post-intervention). The BOSCC is then coded by researchers blind to video time point and intervention status. Decreases in BOSCC scores, indicating symptom improvement, from baseline to mid-intervention and from mid- to post-intervention are compared in responders and non-responders defined by Clinical Global Impression ratings of Improvement (CGI-I) from the same time points. Analyses compare children who are able to generalize to other contexts (defined by decreases of >1 SD on the BOSCC) to the remaining children. Analyses also explore whether cognitive level, adaptive skills or ASD symptoms as measured by the Vineland Adaptive Behavior Scales (VABS) and the Autism Diagnostic Observation Schedule (ADOS) predict decreases on the BOSCC.
Results: Analyses of a subset of data show that approximately 60% of children are defined by CGI-I as responders to treatment and 25% decrease >1 SD on the BOSCC.

These results suggest that although children are able to make improvements within the context of treatment with an individual interventionist, these changes may not be seen in other contexts, such as interactions with parents. No significant differences in cognitive level, VABS domains, or ADOS symptom severity were found between children who were defined as responders on the CGI-I and children who decrease >1 SD on the BOSCC. Additional analyses within a larger dataset will aid in elucidating these results. Conclusions: It is important for researchers to recognize the potential limitations of specific skill acquisition seen in singular research contexts. This may be particularly relevant for minimally verbal children with ASD. Consistent with other work, our findings suggest that generalization is a particular challenge for children with ASD and needs to remain a focus of intervention research.

106 **145.106** Neural Validation of Sensory Subtypes in Autism Spectrum Disorder

ABSTRACT WITHDRAWN

Background:
Distinct sensory subtypes in ASD have been identified (Ausderau et al, 2014; Lane et al, 2014). Sensory subtypes have been posited as a means of identifying clinically meaningful subgroups within ASD. In one subtype model, two dimensions of sensory function have been proposed to underlie sensory subtypes – sensory reactivity and multisensory integration (MSI; Lane et al, 2014). This model is based on parent-report of sensory symptoms. Further elucidation and validation of dimensions underlying sensory subtypes in ASD is needed using neural and behavioural measures. In doing so, hypotheses relating to the mechanisms of sensory disturbance in ASD will be further refined and a new framework for the application of customised therapies will be developed.
Objectives:
In this paper, findings from preliminary studies will be discussed to address the question: do children with ASD classified using Lane et al's sensory subtype model differ in their neural response profiles to sensory paradigms assessing sensory reactivity and multisensory integration?
Methods:
Findings from four preliminary studies investigating the neural correlates of Lane et al's sensory subtype model will be summarised. The studies include the following: 2 x event-related potential studies assessing brain activation response to an auditory oddball paradigm (total ASD n=60), 1 x event-related potential study assessing steady state EEG response to an auditory-tactile multisensory integration paradigm (ASD n=10), and 1 x cardiac study assessing heart rate variability in response to a novel sensory challenge protocol (n=42). All studies included children with ASD aged between 3-15 years. ASD participants were classified initially using Lane et al's sensory subtype model based on parent ratings of sensory function on the Short Sensory Profile (McIntosh et al, 1999). This model classifies children into one of four sensory subtypes: Reactive High/MSI Low, Reactive High/MSI High, Reactive Low/MSI High, Reactive Low/MSI Low. Analyses were then conducted to examine differences between groups on each of the neural measures and for each of the sensory paradigms.
Results:
Preliminary findings indicate that brain activation potentials of children with ASD classified as Reactive High display a sustained positive shift in later (post-400ms) processing of novel auditory stimuli. Children with ASD classified as Reactive Low display no differences in brain activation potentials in the later processing of novel and standard auditory stimuli. Further, children with ASD classified as Reactive High, show increased cardiac sympathetic activity (as measured by pre-ejection period) throughout a novel sensory challenge protocol. Data from the event-related potential study examining response to a MSI protocol is currently being collected.
Conclusions:
On balance, the findings of these preliminary studies provide support for the hypothesis that neural profiles in response to sensory protocols assessing sensory reactivity vary on the basis of sensory subtype classification. Further study is required to confirm these differences particularly in response to sensory protocols assessing MSI. Neural validation of the sensory subtype model in ASD provides an important link between the 'bench and the ball pit' by establishing a framework for both mechanism discovery and clinical practice.

107 **145.107** Occupational Therapy Using Sensory Integration to Improve Functional Skills in Children with Autism Spectrum Disorders – Results of a Randomized Trial

***R. Schaaf**, Thomas Jefferson University, Phildalphia, PA*

Background: Sensory features (hyper and hypo-reactivity to sensation and unusual sensory interests) are a common occurrence in children with Autism Spectrum Disorders (ASD) and are now included in the DSM5 as one manifestation of the 'restricted, repetitive patterns of behavior, interests, or activities' diagnostic criteria. Given the recognition of sensory difficulties as a key feature of the autism diagnosis, interventions that address these sensory features may be an important component of a comprehensive treatment program for ASD. Families indicate that sensory features are among the most debilitating symptoms limiting participation in daily activities for them and their children. Currently, interventions that target these sensory features are controversial and have been criticized due to lack of evidence. This session reports on a randomized control trial aimed at investigating an occupational therapy intervention that targets these sensory features and measures its outcomes.
Objectives: The objective of this session is to report on findings of a randomized trial of occupational therapy using sensory integration to improve adaptive behaviors and functional skills in children with ASD.
Methods: Thirty-two children with a confirmed diagnosis of ASD between the ages of 6-9, matched on mental age and autism severity were randomized to either occupational therapy intervention or usual care for 30 sessions over a 10 week period. The intervention followed a manualized protocol based on the principles of sensory integration that was tested in a previous feasibility study. A random selection of 15% of the sessions was tested for fidelity using a validated measure. Pre-post scores on Goal Attainment Scales (primary outcome measure) and the Pediatric Evaluation of Disabilities Inventory (PEDI - secondary outcome measure - Haley, et al, 2011) – a measure of the child's participation in activities of daily living and socialization were compared.
Results: Children in the intervention arm scored significantly higher on Goal Attainment Scales ($p = 0.003$, $d = 1.2$) and showed improvements in independence in self-care ($p= 0.008$ $d = 0.9$) and socialization ($p = 0.04$, $d = 0.7$) on the PEDI in comparison to the control group. Average fidelity rating was 82 on a scale of 100 indicating treatment adherence.
Conclusions: The study provides preliminary data that occupational therapy using sensory integration may be useful for children with ASD whose sensory features are impacting participation activities of daily living and socialization. The study shows rigor in its use of a manualized protocol, measurement of treatment fidelity, and matching of groups on IQ and severity of ASD. Groups were comparable at pre-treatment on a number of measures and at post treatment on "other services" utilized. This pilot work set the stage for a comparative effectiveness trial, funded by NIH, that will compare this intervention to behavioral intervention and further elucidate its potential effectiveness and utility.

108 **145.108** Omega 3 Fatty Acids and Children with Autism: Consumption and Supplementation in Community Settings

***S. L. Hyman**[1], B. L. Schmidt[2], A. Koehler[3], E. McDonnell[4], E. A. Macklin[5] and P. A. A. Stewart[6], (1)Pediatrics, University of Rochester School of Medicine, Rochester, NY, (2)University of Rochester, Spencerport, NY, (3)Medicine, University of Buffalo, Buffalo, NY, (4)Massachusetts General Hospital Biostatistics Center, Boston, MA, (5)Biostatistics Center, Massachusetts General Hospital, Boston, MA, (6)Pediatrics, University of Rochester, Rochester, NY*

Background: Omega 3 fatty acids, eicosapentaenoic acid and docosahexaenoic acid (DHA+EPA), are commonly used nutritional supplements for children with autism spectrum disorders (ASD). It is unknown whether children with ASD who may be selective eaters meet their daily requirement for DHA+EPA from naturally occurring and/or fortified food sources, whether adequate or excessive amounts are provided through supplementation, or whether nutritional supplementation in community use reflects doses used in treatment trials examining symptoms including inattention and repetitive behaviors.
Objectives: To quantify reported intake of DHA+EPA from both diet and nutritional supplementation in a community sample of children with ASD and examine the demographic and behavioral characteristics of children who are/are not given DHA+EPA supplementation.
Methods: Autism Speaks Autism Treatment Network participants from 5 sites (n=286, 14% female) recorded 3 day diet records for food and supplements. Total intake was quantified using Nutrient Data for System © for EPA+ DHA and supplement manufacturer data. Analyses included T tests or Wilcoxon rank sum tests for continuous data and Fisher's exact tests for categorical data.
Results: Only 1 of the 286 participants (a nonsupplement user) met the daily requirement for DHA+EPA from diet alone. The major dietary sources of omega 3 intake in most children were eggs and chicken. Supplement users (n=43) were similar in age and IQ to nonsupplement users, but more likely to be female (p=0.029) with college educated mothers (p=0.02). The groups did not differ in DHA+EPA consumption from diet alone. Of supplement users, 7% met and 65% exceeded dietary requirements. Supplement users had lower scores on the Child Behavior Checklist for externalizing behaviors (mean 56.6 + 9.6 vs 60.6 + 11.2; p=0.038), on the Children's Sleep Habits Questionnaire (42.3 + 9 vs 45.4 + 9.3; p=0.028) and on the Repetitive Behavior Scale-Revised (26.2 + 17.3 vs 37.5 + 22.2; p<0.001). Doses used in clinical trials, greater than 1000 mg/d, were consumed by 28% of participants given supplements.
Conclusions: Children with ASD are deficit in their intake of Omega 3 Fatty acids from diet alone. Supplementation in the community is typically at a lower dose than the doses evaluated in clinical trials. This unadjusted, cross sectional data cannot determine whether the association of increased DHA+EPA intake with less externalizing behavior, better sleep scores and less repetitive behaviors is related to supplementation or whether children with lower scores are more likely to receive supplements. Future clinical trials might evaluate the impact of a range of doses.
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Speaks Autism Treatment Network serving as the Autism Intervention Research Network on Physical Health. Support was also from CTSI UL1 TR000042.

109 **145.109** On Target for Life: An Executive Function Intervention for Adolescents with Autism Spectrum Disorders

S. Seese[1], *K. M. Dudley*[2], *L. Kenworthy*[3], *L. G. Anthony*[4], *M. A. Werner*[5], *L. Cannon*[5], *L. Mohamed*[6], *C. E. Pugliese*[4] *and J. F. Strang*[7], *(1)Center for Autism Spectrum Disorders, Children's National Medical Center, Rockville, MD, (2)Children's National Medical Center, Center for Autism Spectrum Disorders, Ellicott City, MD, (3)Children's Research Institute, Children's National Medical Center, Rockville, MD, (4)Children's National Medical Center, Rockville, MD, (5)Ivymount School, Rockville, MD, (6)Yale Child Study Center, New Haven, CT, (7)Children's National Medical Center, Silver Spring, MD*

Background:
Executive function (EF) skills are critical for young people as they progress through school. Students with ASD fall further behind their peers in EF skills as they enter middle school. Unstuck and On Target, an elementary school-based cognitive behavioral intervention, has been shown to improve EF skills, behavior and social skills in elementary school students. On Target for Life is an upward age extension of UOT, adapted to address the specific needs of adolescents in middle school. OTL was developed through a participatory process framework targeting EF skills in teens with ASD without intellectual disability. OTL uses scripts, engaging visuals, and in vivo experiments and games in order to apply and generalize EF skills to real world scenarios in the lives of teens with ASD.
Objectives:
1) Evaluate the change in executive functioning skills in adolescents before and after participation in On Target for Life.
Methods:
17 adolescents received the On Target for Life intervention delivered by school staff over the course of 22 sessions. OTL focuses on teaching adolescents how to set goals, be flexible, and learn how to plan and get what they want/need. Our pilot test of the study compared changes from pre-to-post intervention. Data was collected through standardized and experimental child measures. Observations from previous studies of UOT have indicated that with increased flexibility skills, children are more efficient at problem solving. As a measure of efficiency and problem solving, we calculated average problem-solving time on a visual problem solving task (Wechsler Block Design) items pre-to-post intervention. The Challenge Task (CT), an in-vivo observational method, challenges adolescents to be flexible and make organized plans. The CT yields scores on planning and flexibility. The DKEFS Verbal Fluency measure provides a standardized difference score between category and switching fluency, measuring the "cost" in efficiency that demands for flexibility/switching.
Results:
Adolescents who completed the On Target for Life intervention demonstrated significant improvement (faster time) solving Block Design items from pre to post intervention ($t(16)=2.71$, $p=.016$). Total Block Design t-scores did not improve, $t(16)=-.33$, $p=.744$. Students showed improved flexibility skills ($t(16)=3.49$, $p=.003$) and planning skills ($t(16)=4.89$, $p=.001$) on the Challenge Task from pre to post intervention. Scores on the DKEFS switch cost measure did not show improvement, $t(16)=-.71$, $p=.490$.
Conclusions:
These results suggest that most adolescents show some improvement after participation in On Target for Life. However, these results should be interpreted cautiously, as the current study represents only a small number of adolescents without a comparison group. A larger randomized controlled trial (N=36) of adolescents with ASD in main stream schools is currently underway to further evaluate the effectiveness of this intervention. This RCT also includes a companion parent manual and training program to be used in conjunction with the school-based intervention.

110 **145.110** Parent and Child Characteristics of Families Participating in Parent-Mediated Social Skills Interventions for Autism

R. Shalev[1], *M. L. Gordillo*[1], *K. Sullivan*[1], *B. Chen*[1], *R. Doggett*[1], *E. A. Laugeson*[2], *S. Kuriakose*[1] *and A. Di Martino*[1], *(1)Department of Child and Adolescent Psychiatry, The Child Study Center at NYU Langone Medical Center, New York, NY, (2)Psychiatry and Biobehavioral Sciences, UCLA Semel Institute for Neuroscience and Human Behavior, Los Angeles, CA*

Background: A growing literature indicates that parent-mediated social skills interventions, such as *Children's Friendship Training* (CFT; Frankel & Myatt, 2003) and the *Program for the Education and Enrichment of Relational Skills* (PEERS®; Laugeson & Frankel, 2010) increase social competence and friendships among children with Autism Spectrum Disorder (ASD). In CFT and PEERS®, parents are trained to become active agents who provide social coaching to their children during and after treatment. Despite their central role in these interventions, parents' direct impact on their children's treatment outcomes remains unclear. Currently, at the NYU Child Study Center, we are conducting a pilot study on outcomes for children who complete CFT and PEERS® that involves measuring parent and child characteristics before and after intervention.
Objectives: In preparation for future investigations of treatment outcome, the current study examined baseline measures of parents' functioning and their relationships with baseline measures of their children.
Methods: To date, we have enrolled 11 children with ASD (8 males; 7-14 year-old; $M=11.9\pm2.3$) and 11 parents (one per child; 8 mothers, 41-55 year-old; $M=49.2\pm4.7$) undergoing CFT or PEERS®. Parents completed the Social Responsiveness Scale, Second Edition Parent Report (SRS-2-P) and the Child Behavior Checklist (CBCL), which were used to index children's autism severity and their internalizing and externalizing symptoms of psychopathology. Parents' autistic traits were assessed using the SRS-2 Adult Form (SRS-2-A), completed by their spouses. Each parent completed the Positive Affect Index (PAI), which assesses the quality of the parent-child relationship. Bivariate correlational analyses measured the relationships between the above parent and child measures.
Results: Parents did not show clinically significant elevations in autistic traits, as indicated by SRS-2-A Total T-scores (range: 38 – 59, $M=48.7\pm8.5$). Total scores on the PAI varied (range: 30 – 57, M 43.1±8.8). Notably, both measures indicated a wide range of functioning. Parents' scores on the SRS-2-A were positively correlated with their children's scores on the SRS-2-P ($r=.83$, $p=.04$). High relationship quality measured by the PAI was negatively correlated with scores of the Total Externalizing Problems scale ($r=-.85$, $p=.008$) and related subscales (e.g., Rule-Breaking Behavior; $r=-.85$, $p=.007$) on the CBCL. There was not a significant relationship between PAI and SRS-2-P scores.
Conclusions: The association between parents' and children's autistic traits indicates that the poorer children's social skills, the lower those in parents. In addition, higher quality relationships between parents and children were associated with fewer externalizing behavioral challenges in children. Given the centrality of parent-child interactions in CFT and PEERS®, it is important to understand whether parent characteristics or parent-child relationship quality affects treatment outcomes for children who participate in parent-mediated interventions. In future investigations, we will seek to clarify these relationships and to determine whether they serve as mechanisms of therapeutic change.

111 **145.111** Performance-Based Social Skills Intervention Improves Explicit Social Cognition in Children with Autism Spectrum Disorder

E. Kang*, A. Burns, L. Allegue and M. D. Lerner, Stony Brook University, Stony Brook, NY*

Background:
Individuals with autism spectrum disorder (ASD) exhibit deficits in theory of mind (ToM; Frith & Frith, 2003), emotion recognition (Lozier *et al.,* 2014), and social knowledge (Attwood, 2007), all of which are social cognition processes fundamental to social interactions (Kennedy & Adolphs, 2012). These involve explicit understanding of the correct information about a social situation and overt indication of such understanding is required for applying these skills to everyday life. Therefore, most social skills interventions (SSI) for ASD utilize didactic approach to directly and explicitly teach these target skills (e.g., Goldstein & McGinnis, 1997; Laugeson et al., 2009). These SSI have shown positive yet limited effects in social cognitive skills (White et al., 2007).
There is a growing empirical support for performance-based approaches in SSI that provide enriched, *in vivo* social learning and practice opportunities *without* explicit instruction (Lerner et al., 2011; Lerner & White, 2015). It is unknown, however, which (if any) explicit social cognitive processes may be affected directly by these interventions – that is, can explicit social understanding be learned via non-didactic, performance-based approaches?
Objectives:
This study examined the impact of a non-didactic SSI on social cognition processes not explicitly taught. We hypothesized that participating in a performance-based intervention would yield improvements in ToM, emotion recognition, and social knowledge.
Methods:
Children with ASD ($N=13$; $M_{age}=13.25$, $SD_{age}=2.14$) participated in a 6-week social performance-based summer intervention program. They completed measures of explicit social knowledge (Maedgen & Carlson, 2000) and facial emotion identification (Nowicki, 2004). Their parent completed a measure of explicit ToM (Hutchins, Prelock, & Bonazinga, 2012), assessing early, basic, advanced, and total ToM.
Results:
Bivariate correlations revealed negative association between early ToM and deficits in social knowledge, driven by the subscale indicating a tendency to believe passive responses to social situations as correct, and positive association between the subscale indicating a tendency to believe aggressive responses to social situations as correct and errors in emotion recognition (Table 1). Paired samples *t*-tests between pretest and posttest scores evinced improvement in total ToM ($t=2.920$, $p=.014$), which was driven by gains in advanced ToM ($t=2.695$, $p=.021$); improvement in explicit social knowledge regarding assertive behavior ($t=-2.185$, $p=.051$); and improvement in emotion recognition ($t=-2.462$, $p=.015$), which was driven by subtler faces ($t=-3.154$, $p<.001$).
Conclusions:
As measured by parent-reported, self-reported, and behavioral indexes, we found relations among social knowledge, ToM, and facial emotion recognition in children with ASD. More importantly, we found that participating in an SSI that does *not* teach via didactic instruction led to improvements in ToM, identification of emotion in faces, and

explicit social knowledge. Our results suggest that even with minimal didactic instruction or instrumental reinforcement of target skills (e.g., explicit training and feedback on face-emotion recognition or ToM activities), these social cognitive skills can be *implicitly* and *experientially* acquired in children with ASD via engaging in targeted activities. This provides additional support for intact implicit learning in ASD (Foti et al., 2014), and for social performance-based approaches to SSI that provide an enriched environment for children with ASD.

Table 1
Correlations among baseline scores of social knowledge, theory of mind, and emotion recognition

		CABS			ToMI				DANVA Faces
		Total			Total				Total Errors
			Aggressive	Passive		Early	Basic	Advanced	
CABS	Total	1	.46	.83**	-.37	-.57*	-.14	-.38	.17
	Aggressive		1	-.11	.13	.12	.17	.07	.67**
	Passive			1	-.49	-72**	-.26	-.48	-.23
ToMI	Total				1	.69**	.89**	.96**	.23
	Early					1	.45	.61*	.33
	Basic						1	.75**	.16
	Advanced							1	.20
DANVA Faces	Total Errors								1

*$p < .05$. **$p < .01$. CABS = modified Children's Assertiveness Behavior Scale, assessing social knowledge. ToMI = Theory of Mind Inventory, assessing theory of mind. DANVA = Diagnostic Analysis of Nonverbal Accuracy-2, assessing errors in reading nonverbal emotion cues in faces.

Notes. CABS and DANVA have negative direction of scale (higher scores mean greater deficits). ToMI has positive direction of scale (higher scores mean greater ability).

112 **145.112** Pivotal Response Treatment: An Examination of Educators' Maintenance and Generalization of Fidelity of Implementation

J. K. Randolph[1], *J. P. Stichter*[2] *and C. Schmidt*[3], *(1)Thompson Center for Autism and Neurodevelopmental Disorders, University of Missouri, Columbia, MO, (2)Department of Special Education, University of Missouri, Columbia, MO, (3)School of Human Services, University of Cincinnati, Cincinnati, OH*

Background: Pivotal Response Treatment (PRT) is an evidenced-based practice of naturalistic behavioral principles. The increase in social communication and engagement behaviors of children with autism as a result of the intervention is well documented. Most research demonstrates the benefits of PRT as a parent-based intervention, with emergent support for the use of PRT as a school-based intervention. Little is understood about the maintenance and generalization of PRT fidelity.
Objectives: This presentation will review data from a concurrent multiple-baseline design across four educator-student dyads on educators' fidelity of implementation and students' social-communication and engagement across educational contexts once initial fidelity of implementation has been achieved.
Methods: A concurrent multiple-baseline design across four educator-student dyads was employed in order to examine educators' maintenance and generalization of PRT across educational contexts and the subsequent impact on students' social-communication and engagement. Initial training on PRT occurred with each dyad separately over 12, thirty-minute sessions and consisted of modeling, coached practice, and performance feedback during play-based interactions (considered the primary training context). Then, during the two-month follow-up phase the educators' rates of fidelity were probed weekly to determine if they were maintaining adequate treatment fidelity and generalizing the use of PRT to untrained secondary and tertiary educational contexts.
Results: Visual inspection of the data indicates that three of the four educators who were trained to implement PRT were able to maintain the fidelity of implementation in the primary context in which they were trained during the follow-up phase. All four of the educators increased their percentages of implementation of the core behaviors of PRT across contexts during follow-up when compared to their natural rates of these behaviors at baseline. Additionally, one of the four educators was able to consistently generalize PRT with fidelity to an untrained context. Overall, increases in the level of fidelity in which the educators implemented PRT appear to have had an impact on the increased mean rates of the students' social-communication and engagement behaviors. It should also be noted that students' social-communication and engagement behavioral increases were observed in the untrained secondary and tertiary contexts.
Conclusions: These data indicate the potential for some educators to maintain the use of PRT with fidelity without additional consultative support after training has ended, but the results also indicate a need to consider other potential variables to increase the likelihood of treatment maintenance by all educators. Discussion includes the need to better understand the long-term impact on students who are supported by educators using PRT across contexts with fidelity versus the initial positive benefit that is achieved when educators initially reach fidelity. The need for more research on educator characteristics that may predict the need for follow-up consultation to maintain and generalize treatment fidelity is also discussed.

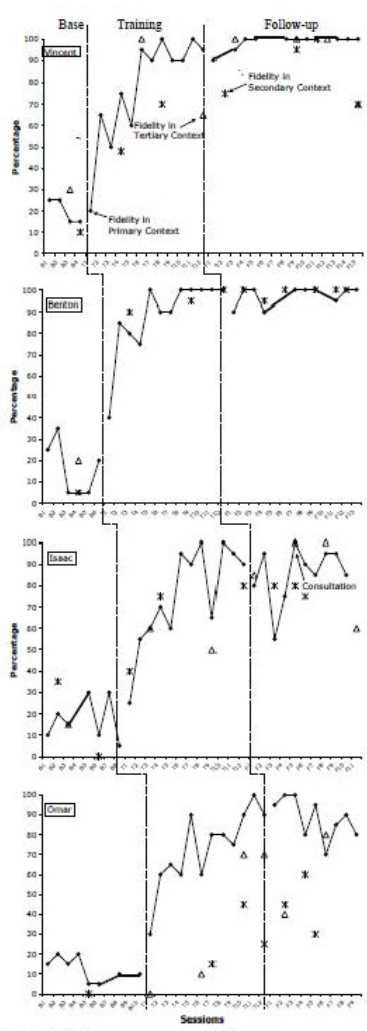


Figure 1. Practitioners' fidelity of PRT across contexts and phases.

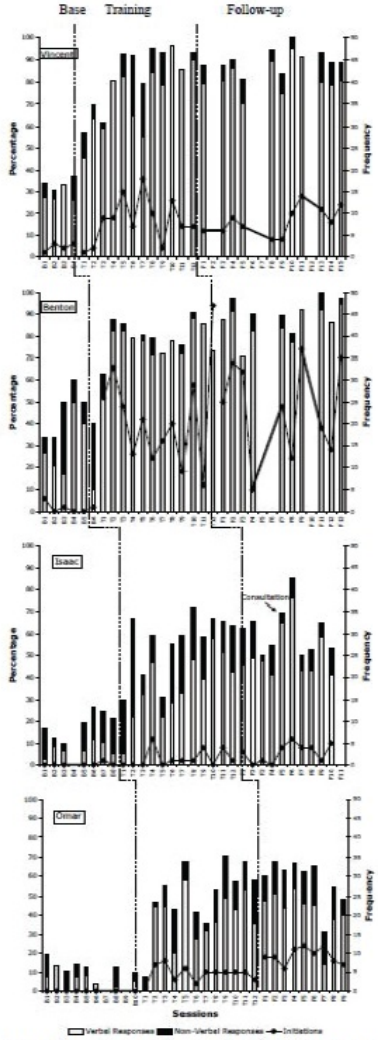


Figure 2. Students' percentages of responses and frequencies of initiations across phases.

113 **145.113** Preliminary Effectiveness of the Autism Life Care Model (ALCM) in Improving Comorbid Internalizing and Externalizing Symptoms in Adolescents with ASD

M. Murray[1], *A. Pearl*[2], *A. Heintzelman*[3], *A. Layton*[1] *and Z. Soulliard*[1], *(1)Penn State Hershey, Hershey, PA, (2)Penn State Milton S. Hershey Medical Center, Penn State College of Medicine, Hummesltown, PA, (3)Penn State College of Medicine, Hershey, PA*

Background: Successful transitions for individuals with ASD to adulthood are critically dependent upon the collaboration across care networks, as well as the inclusion of the individual in decision making. This has been difficult to accomplish for adolescents with ASD who have been poorly served through isolated treatment silos leading to inefficient use of resources and confusion about treatment needs. A PA Statewide Needs Assessment found that close to half of all caregivers of adolescents reported an unmet need for transition services, as well as related unwanted outcomes (e.g., inpatient hospitalization) as they age. The existing system promotes disjointed and narrowly focused care which leads to poor outcomes for adults with ASD. Frustration about this lack of synchrony and patient-centeredness led to the development of the Autism Life Care Model (ALCM) which targets transition-aged youth with ASD. This model provides a consistent, frequent assessment of strengths and needs, patient-centeredness in the establishment and monitoring of treatment goals, as well as collaboration and reinforcement of interventions across disciplines and environments.
Objectives: This study sought to examine the effectiveness of the ALCM pilot program at six months following enrollment in the program. Given the short duration of follow-up, it was expected that individuals enrolled in the program would demonstrate improvements in co-morbid internalizing and externalizing symptoms as a result of increase coordination of care related to treatment goals.
Methods: Twenty-one families participated in the ALCM pilot along with one ALCM Coordinator. Sessions were conducted in an outpatient psychiatry clinic specializing in treating individuals with ASD. Out of the 21 clients (M = 15.90; SD = 2.90) enrolled in ALCM, eight individuals and their parents completed the Child Behavior Checklist (CBCL), the Youth Self Report (YSR), and the Intolerance of Uncertainty Scale(IUS)/Intolerance of Uncertainty Scale for Children (IUSC) at an initial intake session, as well as at a six month follow-up session.
Results: Repeated-measures ANOVAs were completed to assess for significant changes in variables of interest. At the time of the follow-up, caregivers reported on average that their child's number of somatic complaints significantly decreased while their child's ODD problems and intolerance of uncertainty showed a trend toward significantly decreasing. At a six month follow-up session, the individuals with ASD reported a significant decrease in anxious/depressed symptoms, aggressive behavior, somatic problems, antisocial/conduct problems, internalizing problems, and externalizing problems. Additionally, the total amount of reported problems showed a trend toward significantly decreasing. The group means for the majority of these scales fell from the borderline clinically significant range to the normal range of symptomatology on the CBCL and YSR.
Conclusions: Results from the pilot of the ALCM program supported the hypotheses that following engagement in the program, individuals demonstrated decreased self- and caregiver-reported symptoms of comorbid internalizing and externalizing symptoms. Although further research needs to be done to rule-out alternative explanations for these results, the recorded improvements in behavior are promising in regards to the effectiveness of improved coordination of treatment efforts across individual's care networks.

114 **145.114** Preliminary Results of an Emotion Regulation RCT for Children with Autism Spectrum Disorder

J. A. Weiss[1], *P. Burnham Riosa*[1] *and C. S. Albaum*[2], *(1)York University, Toronto, ON, Canada, (2)Psychology, York University, Toronto, ON, Canada*

Background:
Children with ASD frequently experience associated psychopathology, with approximately 70% meeting requirements for a psychiatric disorder (Leyfer et al., 2006). The heightened prevalence of these emotional problems may be linked to emotion regulation (ER) difficulties (Mazefsky et al., 2013). Cognitive behavior therapy (CBT) targeting ER has been found to be effective in children without ASD (Ehrenreich-May et al., 2013), but there is limited evidence of its efficacy for children with ASD.
Objectives:
To evaluate the efficacy of the *Secret Agent Society: Operation Regulation* (SAS:OR, Beaumont, 2013), a multi-component CBT program targeting ER difficulties in children with ASD.
Methods:
Thirty-three children with a confirmed ASD diagnosis (93.9% male) and their parents (78.8% female) participated in the program. Children were 8 to 12 years of age (M = 9.50, SD = 1.13) with at least average IQ (M = 103.19, SD = 14.18, Range: 79-140). Parents, children, and clinicians completed measures of child ER (*Emotion Regulation Checklist*, Shields & Cicchetti, 1997; *Emotion Regulation and Social Skills Questionnaire*, ERSSQ-P; Beaumont & Sofronoff, 2008;*Children's Emotion Management Scale,*

Zeman et al., 2010) and psychopathology (*Behavior Assessment System for Children, 2nd Edition*, BASC-2, Reynolds & Kamphaus, 2004; *Anxiety Disorders Interview Schedule: Parent Interview*; Silverman & Albano, 1996; *Clinical Global Impressions Scale*, Guy 1976) at pre-intervention (baseline), and post-intervention. Following baseline assessment, children were randomly assigned to either a treatment immediately (TI; $n = 16$) or waitlist control condition (WLC; $n = 17$). Groups were not significantly different on child age, gender, IQ, or ASD symptom severity at baseline ($p > .10$).

Results:

Using analysis of covariance to control for pre-intervention levels, parents of children in the TI condition reported significantly lower child negative affect compared to children in the WLC condition post-intervention ($p = .006$). After controlling for baseline levels, additional group main effects were found post-intervention in parent-reported child internalizing symptoms on the BASC-2 ($p = .04$) and socially-mediated emotion regulation on the ERSSQ-P ($p = .001$). Children in the TI condition self-reported greater overall emotion inhibition than children in the WLC condition at post-intervention ($p = .02$). An independent clinician blind to group allocation rated children on an overall improvement in clinical severity, and rated children in the TI condition to have significantly more improvement than those in the WLC condition ($p = .003$). Post intervention group main effects were also observed with regard to the number of psychiatric diagnoses ($p = .014$) and severity of clinical impairment ($p = .028$).

Conclusions:

Preliminary results of this RCT support the efficacy of SAS:OR in improving child psychopathology and ER outcomes according to parent, child, and clinician reports.

115 **145.115** Randomized Controlled Trial of a Technology-Based Intervention to Enhance Academic Organization and Planning in College Students with ASD and ADHD

T. Oswald[1], *A. M. Iosif*[2], *J. D. Hori*[3], *J. Wilson*[4] *and P. C. Mundy*[5], *(1)2825 50th Street, University of California at Davis MIND Institute, Sacramento, CA, (2)Public Health Sciences, University of California Davis, Davis, CA, (3)Student Disability Center, University of California, Davis, Davis, CA, (4)Student Disability Center, UC Davis, Davis, CA, (5)Education and Psychiatry, University of California at Davis, Sacramento, CA*

Background:

Adults with autism spectrum disorder (ASD) and/or attention deficit hyperactivity disorder (ADHD) are less likely to attend or graduate from college than peers with other disabilities or typical development (Shattuck et al., 2012, Dvorsky & Langberg, 2014). Simonoff et al. (2008) found that ADHD was the second most common comorbid disorder in individuals diagnosed with ASD. Further, ADHD symptoms have been found to negatively correlate with study habits and academic adjustment in the college population (Norwalk et al., 2008), suggesting that ADHD symptoms (e.g., monitoring, organization, planning, prioritizing) may contribute to poor academic outcomes in college students with ASD and ADHD.

Objectives:

To examine the novel application of tablet technology, using an academic e-planner app, to help college students with ASD and/or ADHD monitor their assignment and exam due dates, prioritize and plan time for homework, and stay academically organized. The study included an active control group, which used an app that monitored daily water consumption rather than academics, to control for general tablet use and motivation.

Methods:

Participants consisted of 38 undergraduate college students, 28 with ADHD (19 male; 9 female) and 10 with ASD (7 male; 3 female) ranging in age from 18-50 years (M=23.90, SD=6.56). Participants were eligible for the study if they had provided medical documentation of their ASD and/or ADHD diagnosis to the UC Davis Student Disability Center (SDC) and were currently receiving academic accommodations through the SDC. All participants were loaned an iPad tablet for a term and, using stratified randomization based on diagnosis and gender, were assigned either the academic e-planner app or the hydration tracker app. Thirty-eight were randomized and 6 were lost to follow-up (2 with ASD; 1 in treatment and 1 in control), so 32 were included in the primary analyses. The primary outcomes were the subscales (Academic Organization/Monitoring and Hydration Monitoring) of a 15-item instrument developed by the research team.

Results:

For the Organization scale, the improvement at follow-up from baseline was significantly higher (p-value = .04) in the treatment group (follow-up vs. baseline difference = 0.43, 95% CI -0.06 to 0.92) than in the control group (follow-up vs. baseline difference = -0.20, 95% CI -0.60 to 0.20). There were no significant treatment vs. control differences in improvement at follow-up in Hydration Monitoring (p-value ≥ .15), although, as expected, the control group tended to have better improvement in Hydration (follow-up vs. baseline difference = 0.52, 95% CI 0.21 to 0.83) than the treatment group (follow-up vs. baseline difference = 0.14, 95% CI -0.32 to 0.61). The size of the ASD group was too small to allow formal subgroup comparisons, but 3 of the 4 ASD participants in the treatment group showed improvement in Organization that was consistent with the overall treatment group.

Conclusions:

Our study provides evidence that specifically using an app to monitor academics enables students to manage their school workload better. Future research should assess the effectiveness of an academic e-planner app in a broader college community of students with ASD and/or ADHD.

116 **145.116** Reducing Behavior Problems Among Students with Autism Spectrum Disorder: Coaching Teachers in a Mixed-Reality Setting

E. Pas[1], *S. R. Johnson*[1], *K. E. Larson*[1], *L. A. Brandenburg*[2,3], *R. Church*[4] *and C. Bradshaw*[5], *(1)Johns Hopkins University, Bloomberg School of Public Health, Baltimore, MD, (2)Special Education, Kennedy Krieger Institute, Baltimore, MD, (3)School of Education, Johns Hopkins University, Baltimore, MD, (4)Kennedy Krieger Institute, Baltimore, MD, (5)University of Virginia, Curry School of Education, Charlottesville, VA*

Background: The growing number of children diagnosed with an Autism Spectrum Disorder (ASD) indicates that school personnel need to be equipped with the appropriate skills to address the far-reaching needs of these students. Children with moderate to severe ASD are at risk for exhibiting behavior problems including aggression and self-injurious behaviors, which can interfere with learning and impact student safety (Munson et al., 2008; Sullivan & Bradshaw, 2012). These behavior problems prove to be challenging for teachers to manage; yet, relatively few teachers have training in the use of evidence-based interventions for educating students while addressing behavior problems in the classroom (Scheuermann et al., 2003; Shyman, 2012).

Objectives: This study aims to fill these gaps, by exploring the extent to which a teacher-tailored coaching approach that utilizes a state-of-the-art mixed-reality simulator was associated with increased teacher capacity to address the diverse behavioral needs of students with ASD. Targeting the practices of teachers serving these students is consistent with the public health approach to prevention (O'Connell et al., 2009) and is likely an effective and cost-efficient way of addressing the complex needs of multiple children with ASD simultaneously.

Methods: Specifically, 19 teachers in two non-public special education settings serving students with ASD were provided with the intervention. Coaches provided data regarding the amount of time they specifically engaged in each coaching activity. Both teachers and coaches provided ratings regarding the acceptability of the intervention. Classroom observations were conducted by an external observer three times (baseline, post-test, and follow-up). The *Assessing School Settings: Interactions of Students and Teachers*(ASSIST; Rusby et al., 2001) classroom observations were conducted by two research assistants. The ASSIST includes event-based tallies (i.e., counts of specific behaviors) for teacher use of classroom management strategies and student behavior. In addition, the observer provided responses to Likert-type items regarding teacher classroom management, student behavior, and the engagement of students in meaningful participation.

Results: A repeated measure MANOVA demonstrated a significant measure by time effect. Follow-up repeated measures ANOVAs revealed statistically significant improvements in teacher management over time, as well as some evidence of improvements in student behavior. Specifically, observers tallied increasing levels of teacher use of proactive behavioral expectations $F(2, 28) = 6.727$, $p = .004$ and use of approvals $F(2, 28) = 8.123$, $p = .002$. Decreases in student non-compliance were also tallied $F(2, 28) = 3.584$, $p = .041$. Observer ratings of the classroom environment, using Likert-type scales, also improved with regard to teacher proactive behavior management, $F(2, 28) = 6.921$, $p = .004$, teacher monitoring, $F(2, 28) = 14.096$, $p = .000$, teacher control, $F(2, 28) = 17.109$, $p = .000$, and teacher and student meaningful participation, $F(2, 28) = 9.814$, $p = .001$. There were also marginally significant improvement over time in student socially disruptive behaviors approached significance, $F(2, 28) = 3.188$, $p = .057$.

Conclusions: Implications for future research and the practice of teachers in special education settings serving students with an ASD are discussed.

117 **145.117** Social Skills Group Training in High-Functioning Autism Spectrum Disorder: A Pragmatic Multicenter RCT

N. Choque Olsson[1], *C. Coco*[1], *A. Rade*[2], *O. Flygare*[2], *Q. Chen*[2], *S. Berggren*[1], *K. Tammimies*[3] *and* ***S. Bolte***[4], *(1)Department of Women's and Children's Health, Pediatric Neuropsychiatry Unit, Karolinska Institutet, Stockholm, Sweden, (2)Karolinska Institutet, Stockholm, Sweden, (3)Women's and Children Health, Center of Neurodevelopmental Disorders (KIND), Karolinska Institutet, Stockholm, Sweden, (4)CAP research center, Gavlegatan 22, Karolinska Institutet, Stockholm, Sweden*

Background: Despite the continuous need for evidence based interventions for individuals with higher functioning autism spectrum disorder (HFASD) few treatments have been comprehensively evaluated. Social skills group training (SSGT) is a widely applied method for school aged children and adolescents with HFASD. Reviews conclude that there is some evidence for the efficacy of SSGT, but that more rigorous research is needed to draw robust conclusions, and that more focus on external validity is required.

Objectives: This study sought to overcome several of the methodological shortcomings of previous randomized controlled trials of SSGT in HFASD, by examining the by far largest sample ever, using manual-based method, well-defined inclusion and exclusions criteria, psychometrically sound outcome measures, multiple informants including blinded raters, computerized randomization, monitoring of the standard care control treatment as well as personalized medicine and therapy genetics.

Methods: We conducted a pragmatic randomized controlled multicenter trial: Manualized SSGT "KONTAKT" (12 sessions) plus treatment as usual [TAU] versus waiting list TAU only at three points of assessment (baseline, post training, 3 months follow-up) in children and adolescents with HFASD. N=366 individuals aged 7 to 18 years were assessed for eligibility, of which 304 were randomized to SSGT treatment plus TAU (n=153) or TAU only (n=151). Participants have clinical ICD-10 diagnoses of ASD,

corroborated by ADOS, and IQ>70. They were trained at 14 regular health care units by 50 clinicians, in the majority certified in the manualized training. Parent and blind teacher report Social Responsiveness Scale ratings served as primary outcome measures.
Results: Preliminary analyses for parent SRS ratings show significant effects of SSGT "KONTAKT" on SRS social cognition scores at follow-up. Blind teacher SRS ratings show significant post treatment effects for social cognition and autistic mannerisms. Further analyses for age group yield that adolescents show significant symptom improvement for the SRS total score post training and at follow-up on the parent but not the teacher report form.
Conclusions: Findings indicate that SSGT "KONTAKT" (i) is feasible in naturalistic clinical settings, (ii) leads to various social communication symptoms improvements, (iii) and has higher effects in adolescents than in children. Furthermore, (iv) results indicate that parents report more improvements than teachers. Ongoing moderator analyses for sex, age, comorbidity, medication, severity, language, IQ and other variables, as well as genome-wide methods such as SNP microarrays and next generation sequencing will identify sets of predictors of individual SSGT response.

118 **145.118** Social Tools and Rules for Teens (The START Program): Results of a Randomized Controlled Trial of an Experiential/Didactic Socialization Program for Adolescents with ASD

***T. Vernon**, A. Miller, J. Ko, A. Barrett and E. McGarry, Koegel Autism Center, University of California Santa Barbara, Santa Barbara, CA*

Background: Experiential learning, or the process of learning through authentic experiences and subsequent reflection on those encounters, is an essential process in the development of core social competencies. There is a unique benefit to gaining exposure to the full range of dynamic variables associated with real-world social encounters, which cannot be replicated via secondhand accounts and instructional lessons. Unfortunately, adolescents with ASD often do not possess the prerequisite skillset and motivation to sustain the level of social immersion needed to benefit from this learning process. Additionally, these individuals may not have access to an accepting peer environment to facilitate acquisition of the very skills necessary to avoid future social rejection. Their persisting social vulnerabilities can limit their long-term relational success, warranting a need for comprehensive social programming. There may be significant benefit to a group socialization program that combines a safe experiential learning context (i.e. an environment that allows for social experimentation and skill development) with a didactic format that emphasizes traditional skill instruction.
Objectives: This RCT evaluated a multi-component socialization intervention to simultaneously target motivational, conceptual, and skill deficits using a hybrid experiential/didactic treatment approach. This investigation evaluated the impact of the 20-week START program on the social functioning of adolescents with ASD through the use of survey and conversational measures.
Methods: Thirty-six adolescent participants were randomized to immediate or delayed treatment conditions. The START socialization program consisted of 20 sessions offered once a week that placed equal emphasis on experiential social immersion and didactic social lessons. Participants engaged in individual therapeutic check-in sessions, free socialization periods, structured social activities, discussion of specific skills, and checkout sessions with parents. Program components included emphasis on creation of a club-like atmosphere, the inclusion of typically developing high school peer models, an individually identified target social skill for each participant (that was monitored, tracked, and updated every five weeks), use of self-management technology to discretely target these skills during the unstructured socialization time, skill depictions from popular television shows, and weekly social assignments. Participants in both groups were assessed at intake and after the 20-week duration of the program.
Results: Evidence of significant social competence improvements were observed exclusively in the immediate treatment group, including changes in Social Responsiveness Scale-2 (SRS-2) standard scores (pre=75.7, post=68.1, $p<0.05$), Social Skills Improvement System (SSIS) standard scores (pre=86.9, post=100.7; $p<0.05$) and Social Competence & Motivation Scale (SCMS) scores (pre=70.6, post=86.6; $p<0.001$). Notable improvements were also noted in coded live conversation probes recorded pre to post-treatment.
Conclusions: The results of this RCT suggest that there may be unique benefits to a socialization curriculum that offers both experiential and didactic training components within a single peer-facilitated intervention. These findings are an important step in identifying optimal strategies to simultaneously target the complex, intertwined factors that limit social progress in adolescents with ASD. Specifically, creating an experiential context may give adolescents the opportunity to finally become fully immersed and accepted by a peer group, which then becomes the ideal forum in which to practice and master critical social competencies.

119 **145.119** Special Education Autism Classification

***K. Sidwell**[1], D. Lincer[2], J. Solis[2], J. Shenouda[1] and W. W. Zahorodny[3], (1)Rutgers University, Newark, NJ, (2)Pediatrics, Rutgers University, Newark, NJ, (3)New Jersey Medical School, Westfield, NJ*

Background:
As increasing numbers of students are diagnosed with Autism Spectrum Disorder (ASD), schools are under greater pressure to provide appropriate special education services. Empirical evidence is needed to inform special education providers about the characteristics of students with ASD who are served under different eligibility classifications and to describe the placement and program characteristics associated with educational growth. Some recent studies suggest that severity of impairment due to ASD and intellectual capacity are associated with special education under the Autism classification. However, there is a paucity of information on this topic from recent studies in populous, diverse, regions.
Objectives: The purpose of this study is to describe the characteristics of ASD children associated with an Autism classification for special education services in metropolitan New Jersey.
Methods:
Study data were from the New Jersey Autism Study (NJAS), an ASD surveillance investigation conducted in Essex, Union, Hudson and Ocean counties, over 5 successive cycles (2000, 2002, 2006, 2008 and 2010). NJAS data were based on review, analysis and independent ASD case-determination derived from information contained in health and education records. Demographic information, level of impairment due to ASD, level of cognitive ability and other case-specific data, including the educational and program classification of children, was analyzed. Socioeconomic status (SES) was represented by a community-level index. Analysis was performed using descriptive statistics and Chi-square tests.
Results:
Among 1,985 ASD cases identified by multiple cycles of active surveillance, > 95% were receiving special education services. Forty four percent of these children (881 children) were served under the Autism classification, the most prevalent eligibility type accorded children with ASD. ASD diagnostic subtype (Autistic Disorder vs. PDD-NOS) was associated with Autism classification, with 76% of Autism-classified students meeting the diagnostic pattern of Autistic Disorder, as opposed to PDD-NOS (p<.001). Severity of impairment due to ASD was significantly associated with Autism classification, such that 75% of Autism classified students had moderate or severe levels of impairment (p=.001). Cognitive ability was also negatively associated with Autism classification, with 40% of Autism-classified students showing an intelligence quotient (IQ) below 70 (p=.001). Interestingly, ASD children with comorbidities—both Attention Deficit Hyperactivity Disorder (ADHD) and (other) psychiatric disorders—showed a lower likelihood of being Autism-classified (p=.001). Neither SES or race, nor socioeconomic status of ASD cases was associated with likelihood of being served under an Autism classification.
Conclusions:
The study findings suggest that the most significant factors contributing to an Autism classification for special education services are ASD diagnostic subtype, severity of impairment due to ASD and cognitive impairment. ASD students with co-morbid diagnoses usually received services under other eligibility classifications, including Other Health Impaired (OHI) and Emotionally disturbed. We did not identify significant associations between sex, race and SES and Autism classification, indicating apparent lack of obvious disparities in this regard. The findings are informative because they represent multiple large, complete ASD populations from a specific metropolitan region, but our findings may not be representative of Autism classification patterns in other states.

120 **145.120** Statewide Assessment of Teachers' Perceptions Related to Educating Students with Autism Spectrum Disorders

***S. E. Blumberg**[1], W. A. Loring[1], H. Huber[2], E. M. Kuntz[2], V. F. Knight[2], L. J. Garrett[1] and P. Juarez[1], (1)Vanderbilt University Medical Center, Nashville, TN, (2)Vanderbilt University, Nashville, TN*

Background: Students with Autism Spectrum Disorder (ASD) often receive services through state Departments of Education IDEA Programs. Federal legislation calls for educators serving these students to use evidence-based practices (EBPs). The process of identifying and correctly implementing EBPs has become increasingly demanding for educators working with students with ASD. As such, preparation and training in EBPs for educators is a pressing need.
Objectives: This program evaluation gathered educators' perceptions on the importance and level of preparedness across instructional areas, use of instructional practices, access to training or resources on EBPs for individuals with ASD and perceived comfort when implementing EBPs before and after training.
Methods: A survey was sent to special educators in Local Education Agencies across a state in the southeastern United States serving in Preschool through High School settings. Questions included frequency of usage of EBPs as defined by the National Professional Development Center on ASD, sources of training on these practices, factors influencing the selection of practices, and instructional skills. In an additional phase, educators attending ASD specific training sessions were instructed to self-report perceived comfort regarding implementation of specific EBPs, both before and after training.
Results:
A total of 535 special educators provided complete survey responses. Educators indicated the following non-academic areas were *very important* to teach - social skills (91.6%), communication (87.3%), daily living skills (86.7%), self-determination (75.5%), and vocational skills (72.7%). However, there was a notable decrease in the percent who indicated feeling *very prepared* to teach these subjects (social skills: 56.1%, communication: 42.4%, daily living skills: 55.3%, self-determination: 43.7%, and vocational skills: 24.1%).

Reported frequency of utilizing EBPs when teaching was variable ranging from 12.4% - 88.8% being used *at least weekly*. The most frequently reported were modeling (88.8%), Picture Exchange Communication System (68.6%), ABA-based interventions (67.8%), cognitive behavioral intervention (60.2%), and visual supports (61.1%). Despite reported use, participants reported having no access to training (e.g., live/online trainings, print/electronic resources) for those most frequently used EBPs – (modeling:42.8%, Picture Exchange Communication System: 56.1%, ABA-based interventions:49.0%, cognitive behavioral intervention:57.2%, and visual supports:54.2%). Additional data regarding EBPs educators reported using most and least will be presented.
Additional data on perceived confidence in implementing EBPs prior to and following receiving ASD specific training is under analysis. Preliminary results indicate participants reported higher confidence levels in implementing specific EBPs correctly before receiving training than they reported after receiving training.
Conclusions: The preliminary results of this project indicate educators statewide recognize the importance of students with ASD receiving instruction in core content areas and non-academic areas, however many feel they lack preparedness to do so. Teachers report implementing EBPs in classrooms but not having access to training and resources. Furthermore, reported levels of confidence were noted to decrease immediately after receiving training, indicating educators may not be implementing the reported EBPs with fidelity or fully comprehending accurate means of implementation. Therefore, the need to provide focused and ongoing training and support for educators in these areas is crucial.

121 **145.121** Sticking with It: Psychotherapy Outcomes for Adults with ASD in a University Counseling Center

E. Anderberg[1], *E. S. Neeley Tass*[1], *J. C. Cox*[1], *J. I. Cline*[1], *D. Petersen*[1], *D. M. Erekson*[1] *and M. South*[1,2], *(1)Brigham Young University, Provo, UT, (2)Psychology and Neuroscience, Brigham Young University, Provo, UT*

Background:
Young adults with autism spectrum disorders (ASD) experience high rates of comorbid mental health concerns as well as distress arising from the core symptoms of autism. Many adults with ASD seek psychological treatment in outpatient facilities in their communities that are not specifically geared towards individuals with ASD. However, few studies have looked at the effectiveness of standard psychotherapeutic care in adults with ASD.
Objectives:
This study aims to discover how individuals with autism spectrum disorders fare in psychotherapy within a college mental health care setting compared to their neuro-typical peers.
Methods:
Data for this study were pulled from a large data set containing information on 34874 clients that visited the Brigham Young University Counseling and Psychological Services (CAPS) center for psychotherapy from 1994-2015. Therapy case notes (N=271,343) were searched for terms associated with autism spectrum disorders ("autism," "Asperger's," "spectrum," etc.) and each flagged case note was coded for the diagnostic relevance of the term. Finally, each client's case note ratings were merged and a final diagnostic code was determined: Confirmed ASD (CASD)(N=95), Probable ASD but is not diagnosed (PASD)(N=109), or Does not have ASD (Neuro-typical, NT) (N=34670).
The CAPS uses the Outcome Questionnaire-45 (OQ) to track distress at each session. The well-validated OQ-45 is generally completed shortly before every session the client attends and has been shown to be sensitive to change across the course of therapy. Change in OQ scores across sessions was analyzed with a repeated measure mixed model using lag 1 autocorrelation to account for within subject correlation.
Results:
Clients with confirmed or probable ASD showed no difference in level of distress at intake compared to their neuro-typical peers (CASD, M = 68.1; PASD, M = 69.4; NT, M = 67.4; $p = .90$). However, clients with confirmed and probable ASD stayed in treatment for a significantly larger number of sessions than neuro-typical clients (CASD, M = 6.7; PASD, M = 6.0; NT, M = 4.2; $p < .001$). Clients with confirmed ASD also improved at a faster rate in therapy than neuro-typical clients, especially after the first five sessions. We are undertaking additional analyses to look at the relationship between OQ-45 scores at intake and eventual outcome.
Conclusions:
Overall, adult therapy clients with autism spectrum disorder appear to benefit from typical community psychotherapy approaches as much or even more than their neuro-typical peers. They also tend to stay in therapy longer than their peers, which may indicate that they do not feel relief of distress as quickly and require more sessions to feel as though therapy was successful. Results indicate that adults with ASD benefit greatly from psychotherapy the longer they stick with it, and should be encouraged to continue in therapy even if they do not feel immediately that it is helping.

122 **145.122** Stop. Breathe. be. Supporting Youth with Autism Spectrum Disorder Using Mindfulness Training

K. S. Thom *and J. Montgomery, University of Manitoba, Winnipeg, MB, Canada*

Background:
Youth with Autism Spectrum Disorder (ASD) with average and above average intellectual abilities have been identified as a particularly at-risk group. Persisting impairments in self-regulation, social communication and interaction, coupled with increasing awareness of social differences and limited services places these youths at significant risk of secondary social and emotional problems, including high rates of loneliness, victimization, and mental health problems. Mindfulness-based interventions (MBIs) have emerged in the literature as a promising approach for improving coping, social and emotional skills in a variety of adult and child populations, however, research in MBIs and ASD remains limited. By offering training in self-regulatory and self-awareness skills, MBIs may be particularly effective in improving the social and emotional well-being of youth with ASD.
Objectives:
The purpose of this study was to investigate whether mindfulness training is an acceptable and effective approach for improving social and emotional well-being in youth with ASD.
Methods:
Adolescents with ASD between the ages of 13 and 17 years, with a VIQ > 80, were recruited for this study. Adolescents meeting inclusion criteria (N= 14) participated in a 9-week, small group MBI which focused on training youth in self-awareness, stress management, and positive coping strategies. Participants completed pre- and post-training measures including: 1) a measure of emotional intelligence, the BarOn Emotional Quotient-Inventory: Youth Version; 2) a measure of emotional dysregulation, the Difficulties in Emotion Regulation Scale; 3) a social/emotional outcome measure, the Behaviour Assessment System for Children, Second Edition: Self-Report of Personality; and 4) a measure of mindfulness, the Cognitive and Affective Mindfulness Scale-Revised, in a randomized order. Parents of the adolescents completed 1) a screening instrument for ASD, the Autism Quotient: Adolescent Version (pre-training only); 2) a Participant Information Questionnaire assessing diagnostic and developmental history (pre-training only); 3) a social/emotional outcome measure, the Behaviour Assessment System for Children, Second Edition: Parent Rating Scale; and 4) a social skills measure, the Social Skills Improvement System: Parent Rating Scale. Parents and adolescents also completed a post-intervention feedback survey to assess acceptability and feasibility of the intervention.
Results:
Parents reported significant improvements in adolescents' social skills and reductions in problem behaviors following the 9-week MBI. Adolescents reported no significant changes in emotion dysregulation, emotional intelligence, and mindfulness. Quantitative and qualitative responses from the parent and adolescent feedback surveys indicated high ratings of program satisfaction and feasibility, as well as improvements in self-calming, self-management, and emotional skills. Results are considered exploratory and generalizability is limited by the study's small sample size and lack of control group.
Conclusions:
The results from this study add to emerging empirical support for mindfulness training in youth with ASD by providing evidence to suggest that this approach is engaging, acceptable, and effective in improving social and emotional skills and well-being. The results of this study also highlight important measurement considerations, including the utility of mixed-methods assessment strategies. Implications for group-based interventions, program evaluation, and future research will be discussed.

123 **145.123** Study of Effectiveness of the Emotion Regulation Training on Social Skills and Repetitive Behaviors in Children with High Functioning Autism

S. Rezaei Dehnavi[1], *S. Rashidi*[2] *and A. R. Bakhshashye*[3], *(1)Payame Noor university, Isfahan, Iran, (2)Islamic Azad University Yazd Branch, Isfahan, Iran, (3)Islamic Azad University Yazd Branch, Yazd, Iran*

Background: Emotional regulation education was recommended to improve social skills and reducing in repetitive behaviors in previos studies.
Objectives: The purpose of this study was study the effectiveness of the emotion regulation education on social skills and repetitive behaviors in children with High Functioning Autism(HFA).
Methods: The research was experimental Using a two Groups Pre and Post Test design . 28 children with HFA were selected and randomly assigned in two experimental and control groups The experimental group participated in emotion regulation training basis on manual of the Stress and Anger Management Program (STAMP) in nine sessions (two sessions per week) . Social Skills Rating Form of Triad Social Skills Assessment (TSSA) and Repetitive behaviors Inventory were applied to assess dependent variables. Covariance analysis was used to analyze the data
Results: The results indicated that social skills in experimental group had been significantly($p<0.00$) improved , but there was no difference in repetitive behavior in two groups.
Conclusions:

Basis on the results of this study. Emotional regulation education is recommended for improving the social skills in children with HFA.

124 **145.124** Summer Camps As Social Performance Intervention for Adolescents with ASD and Their Peers

J. Kaboski[1], *J. J. Diehl*[2], *K. E. Kawalec*[3], *K. Tang*[4], *H. N. Van Steenwyk*[5], *H. Miller*[6], *M. Prough*[7], *J. Riemersma*[7], *G. Ramos*[7], *D. Klee*[7], *L. T. Simon*[8], *J. Georgeson*[7] *and E. Tracy*[7], *(1)University of Notre Dame, Granger, IN, (2)LOGAN Community Resources, Inc., South Bend, IN, (3)University of Notre Dame, Hammond, IN, (4)Psychology, University of Notre Dame, Notre Dame, IN, (5)F.U.N. Lab at the University of Notre Dame, Brainerd, MN, (6)University of Notre Dame, Notre Dame, IN, (7)University of Notre Dame, South Bend, IN, (8)University of Notre Dame, Spring Lake, MI*

Background: For adolescents with ASD who have developed the requisite social *skills*, there are limited opportunities to improve social *performance*(Koegel et al., 2012). Koegel et al. (2012) tested the effectiveness of a social performance approach with elementary school-age children in their school setting with typically developing (TD) peers. This approach was unique from other peer-mediated models in that the participating peers were not selected or trained to work with children with ASD. Rather, the success of the approach relied on the shared interest of the children to facilitate natural social interactions. Whether such approach could successfully be adapted to adolescents with ASD is yet unclear.

Objectives: We provided a series of technology-related summer camps, which offered an engaging and supportive environment in which adolescents with ASD could practice appropriate social and collaborative skills with TD peers. Shared common interest was in one of two topics: robotics or computer game programming (CGP). The primary goal of the camp was to improve social anxiety and social skills.

Methods: We recruited 33 individuals with ASD and 36 TD peers, ages 10-17 years, who received general education science instruction at school, and expressed interest in either robotics or CGP. Participants completed a weeklong summer camp, during which they were trained in programming either a humanoid robot or computer games, depending on the type of camp in which they were participating. In all camps, participants had the opportunity to program a robot or computer game while collaborating in pairs (1 ASD: 1 TD). Participants were not labeled as having ASD. Social skills were taught indirectly through assigned technology-related exercises, such as programming the robot to make appropriate eye gaze and gestures to interact naturally with the audience. Pre- and post-treatment data were collected on participant-reported levels of social anxiety (Social Anxiety Scale) and parent-reported social skills (Social Skills Improvement System).

Results: The data from all camps were combined and a series of paired samples *t*-test were conducted to compare pre- and post-intervention data. The ASD group experienced a significant improvement on social skills and social anxiety from pre- to post-test. It should be noted that averages for the ASD never reached the standardized norm on the measures. While the TD group did experience some improvements in both measures, they never reached significance. This is to be expected considering their already desirable levels of social skills and social anxiety at the start of the camps (see Table 2). When the sample was analyzed separately by the type of camp, the ASD sample in the robotics camp showed improvements in both social skills and social anxiety while the ASD sample in the CGP camp showed improvements in only social anxiety. TD children, regardless of the type of camp, did not show any improvements.

Conclusions: These results provide a strong support for the effectiveness of social performance-based camps for adolescents with ASD. Whether there is something unique about programming humanoid robots that is more conducive to social skills learning needs to be explored further.

Table 1. Pre- vs. Post-Intervention Data for All Camps Combined

Measures	Pre-Test *M (SD)*	Post-Test *M (SD)*	*t*	*p*
ASD Group (*N*=32)				
SAS-A/SASC-R: Total score	47.73 (15.21)	42.91 (16.38)	4.12	.00**
SSIS: Social Skills Scale	81.53 (14.08)	85.78 (12.59)	-3.17	.00**
TD Group (*N*=27)				
SAS-A/SASC-R: Total score	37.33 (11.52)	35.38 (12.39)	2.30	.03*
SSIS: Social Skills Scale	102.46 (11.93)	104.03 (11.37)	-1.30	.20

Note. SASC-R = Social Anxiety Scale for Children – Revised; SAS-A = Social Anxiety Scale, the Adolescent adaptation; SSIS = Social Skills Improvement System.
*p<.05, **p<.01

Table 2. Robotics Camp vs. CGP Camp (Reporting on ASD participants only)

Measures	Pre-Test *M (SD)*	Post-Test *M (SD)*	*t*	*p*
Robotics Camp (*N*=24)				
SAS-A/SASC-R: Total score	46.88 (14.91)	41.25 (16.13)	3.65	.00**
SSIS: Social Skills Scale	81.33 (14.92)	86.33 (12.89)	-3.10	.01*
CGP Camp (*N*=9)				
SAS-A/SASC-R: Total score	50.00 (16.70)	47.33 (17.18)	2.63	.03*
SSIS: Social Skills Scale	82.13 (12.04)	84.13 (12.3)	-0.87	.42

Note. SASC-R = Social Anxiety Scale for Children – Revised; SAS-A = Social Anxiety Scale, the Adolescent adaptation; SSIS = Social Skills Improvement System.
*p<.05, **p<.01

125 **145.125** Surviving and Thriving in the Real World: A Daily Living Skills Intervention for Adolescents with ASD

A. Duncan[1], *C. L. Thomas*[1], *L. A. Ruble*[2] *and L. J. Stark*[1], *(1)Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (2)University of Kentucky, Lexington, KY*

Background: Adolescence is a time of critical milestones, and those with autism spectrum disorder (ASD), even those who are high functioning (IQ >70), have difficulties successfully transitioning to the adult world in areas such as independent living and employment (Hume et al., 2014). In one study, 46% of parents reported that adults with high functioning ASD required "extensive help" completing activities of daily living, which impacted their ability to maintain employment (Farley et al., 2009). Daily living skills are everyday activities such as personal hygiene, cooking, cleaning, and managing money. Daily living skills were the only significant factor that predicted a positive outcome in adulthood for individuals with ASD, and have been linked to a more successful outcome in college, employment, and independent living (e.g., Klinger et al., 2015). Despite their importance, the daily living skills of adolescents with high functioning ASD fall far below what would be expected based on their IQ and chronological age (Duncan & Bishop, 2015). However, daily living skills can be taught using empirically-based strategies. Currently, there are no evidence based intervention packages that target the acquisition of daily living skills in adolescents with high functioning ASD.
Objectives: The primary aim of the current study was to develop and evaluate the intervention package, *Surviving and Thriving in the Real World (STRW)*, to increase critical daily living skills in adolescents with high functioning ASD. A pre-post trial was conducted in order to refine tools for measuring individual progress on targeted daily living skills (i.e., goal attainment scaling), maximize recruitment and retention strategies, finalize the intervention protocol, determine efficacy, and assess feasibility and

acceptability.
Methods: The pre-post trial consisted of 8 adolescents with ASD between 14-18 years and their parents. All participants had IQs>70 and met criteria for ASD on the ADOS-2. Information on daily living skills was collected using (1) the Vineland Adaptive Behavior Scales, 2nd Edition and (2) a goal attainment scale that was created for each adolescent from a parent interview that assessed skills in the goals targeted in the STRW intervention. STRW consists of 12 group sessions with adolescents and their parents that targets skills in the areas of hygiene, cooking, laundry, and money management. Data on factors such as acceptability, feasibility, and satisfaction were collected after each assessment. Daily living skills will be re-evaluated after completion of STRW.
Results: The pre-post trial for STRW is currently being conducted and will be completed by February. Statistical analyses will be conducted to examine predictors, primary outcomes, and feasibility, acceptability, and satisfaction.
Conclusions: The current study is the first step in the development and evaluation of a daily living skills intervention for high functioning adolescents with ASD. The results of the pre-post trial of STRW will determine initial efficacy and evaluate acceptability, feasibility, and satisfaction. A daily living skills intervention has the potential to directly affect current functioning and future adult outcomes in adolescents with high functioning ASD by increasing capabilities for skills that are needed to be successful in independent living, college, and employment.

126 **145.126** Teaching Emotion Recognition with the Transporters DVD

***P. LaCava**, Rhode Island College, Providence, RI*

Background: Facility with understanding, recognizing and responding one's own and others' emotions is at the core of social interactions (Baron-Cohen, 1995; 2003). In a variety of experimental tasks, children with Autism Spectrum Disorders (ASD) have shown delays in recognizing and understanding emotions (Golan et al., 2009). To improve emotion recognition skills several tactics have been successfully used. This includes more traditional approaches (i.e., direction instruction, ABA, etc.), computer programs such as Mind Reading (Baron-Cohen et al. 2003; LaCava et al., 2007; LaCava et al., 2010), or FaceSay (Hopkins et al., 2011), and the Transporters DVD (Golan et al., 2009). While experimental studies have shown the Transporters to be a motivating and effective way to teach emotions (Golan et al., 2009; Young & Posslet, 2012; Williams et al., 2012), no research to date has addressed the efficacy of the Transporters with American children.
Objectives: To complete a pilot study to assess if the Transporters DVD can improve emotion recognition of American children with ASD. We hope to use this study's findings to support a full clinical trial of the Transporters in the United States.
Methods: We are implementing a small pilot study using a one group pre-test post-test design with children ages 4 to 10. Currently 6 children have completed the study, with 3 more currently using the program; we intend to have between 10 to 15 participants in the final sample. 33% of our current sample is from a minority racial group. All participants will have an official diagnosis of ASD if diagnosed after DSM-5 2013 changes or a diagnosis of autistic disorder, Asperger syndrome or PDD-NOS, if diagnosed prior to 2013. At pre-testing parents are asked to complete the Social Emotional Evaluation Questionnaire (Wiig, 2008) and the Childhood Autism Spectrum Test. Children complete the Peabody Picture Vocabulary Test (Dunn & Dunn, 2007), the Social Emotional Evaluation Identifying Common Emotions and Identifying Emotional Reactions subtests (Wiig, 2008), and three researcher made computerized emotion recognition tasks (based on Golan et al., 2009). The intervention consists of 4 weeks of watching the Transporters DVD in either the home or school setting for at least 15 minutes a day/5 days a week. At post-testing we reassess children on the emotion recognition measures.
Results: We are still collecting data at this time but initial results suggest that the Transporters DVD is effective in helping about half of the participants to increase their emotion recognition performance from pre to post testing.
Conclusions: Final conclusions will be made once all participants complete the study. However, as no peer-reviewed publication currently exists about the Transporters efficacy in the United States, these initial findings will be important for families and practitioners making intervention decisions.

127 **145.127** Teaching Research Staff Implementation of a Social Skills Intervention: An Extension of Behavior Skills Training

***J. Day-Watkins**[1], A. Pallathra[2], J. E. Connell[1] and E. S. Brodkin[2], (1)Drexel University, Philadelphia, PA, (2)University of Pennsylvania, Philadelphia, PA*

Background: Behavior skills training (BST) is a parent and staff training package that includes verbal instructions, modeling, rehearsal, and feedback (Nosik, Williams, Garrido, & Lee, 2013). BST relies on the presence of a trainer throughout the training period. It may be advantageous to find training arrangements based on BST that reduce the reliance on a trainer (Giannakakos, Vladescu, Kisamore, & Reeve, in review). One such variation is video modeling with voiceover instruction (Vladescu, Carroll, Paden, & Kodak, 2012). This package includes voiceover instruction that describes the behaviors being modeled in the video.
Objectives: The present study sought to use BST to teach three adult participants (research staff) to implement a video modeling intervention aimed at teaching social skills to adult consumers with autism spectrum disorder (ASD). After training, we sought to assess generalization to three untrained social skills: transitioning conversation, listening to conversation, and empathetic responses. The overall goal of the study was to extend the BST literature to training social skills interventions.
Methods: Three participants were taught to provide a video model to teach a confederate to engage in one social skill (i.e., approach and greet others). During baseline trials, participants were given access to written instructions before role-play with the confederate. During role-play, the confederate engaged in a variety of scripted correct and incorrect responses. During treatment, participants were given a video model with voice-over instruction. The training video depicted how to teach social skills by introducing a video model in the presence of an error. The training video included written and auditory prompts that highlighted critical steps in the task analysis and where to input data collection. After access to the training video, participants repeated role-play trials. Following the role-play, feedback was provided to participants on steps completed correctly and incorrectly. Generalization probes were conducted with an adult with ASD who was not associated with training.
Results: All participant scores increased from baseline (*M=8%)* to treatment (*M=96%).* Participants met the training criterion for mastery within 2-3 treatment sessions. Generalization was demonstrated across novel skills from baseline (*M*=6%) to treatment (*M*=86%).
Conclusions: Following BST, participants demonstrated correct use of a video model to teach a social skill. Participants generalized use of the video model to teach as many as three additional novel social skills. These data indicate the efficiency of BST by demonstrating spontaneous skill acquisition when only a subset of skills is directly trained, in this case one social skill. Furthermore, the use of a video reduces the amount of direct training time for staff trainers. This study extends the BST literature in two ways. First, it uses BST to train staff to implement a social skills intervention. Second, in a separate study currently in progress, the same participants are training adult consumers with ASD to engage in the social skills described here. To our knowledge, this may be the first BST study to report effects on consumers' behavior.

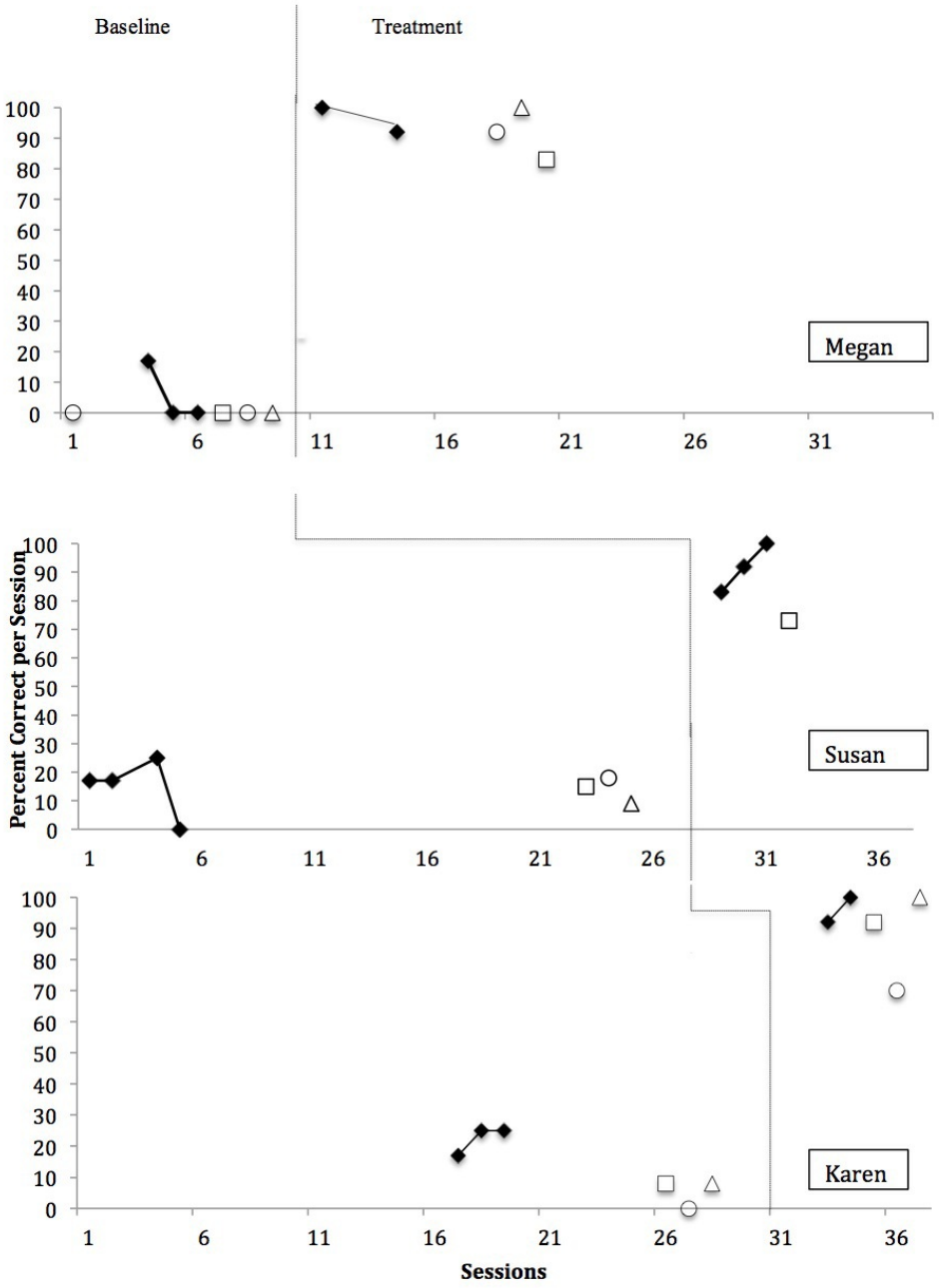


Figure 1. Percent of correct responses per session. Filled diamonds represent trained skill; open squares, circles and triangles are generalization skills 1, 2, and 3 respectively. Generalization conducted with an actual consumer not used in training.

128 **145.128** The Efficacy of Student-Assisted LEGO Therapy in Children with Autism Spectrum Disorders Using the Autism Impact Measure

J. Gehricke[1,2], *R. steinberg Epstein*[1], *L. Lam*[1], *A. Z. Chester*[1], *T. Thampipop*[1], *K. Pesterfield*[1], *R. Bisht*[1], *S. Quan*[1] *and J. H. Donnelly*[1,2], *(1)The Center for Autism & Neurodevelopmental Disorders, Santa Ana, CA, (2)University of California, Irvine, Santa Ana, CA*

Background: Since children with Autism Spectrum Disorders (ASD) are naturally drawn to repetitive and predictable patterns, LEGO Therapy is advantageous in attracting and motivating children with ASD due to its structured play, intrinsically enjoyable properties, and opportunities for originality. LEGO Therapy allows participants to practice verbal and nonverbal communication with an emphasis on social support, social problem solving, and conflict resolution; all of which are impairments associated with ASD. Behavioral interventions using LEGO aim to help children with ASD initiate and sustain higher quality interactions with peers.
Objectives: The present study was designed to examine the short-term effectiveness of LEGO therapy in improving ASD symptoms, including sensorimotor symptoms (e.g., fascination with looking and touching objects, avoiding sounds, textures and smells), social communication (e.g., social withdrawal, eye contact), and repetitive behaviors (e.g., repetitive body movements, lining things up).
Methods: Twelve children with ASD between the ages of 6 and 14 participated once per week for five weeks in one-hour LEGO Therapy sessions. During each session, participants were paired with a student assistant and engaged in LEGO play, taking turns as either a “builder” or an “engineer.” To monitor progress, parents were given the Autism Impact Measure (AIM), a 41-item parent survey shown to be a reliable measurement for tracking short-term improvements in ASD symptoms and impairments. Parents reported the frequency of ASD symptoms and their impact on daily functioning in their child over the last two weeks at baseline and after completion of the five-week period. The data processing and analysis was conducted with SPSS Statistics 21 using Wilcoxon tests at a one-tailed probability level of 0.05.

Results: Overall, LEGO Therapy significantly decreased the impact of ASD symptoms on daily functioning from baseline to study completion (p = 0.027). More specifically, LEGO Therapy significantly reduced the impact of sensorimotor symptoms (ps ≤ 0.021) as well as deficits in social communication (ps ≤ 0.017) on daily functioning.
Conclusions: The findings suggest that LEGO Therapy can significantly improve the daily functioning of children with ASD, particularly in symptoms associated with deficits in sensorimotor functioning and social communication.

129 **145.129** The Influence of Cognitive Empathy in Predicting Changes in Social Skills Improvement for Adolescents with ASD Following the UCLA PEERS® Program

L. Zhang[1], *J. W. Yang*[1], *E. Veytsman*[2] *and E. A. Laugeson*[2], *(1)The Help Group-UCLA Autism Research Alliance, Sherman Oaks, CA, (2)Psychiatry and Biobehavioral Sciences, UCLA Semel Institute for Neuroscience and Human Behavior, Los Angeles, CA*

Background: Empathy involves the capacity to recognize, identify, understand, and experience the emotional states of others, and is essential to the development and maintenance of meaningful relationships (Davis, 1980). In particular, empathy requires both the ability to share the emotional experience of the other person (affective component) and an understanding of the other person's experience (cognitive component) (Decety & Jackson, 2004; Eisenberg & Eggum, 2009; Hodges & Klein, 2001). Baron-Cohen and Wheelwright (2004) characterize high functioning autism spectrum disorder (ASD) as an empathy disorder, arguing that those with ASD often lack empathy and are unresponsive to socio-emotional cues. The Program for the Education and Enrichment of Relational Skills (PEERS®) is an evidence-based, caregiver-assisted social skills training program (Laugeson & Frankel 2010), which has been shown to improve social skills and empathy in youth with ASD without intellectual disabilities. While improvements in empathy have been observed, the extent to which empathy at post-treatment is related to improvement in social skills following PEERS® has yet to be examined.
Objectives: The present study examines the relationship between post-treatment levels of empathy and the improvement in social skills for adolescents with ASD following the PEERS® social skills intervention.
Methods: Participants in this study included 90 adolescents (67 males, 23 females) with ASD ranging from 11-18 years of age (*M*=13.86, *SD*= 1.76) and their parents who presented for social skills treatment through the UCLA PEERS® Clinic. Adolescents and parents attended weekly 90-minute group treatment sessions over a 14-week period. Skills related to making and keeping friends and handling peer conflict and rejection were taught through didactic instruction using concrete rules and steps of social etiquette, role-play demonstrations of targeted skills, in-session behavioral rehearsal activities, and parent-assisted weekly socialization homework assignments.
In order to understand the relationship between empathy and social skills improvement following treatment, parents completed the Social Skills Improvement System (SSIS; Gresham & Elliot, 2008) pre-and-post intervention. Empathy was assessed at post- intervention through parent reports on the Empathy Quotient (EQ; Baron-Cohen & Wheelwright, 2004), which assesses empathy levels among adolescents with ASD. Pearson correlation coefficients were calculated to examine the relationship between parent-reported EQ following treatment and the change in parent reported SSIS from pre- to post-test.
Results: Results indicate that cognitive empathy on the EQ following treatment was associated with improvement in Communication ($p<.05$), Assertion ($p<.01$), and Internalizing Problem Behaviors ($p<.05$) on the SSIS. No statistically significant correlations were observed between total scores on the EQ, SSIS, or other subscales.
Conclusions: These findings suggest that adolescents with ASD whose parents reported higher cognitive empathy following the PEERS® program were more likely to have better communication skills, assertion, and exhibit less internalizing problem behaviors following treatment. These findings are useful in understanding the relationship between empathy and improvement in social skills following treatment, and distinguishing those who may be more likely benefit from targeted social skills treatment.

130 **145.130** The Influence of Self-Esteem in Predicting Social Anxiety in Adolescents with ASD Following the UCLA PEERS® School-Based Curriculum

J. Albright[1], *C. C. Bolton*[2], *N. Rosen*[1], *L. C. Tucci*[3] *and E. A. Laugeson*[2], *(1)Psychiatry, UCLA, Los Angeles, CA, (2)Psychiatry and Biobehavioral Sciences, UCLA Semel Institute for Neuroscience and Human Behavior, Los Angeles, CA, (3)The Help Group/UCLA Autism Research Alliance, Sherman Oaks, CA*

Background: As a result of social skill deficits and heightened social demands common to adolescence, teens with Autism Spectrum Disorder (ASD) are particularly susceptible to feelings of anxiety. In fact, 11% to 84% of adolescents with ASD report feelings of impairing anxiety (White et al., 2010). In typically developing adolescents, self-esteem has been linked to peer acceptance and social activity, which in turn impedes feelings of social anxiety. However, research has yet to explore the impact of self-esteem on social anxiety in this population. The Program for the Education and Enrichment of Relational Skills (PEERS®) School-Based Curriculum is a 16-week evidence-based social skills intervention that addresses social skill deficits by teaching students how to make and keep friends. While this program has been shown to improve social functioning, and decrease social anxiety in some cases, the relationship between self-esteem and social anxiety has yet to be explored.
Objectives: The present study seeks to examine how baseline self-esteem predicts changes in levels of self-reported social anxiety following a school-based social skills intervention for adolescents with ASD.
Methods: Participants included 106 adolescents, ranging from 11-18 years of age (M=15.08, SD=1.82). Participants received 30 minutes of daily social skills instruction in the classroom over a 16-week period. Teachers provided instruction on the PEERS® curriculum through didactic presentation, role-play demonstrations, behavioral rehearsal activities, and review of socialization homework assignments. In order to understand the relationship between self-esteem and social anxiety, students completed the Piers Harris Self-Concept Scale Second Edition (PHS2; Piers, Harris, and Herzberg, 2002) at pre-test to measure self-esteem, and the Social Anxiety Scale for Adolescents (SAS-A; La Greca, 1993) at post-test to measure social anxiety. Regressions were calculated to examine the relationship between PHS2 sub-scales and the SAS-A. T-tests were calculated to compare pre/post measures of overall self-esteem and social anxiety.
Results: Results indicated that higher youth-reported self-esteem on the PHS2 at baseline significantly predicted social anxiety as measured by the SAS-A ($p<0.001$) post-treatment. A two-factor model accounting for Intellectual Status ($p<0.001$) and Popularity ($p<0.001$) were able to account for 33% of the variance in social anxiety post-treatment. Results also indicated that overall self-esteem significantly increased from pre-test to post-test, $t(105)=-3.06, p=0.003$.
Conclusions: These findings suggest that adolescents with ASD who report higher levels of self-esteem prior to receiving the PEERS® intervention are less likely to report feelings of social anxiety following treatment. Specifically, adolescents who endorse more confidence in social functioning and intellectual ability prior to treatment are less likely to experience anxiety brought on by social interactions following the intervention. In addition, overall self-esteem improved, while overall social-anxiety decreased, following the PEERS® School-Based Curriculum. These findings provide useful information about who is most likely to benefit from treatment, allowing for more targeted intervention.

131 **145.131** The Relationship Between Friendship Quality, Companionship and Social Engagement in Adolescents with Autism Spectrum Disorder

J. W. Yang[1], *L. C. Tucci*[2], *Y. Bolourian*[3], *E. Veytsman*[4], *C. C. Bolton*[4] *and E. A. Laugeson*[4], *(1)The Help Group-UCLA Autism Research Alliance, Sherman Oaks, CA, (2)The Help Group/UCLA Autism Research Alliance, Sherman Oaks, CA, (3)University of California - Riverside, Riverside, CA, (4)Psychiatry and Biobehavioral Sciences, UCLA Semel Institute for Neuroscience and Human Behavior, Los Angeles, CA*

Background:
Impaired social functioning among youth with Autism Spectrum Disorder (ASD) may lead to lack of social engagement, companionship, and poor friendship quality (Orsmond, Krauss, & Seltzer, 2004; Bauminger & Kasari, 2000). Greater friendship quality has been associated with fewer social problems, and less internalizing or externalizing problem behaviors. Having at least one close friend has been shown to be a protective factor against peer victimization and better overall adjustment in adolescents (Waldrip, Malcolm, & Jensen-Campbell, 2008). Children with ASD often report having friendships in school settings, but these friendships are often focused on circumscribed interests with little outside social engagement (Church, Alisanski, & Amanullah, 2000). Despite the growing research examining the social functioning of school-aged children with ASD, little is known about the friendship quality and social engagement in older youth (Macintosh & Dissanayake, 2006).
Objectives:
The present study seeks to address this research gap by examining the relationship between friendship quality and social engagement among adolescents with ASD in school settings.
Methods:
Participants included 106 adolescents (males=86; females=20) ranging from 12-18 years of age (*M*=15.08; *SD*=1.82) at The Help Group's Village Glen School, a nonpublic school for youth with ASD. Participants were involved in a larger treatment outcome study investigating the effectiveness of the PEERS® school based curriculum (Laugeson 2014). In order to examine the relationship between friendship quality and social engagement, adolescents completed the Friendship Quality Scale (FQS; Bukowski, Hoza, & Bolvin, 1994) at baseline, which assesses overall friendship quality along the domains of companionship, helpfulness, closeness, conflict, and security. Additionally, in order to assess social engagement, adolescents completed the Quality of Socialization Questionnaire (QSQ; Frankel & Mintz, 2008) prior to treatment. The QSQ measures the number of hosted and invited get-togethers and degree of conflict during get-togethers in the previous month. Pearson correlation coefficients were calculated to examine the relationship between friendship quality on the FQS and social engagement using the QSQ.
Results:
Results indicate that higher baseline total scores on the FQS are correlated with higher baseline scores on the QSQ frequency of invited get-togethers ($p<.05$), and with lower baseline scores on the QSQ conflict scale ($p<.05$). In addition to these findings, companionship on the FQS is correlated with higher baseline scores of frequency of invited get-togethers ($p<.001$) and hosted get-togethers ($p<.001$) on the QSQ. Higher baseline companionship scores on the FQS are also correlated with lower baseline scores on the QSQ conflict scale ($p<.002$). No other statistically significant correlations across the subscales of the FQS and QSQ were found.

Conclusions:
These findings suggest that adolescents with ASD that report greater friendship quality and demonstrate higher companionship are more likely to be social engaged with their peers, and experience less conflict within their friendships. These results suggest that when the treatment priority is to increase social engagement and decrease conflict, the need for more targeted interventions to improve friendship quality and companionship may be warranted.

132 **145.132** The Relationship Between Treatment Acceptability and Child Outcome in Group CBT for Youth with ASD and Anxiety

C. E. Walsh[1], *A. Blakeley-Smith*[2], *L. G. Klinger*[3], *A. Keefer*[4], *A. Duncan*[5], *S. E. O'Kelley*[6], *S. Hepburn*[7], *E. Moody*[8] *and J. Reaven*[9], *(1)3037247659, University of Colorado Denver, Denver, CO, (2)Univ. of Colo. Denver-JFK Partners, Aurora, CO, (3)Psychiatry, University of North Carolina TEACCH Autism Program, Chapel Hill, NC, (4)Kennedy Krieger Institute, Baltimore, MD, (5)Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (6)Psychology, University of Alabama at Birmingham, Birmingham, AL, (7)University of Colorado / JFK Partners, Aurora, CO, (8)University of Colorado Anschutz Medical Campus, Aurora, CO, (9)Univ. of Colorado Denver-JFK Partners, Aurora, CO*

Background: Children with ASD are at increased risk for developing anxiety and modified cognitive-behavioral therapy (CBT) interventions can be effective in reducing anxiety in this population (Lang et al., 2010). CBT for anxiety consists of psychoeducation (e.g., somatic management, attention to automatic negative thoughts) and graded exposure (facing fears a little at time) (Velting et al., 2004). However, client resistance is typically highest during exposure practice compared to psychoeducation (Abramowitz et al., 2002). Little is known about how children with ASD (and their parents) perceive the acceptability of treatment and in particular, exposure. In fact, it is important to understand whether clients must consider a treatment helpful (or acceptable) in order to improve. Currently, the relationship between treatment acceptability (e.g., perceptions about a treatment and whether it is deemed helpful; Kazdin et al., 2005) and treatment outcomes in CBT for youth with ASD is unknown. Gaining a better understanding of this relationship may allow researchers to refine intervention content and delivery. **Objectives:** (1) To examine overall ratings of acceptability for parents and children completing the Facing Your Fears (FYF) intervention (Reaven et al., 2011) (a group CBT treatment for youth with anxiety/ASD); and (2) To compare acceptability ratings for psychoeducation (sessions 1-6) and exposure (sessions 7-13) among parents and children; and (3) To determine the association between acceptability and child outcome (child and parent report on the SCARED). **Methods:** This study was part of a larger, multi-site study, investigating the impact of clinician training on treatment fidelity and youth anxiety treatment outcome. A three group parallel design was used to randomize eight clinician cohorts to one of the three training conditions. Acceptability ratings were collected from parents and children who participated in the 14-week FYF intervention at four outpatient clinics across the US. Acceptability was rated for each activity across sessions and rated on a 5-point-Likert scale (1=Not helpful; 5=Very helpful). A sub-sample of 63 children with ASD ages 8-14 (and their parents) were included in the analyses. **Results**: Mean acceptability ratings for children and parents were high for the overall treatment (Parent Overall: *M*=4.4, *SD*=.42; Child Overall: *M*=4.12, *SD*=.64) Children and parents did not differ on their ratings for psychoeducation (Parent: *M*=4.39, *SD*=.40; Child: *M*=4.07, *SD*=.63) and exposure (Parent: *M*=4.46, *SD*=.48; Child: *M*=4.19, *SD*=.76) sessions. However, ratings of child acceptability of the overall treatment were significantly related to child outcome (child report on the SCARED), *r*=.292, *p*<.05. More specifically, higher child acceptability ratings of exposure sessions were significantly related to a reduction in child anxiety symptoms, *r*=.355, *p*<.05. **Conclusions:** Overall, parents and children rated the FYF treatment as helpful in treating anxiety. However, children who rate exposure sessions as helpful were more likely to report a reduction in anxiety symptoms. Given that exposure is considered an “active ingredient” in anxiety treatment, acceptability of exposure may in fact be important for change to occur. Implications for the importance of measuring acceptability in treatment research will be discussed.

133 **145.133** The Use of an Online Intervention to Improve Emotion Identification in Clinical and Non-Clinical Young Adults with a Range of Autistic Behaviors

C. Dickter[1], *J. Zeman*[2], *J. Burk*[1], *C. I. Mitchell*[1], *K. Chaney*[3], *J. Ball*[4] *and M. Urbano*[5], *(1)College of William & Mary, Williamsburg, VA, (2)Psychology, College of William and Mary, Williamsburg, VA, (3)Rutgers University, New Brunswick, NJ, (4)EVMS, Norfolk, VA, (5)Eastern Virginia Medical School, Norfolk, VA*

Background:
Individuals with autism spectrum disorder (ASD) exhibit differences in selective attention and emotion identification compared to non-ASD individuals. Little research has developed interventions aimed at young adult individuals who display autistic behaviors, although this is a developmental period of critical transitions.
Objectives:
This study aimed to develop and evaluate novel, short-term, online training sessions to improve selective visual attention and emotion identification in young adults with a wide range of ASD behaviors. Changes in task performance over time were assessed, as were potential differences between participants with a clinical autism diagnosis and a group of non-diagnosed individuals with high or low degrees of autistic behaviors.
Methods:
Fifty-four individuals (28 males; *Mage* = 19.73) completed the training sessions. Autistic behaviors were assessed with the Autism Quotient (AQ; Baron-Cohen et al., 2001). Seventeen individuals clinically diagnosed with ASD were recruited from the autism clinic at a local medical school (M_{AQ} = 26.50; *SD* = 3.93). The remaining participants were recruited from a small liberal arts university, 20 of whom reported autistic traits in the clinical range (M_{AQ} = 30.14; *SD* = 4.38) and 17 who reported few autistic behaviors (M_{AQ} = 9.47; *SD* = 2.52). The training strategies included eight online sessions completed over the course of three weeks. The training sessions included: 1) an oddball task that trained participants to press a key on some trials while refraining from responding on others, 2) a classic Stroop task, 3) a task training participants to identify the emotions of faces varying in the ambiguity of the emotion, 4) a task that trained participants to switch between identifying emotions on faces and identifying the color of the backgrounds behind the faces, 5) an antisaccade task training participants to identify emotion faces on either side of a screen, and 6) a task in which participants were trained to identify the emotions displayed by faces in which only the eyes were presented.
Results:
Performance on the six training tasks was assessed with a series of 3 (Number of Training Sessions) x 3 (Group: Clinical, High AQ, Low AQ) mixed-model ANOVAs. Results revealed that there was a significant interaction on the eyes training task, $F(4, 102) = 4.12$, $p = .006$. Simple main effects analyses demonstrated that over the course of the three sessions, both the clinical sample (M_1 = 58.12; M_2 = 65.93; M_3 = 70.83), $F(2, 32) = 22.45$, $p < .001$, and the non-clinical High AQ sample (M_1 = 79.59; M_2 = 83.06; M_3 = 84.03), $F(2, 38) = 4.36$, $p = .029$, showed significant improvements. The low AQ sample did not show improvement. There were no differences in performance on the other tasks.
Conclusions:
These data indicate that an online intervention using a complex task involving the recognition of emotions might improve the ability of diagnosed individuals or those who report high levels of autistic behaviors to recognize emotional expressions.

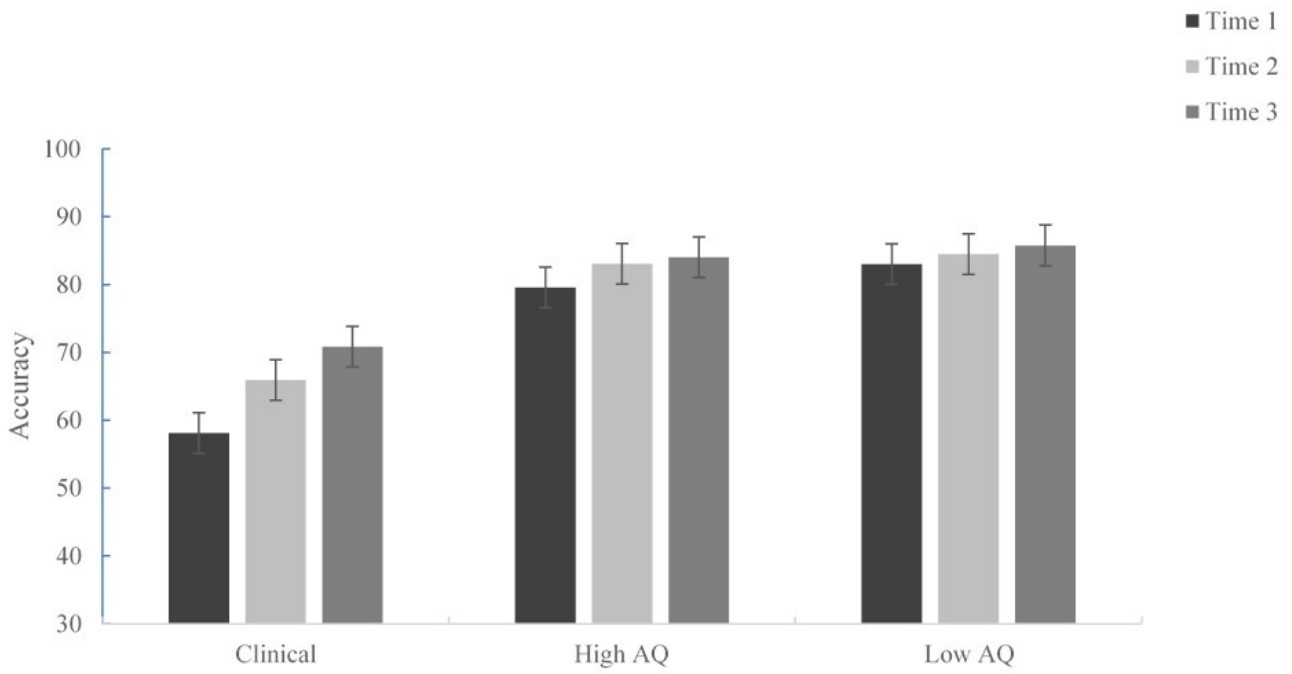


Figure 1. Accuracy on the eyes task as a function of group and training session.

Note. Error bars represent standard error.

134 **145.134** Training Teachers Implementing Reading Skills & Literacy Programming within Schools

K. Johnsen[1]*, J. Salt*[1] *and S. LaMontagne*[2]*, (1)Have Dreams, Park Ridge, IL, (2)Have Dreams, Evanston, IL*

Background:
While some students with ASD may proceed through literacy development at a typical pace, many students struggle with some aspect of literacy skills. Students with ASD may struggle with letter recognition, decoding, or reading comprehension. In addition, some characteristics of ASD, e.g. theory of mind and struggles with understanding social behavior, may affect the interpretation of a characters intentions or actions in a storyline. Teachers rarely receive specialized training in autism, and may encounter difficulties in their attempts to provide effective literacy opportunities for their students with ASD.
During our training, participants learn how to apply literacy interventions across a range of skill sets (early reading, emergent reading, fluent readers). The training is multi-modal. It includes lectures, real life examples, video demonstration, and opportunities to create adapted reading materials. At the end of training, participants must be able to create and teach reading activities; as well as provide multiple literacy opportunities for their pupils. The training incorporates structured teaching methodology which is specifically designed to accommodate the characteristic strengths, and neurological differences of individuals on the autism spectrum.
Objectives:
This study investigated the effectiveness of the training model to increase teacher competence in literacy programming. The study addressed (i) competence of literacy programming gained across the training period (ii) the implementation of specific reading strategies following training.
Methods:
(i) Participating teachers (n= 70) who attended the training workshop completed a structured questionnaire pre and post training.
The questionnaire was developed and piloted by the lead trainers to assess key aspects of literacy skills interventions. Each of three sections described a student with skills sets at the concrete level (pre-reader); intermediate level (emergent reader); abstract level (fluent reader). Participants answered four questions in each section regarding that child. The final questionnaire had 12 questions; maximum total score of 72.
(ii) 10-14 days following training, participants were contacted by email and asked to return a survey of literacy skills strategies they implemented in their schools.
Results:
i) T-test revealed that there was a significant (p<.01) increase in competence scores pre and post training at each level of literacy development (concrete, intermediate, abstract).
ii) A response rate of n= 42 (60%) was achieved for the follow up survey.
Follow up questions indicated that some aspect of the structured teaching training was implemented into practice by n=40 (95%) of responders. Direct observation of a small number of classrooms was achieved at follow up (n=10). Self-report and direct observation of implemented strategies was 100%, indicating that self-report was accurate in a small sample.
Conclusions:
By attending the training, participants increased their confidence in their ability to teach literacy, at any level of reading ability, to individuals with ASD. Furthermore, once they returned to their home schools they implemented a multitude of literacy techniques. Although satisfaction of training was very high, desire for ongoing consultation is an issue that could be addressed. These results indicate the effectiveness of our training program. The training is now being provided to other professionals in the field.

135 **145.135** Treatment Fidelity and the Mainstream Environment: Predictors of Successful Outcomes for ASD Youth

M. C. Wills[1]*, L. Kenworthy*[2]*, L. Cannon*[3]*, J. F. Strang*[4]*, C. Luong-Tran*[5]*, J. L. Sokoloff*[6]*, E. Bal*[7]*, A. C. Armour*[8] *and L. G. Anthony*[1]*, (1)Children's National Medical Center, Rockville, MD, (2)Children's Research Institute, Children's National Medical Center, Rockville, MD, (3)Ivymount School, Rockville, MD, (4)Children's National Medical Center, Silver Spring, MD, (5)Children's National Medical Center, Center for Autism Spectrum Disorders, Lorton, VA, (6)University of Missouri, Columbia, MO, (7)Kennedy Krieger Institute, Baltimore, MD, (8)Children's National Medical Center, Arlington, VA*

Background: Thirty-seven percent of students with an autism spectrum disorder (ASD) spend the majority of the school day in the mainstream environment, making inclusion classrooms the optimal setting for the delivery of ASD interventions (U.S. Department of Education, 2015). However, the increased executive and social demands present within this environment pose major challenges for the dissemination of evidence-based treatments (Humphrey & Lewis, 2008). Therefore, it is critical for researchers to measure the extent to which interventions are being delivered as intended within the school setting, and utilize this information to make treatment manuals more accessible, identify optimal levels of treatment fidelity, and enhance student outcomes.
Objectives: The purpose of this study is to 1) evaluate the role of treatment fidelity and interventionist characteristics on student behavioral outcomes; 2) examine the relationship between fidelity and the experience/training of the interventionist; and 3) determine group differences in fidelity, interventionist characteristics, and student outcomes.
Methods: All children had IQ>70 (*M*=108.45, SD=18.01), met ASD criteria on the ADOS or ADI, and were in the 3rd–5th grade (*M*=9.52, *SD*=1.02). Participating schools (N=14) were randomly assigned to either the UOT intervention (10 schools; 16 interventionists; 47 students) or a social skills training program (4 schools; 7 interventionists; 20 students).
Fidelity observations were used to evaluate the quality of treatment implementation across the 23 intervention groups (e.g., intervention adherence, group/time management, student engagement, etc.). Classroom observations were conducted to measure pre-post changes in real-world functioning (i.e., cognitive flexibility, planning, and social appropriateness). All observations were conducted by a blind evaluator 2-3 times throughout the school year (~15 minutes each). The Challenge Task (CT), an ADOS-like interview designed to measure executive functioning, was also used as a measure of pre-post change in flexibility, planning, and social appropriateness. Independent

samples t-tests were used to evaluate group differences. Correlational analyses were used to measure the relationship between fidelity and interventionist experience/training. Longitudinal linear models with random effects for school and student were used to measure the effect of fidelity on student outcomes.
Results: There were significant group differences in treatment fidelity (t=3.45, p<.01), acquired knowledge (t=-2.24, p<.05), years of experience (t=3.2, p<.01), with UOT interventionists demonstrating higher levels of acquired knowledge (M=70.31, SD=18.42) and SST interventionists adhering to higher levels of fidelity (M=86.92, SD=5.14) and having more years of experience (M=16.20, SD=12.04). In comparison to SST, UOT groups also demonstrated greater improvements in CO Plan (t=-6.97, p<.001), CO Flex (t=-11.02, p<.001), and CO Social (t=-6.44, p<.001). Treatment fidelity was correlated with higher levels of acquired knowledge, r=.40, p<.05. There was no significant effect of treatment fidelity, years of experience, or acquired knowledge on student outcomes.
Conclusions: Results suggest that high levels of treatment fidelity and professional experience are not required in order to achieve successful treatment outcomes in the mainstream educational setting. While additional research is needed in this area, these data provide support for the training of school personnel to implement evidence-based practices for students with ASD.

136 **145.136** Understanding Theory of Mind Improvements As a Result of Face Processing Instruction

C. A. Wall[1], *L. Rice*[2] *and F. Shic*[1], *(1)Yale Child Study Center, Yale University School of Medicine, New Haven, CT, (2)Moorpark Unified School District, Simi Valley, CA*

Background: *FaceSay* is a computer-based intervention that offers students simulated practice with eye gaze, joint attention, and facial recognition (Symbionica, LLC). Previous research has demonstrated that *FaceSay* improves emotion recognition and theory of mind (ToM) in school-aged children with ASD (Rice et al., 2014). ToM skills are not directly targeted with *FaceSay*, and the mechanism behind these improvements is not yet understood. In order to determine the specific components of ToM that are affected by this intervention, between-group differences in categories of items on the NEPSY-II ToM subscale were examined (Korkman, Kirk, & Kemp, 2007).
Objectives: To explore the components of ToM that are influenced by intervention with *FaceSay*. Potential differences were assessed using a: 1) theoretical approach to item grouping based on the NEPSY-II manual, and 2) statistical approach to item grouping.
Methods: Thirty-one school-aged children (M_{age}=7.76 years) meeting the educational criteria for ASD participated in a randomized-control trial studying the effects of intervention with FaceSay (Experimental group) versus an educational program (Control group) for 10 weeks. Students' ToM skills were assessed pre- and post-intervention using the ToM subtest of the NEPSY-II. Items were grouped into constructs using the NEPSY-II manual and exploratory factor analyses (EFA) with Varimax rotation. The Verbal Task and Contextual Task were treated separately for all analyses. Theoretical constructs were excluded if they were indexed by only one item. Factors were generated using pre-intervention data, and regression scores were calculated for each student at both time points using pre-intervention models. Repeated-measures ANOVAs were conducted to assess the effects of the intervention on each set of items.
Results: Results of the theoretical analyses indicated that groups differed on items assessing the understanding of false belief (F(29,1)=5.59, p<.05, partial η^2=.19), imitation (F(29,1)=8.55, p<.01, partial η^2=.28), and figurative language (F(29,1)=10.33, p<.01, partial η^2=.26), with those undergoing the intervention experiencing greater improvement. Results of the EFA recommended extracting five components, accounting for 63.7% of the variance. Repeated-measures ANOVAs resulted in a significant effect for the fourth factor (F(29,1)=7.86, p< .01, partial η^2=.21). This factor represented higher performance on items 4 (imitation/pretending) and 15 (understanding figurative language) of the NEPSY-II, with individuals in the the Experimental group seeing greater improvement. These items were similar, and unique, in that they both mentioned fingers and required students to think abstractly about this body part.
Conclusions: Results highlight two methods for assessing change in ToM as a result of intervention with *FaceSay*. There was some overlap in the items that were noted by both sets of analyses. Intervention with *FaceSay* led to improvements in imitation and figurative language items. The construct most closely targeted by *FaceSay* is imitation; the game "Follow the Leader" asks students to manipulate one avatar's face to match the facial expression of another. In addition, the game often offers instruction or reinforcement using figurative language, such as "Let's roll!" that offers students additional exposure to this manner of speaking. Future work should continue to explore the beneficial effects of *FaceSay* intervention.

137 **145.137** Understanding the Essential Elements of a Transition Program in Preparing Individuals with Autism Spectrum Disorder for Adulthood

G. Y. H. Lam[1], *J. C. Timmons*[2] *and A. Zalewska*[2], *(1)School Psychology Program, Department of Educational and Psychological Studies, University of South Florida, Tampa, FL, (2)Institute for Community Inclusion, University of Massachusetts Boston, Boston, MA*

Background:
There is an increasing number of individuals with Autism Spectrum Disorders (ASD) entering adulthood. They struggle through the post-school transition to attain promising adult outcomes, such as employment and postsecondary education. A 30-week multi-component community-based transition program provides these young adults with opportunities for self-exploration and career planning through activities such as classroom instruction, internship experience, and peer mentoring.
Objectives:
To understand stakeholders' experiences and to investigate the essential elements in a community-based transition program that aims to promote independence and support post-school outcomes in young adults with ASD.
Methods:
As a part of a program evaluation, 18 stakeholders were recruited to participate in individual semi-structured interviews. A purposeful sampling method was used to recruit a range of stakeholder groups, including program staff, peer mentors, community collaborators, students with ASD, parents, alumni with ASD who had graduated from the program, and alumni's parents. Stakeholders were asked to describe their experience in the program, how their experience contributed to students' growth and development, and recommendations for improvements. All interviews were transcribed verbatim and were subjected to thematic analysis using a constant comparative method, which involved generating themes and codes as well as memo writing.
Results:
Findings from the qualitative data analysis revealed a set of values that permeated all program components, including student-centeredness, strength-based perspective, customized and individualized supports, and organizational and professional development. These fundamental principles pervaded each of the main program components, namely knowledge about self and career, practice in real-world contexts, and support through a safe environment. Throughout the program, both students and parents underwent a period of personal growth and transformation, in which parent transformation was marked by learning to "let go," while student transformation manifested as an emerging confidence in terms of (a) self-awareness, (b) self-esteem, (c) independence, (d) preparedness, and (e) social competence. Stakeholders also identified program barriers and suggested areas of improvement, including (a) strengthening autism awareness training to external collaborators; (b) providing structured support to the internship experience; (c) building partnerships with the local community; (d) providing instructional support to students with diverse abilities; (e) explicating program mission and expectations; (f) providing support to families and peer mentors; and (g) building post-program student and family capacity.
Conclusions:
The present program evaluation revealed essential program features that support youth-to-adulthood transition for individuals with ASD. Poster participants will be able to learn about effective components of a transition program and to incorporate them within their current programs and future endeavors to improve adult outcomes of the ASD populations. Future research could further explore the evidence base of the abovementioned programmatic features with a more vigorous design.

138 **145.138** Using Multiple Informants to Assess Social Functioning and Treatment Outcome for Adolescents with ASD Following the UCLA PEERS® Program

E. Veytsman[1], *C. Ferrendelli*[1], *J. W. Yang*[2], *C. C. Bolton*[1] *and E. A. Laugeson*[1], *(1)Psychiatry and Biobehavioral Sciences, UCLA Semel Institute for Neuroscience and Human Behavior, Los Angeles, CA, (2)The Help Group-UCLA Autism Research Alliance, Sherman Oaks, CA*

Background: Assessment of social functioning of youth with social challenges consistent with Autism Spectrum Disorder (ASD) is complicated by conflicting informant perceptions. For youth with ASD, self-report of symptoms of psychiatric diagnoses should be interpreted with caution (Mazefsky et al. 2011), as this population has shown poor diagnostic agreement with parents (Storch et al. 2012), underscoring the need for multiple informants, including teachers and therapists. Research shows concordance rates between parent and adolescent report are widely heterogeneous, dependent upon the instrument, the disorders under investigation, and the informant characteristics (Mazefsky et al. 2011). Understanding the discrepancy between parent, teacher, and self-report of social functioning and treatment outcome among youth with social challenges is critical for determining the most reliable informants.
Objectives: The current study examines perspectives from multiple informants following a 14-week evidence-based social skills intervention for adolescents with ASD in order to investigate perceptual differences of social skills functioning and changes over time.
Methods: Participants included 239 adolescents with ASD referred for social skills training in outpatient and school settings. Among the clinic sample, participants included 133 adolescents (males=110; females=23) 11-18 years of age (M=14.02, SD=1.79) with ASD who attended 14 sessions of a weekly 90-minute social skills group with their parents using the Program for the Education and Enrichment of Relational Skills (PEERS®; Laugeson & Frankel 2010). Within the school sample, participants included 106 adolescents (males=86; females=20) 11-18 years of age (M=15.08, SD=1.82) with ASD who received daily teacher-facilitated social skills instruction in the classroom using the PEERS®school-based curriculum (Laugeson 2014). In order to assess perceptual differences of social functioning, adolescents and parents completed the Social Anxiety Scale (SAS; La Greca 1999), Quality of Socialization Questionnaire (QSQ; Frankel & Mintz 2008), and Empathy Quotient (EQ; Baron-Cohen & Wheelwright 2004) at pre and post-test. Parents and teachers also completed the Social Skills Improvement System (SSIS; Gresham & Elliott 2008) and Social Responsiveness Scale (SRS; Constantino 2005) pre and post-treatment. Paired sample T-tests and Pearson product-moment correlations were conducted to examine informant perceptions of adolescent social functioning across settings, and Bonferroni adjustments were made.

Results: Results reveal moderate and significant correlations between parent, adolescent and teacher report for measures of social functioning. However, there were significant differences (*p's*<.001) between parent and adolescent report of social anxiety and engagement, and parent and teacher report of social skills and autism symptoms at baseline and post-treatment. These differences decrease at post-treatment across measures in both samples, signifying increased agreement between informants following intervention. Conversely, differences in adolescent and parent report of social engagement measured by the QSQ significantly (*p*<.001) increase at post-treatment in the school-based sample.
Conclusions: This study highlights the complexity of using multiple informants in the assessment of social skills across settings. Although significant differences between reporters decreased over time in the outpatient sample following treatment, the increase in differences in the school-based sample may be explained by less parent involvement in this setting. The results demonstrate the need for multiple informants in social skills assessments.

Table 1, *Concurrent Validity of Parent and Adolescent Report of Social-Engagement Post Treatment*

	QSQ Parent Report		
	r	*p*	*N*
Teen report: Hosted get-togethers (Clinic)	.31	< .001	111
Teen report: Invited get-togethers (Clinic)	.31	< .001	111
Teen report: Hosted get-togethers (School)	.44	< .000	76
Teen report: Invited get-togethers (School)	.18	.31	76

Note. Pairwise deletion was used in the calculation of bivariate correlation coefficients, resulting in small decreases for the sample sizes across the measures included in this analysis. QSQ=Quality of Socialization Questionnaire (Frankel & Mintz, 2008).

139 **145.139** Using Peers As Supports for Adult College Students with ASD

J. Hooker[1], *L. Morgan*[2], *T. Dasher*[2] *and A. Leatzow*[2], *(1)Communication Science and Disorders, Florida State University, Tallahassee, FL, (2)Florida State University Autism Institute, Tallahassee, FL*

Background:

As a result of the increased prevalence rate (CDC, 2014), a larger of population of individuals with autism spectrum disorder (ASD) and normal intelligence are transitioning into college. While 'high functioning' individuals have the intellectual capability to participate in postsecondary education, their success is often stymied by difficulties in the areas of executive functioning, social communication, and mental health. Currently, these challenges are met with a dearth of research examining the effectiveness of supports and programs designed to promote success (Gelbar, Smith, & Reichow, 2014), highlighting the need for systematic studies with this population.

Objectives:

This study seeks to evaluate the initial effectiveness of the *College Peer Coach Program* for adult college students with ASD. We hypothesize that adults who participate in the program will report positive gains on measures of well-being and executive functioning between baseline and post-intervention.

Methods:

Five adults diagnosed with ASD, currently enrolled at a local post-secondary institution, were initially recruited for the current study. Participants, all of whom are male, range in age (18 to 24) and academic rank (1 freshman, 3 sophomores, and 1 junior). A series of self-report measures related to well-being (e.g., WHOQOL-BREF, GAD-7, PHQ-9), executive functioning (BRIEF-A), and reported needs (College Student Needs Assessment) are administered at the start and conclusion of each semester. Participants were randomly assigned to a trained, undergraduate Peer Coach to meet on a weekly basis for 12 weeks each semester of participation. Peer Coaches were trained to support participants in areas related to social participation, communication, college adjustment, and independence using four strategies either evidence-based for children and adolescents with ASD or recommended for college students with ASD by experts in the literature: visual supports, role-playing, direct questioning, and environmental arrangements (Wong, et al., 2014; Wolf, Brown, & Bork, 2009; VanBergeijk, Klin, & Volkmar, 2008).

Results:

Preliminary analyses of baseline measures (N=5) confirm significant need in the areas of social participation, executive functioning, and well-being. WHOQOL-BREF scores indicated lower quality of life ratings in the social domain (mean domain score = 9.00) compared to averages of a larger sample of individuals with similar demographics (Skevington, Lotfy, & O'Connell, 2004). BRIEF-A scores highlight difficulties in the area of metacognition, (mean T-score= 62.00); with the greater difficulty reported on the initiating, shifting attention, and planning/organizing subscales (mean T-scores: 60.00 for all). Participants also endorsed an elevated number of depression symptoms according to PHQ-9 scores (mean= 5.8). An additional three to five participants will be recruited during the following semester. Pre-intervention and post-intervention score differences on all outcome measures will be presented.

Conclusions:

These preliminary results provide an indication of challenges reported by current college students with ASD. In concordance with the literature, this sample experiences particular difficulties in the areas of executive functioning and social participation. Future analysis of the relationship between peer support and outcome measures will be discussed.

140 **145.140** Using a Parent-Assisted Gaming Intervention to Improve the Social-Emotional Skills of Children with Autism Spectrum Disorders – a Randomized Controlled Trial

R. B. Beaumont[1]*, H. A. Walker*[2] *and K. Sofronoff*[3]*, (1)Social Skills Training Institute, St Lucia, QLD, Australia, (2)School of Psychology, University of Queensland, St Lucia, Australia, (3)School of Psychology, University of Queensland, Brisbane, QLD, Australia*

Background:

Families living in remote locations often have limited access to specialist Autism Spectrum Disorder (ASD) services. Tele-health services offer a cost-effective, practical solution to this problem. Few studies have evaluated the utility of this approach for parents of children with ASD, however, particularly in the domain of social-emotional skills training.

Objectives:

To evaluate the effectiveness of the Secret Agent Society Computer Game Pack (SAS) with weekly online/telephone group parent support in improving the emotion regulation and social skills of children with ASD.

Methods:

Seventy children with ASD (60 males, 10 females) aged between 7 and 12 years (M= 9.89, SD = 1.37) and their parents participated in the trial. All children had cognitive abilities at least within the average range and were recruited from three Australian states. Parents were primarily married, of European ethnicity and tertiary educated. Families were randomised to the SAS or CIA conditions. The SAS condition involved parents participating in a 150 minute group Skype introductory meeting with the lead trial researcher, followed by 10 weekly group phone or Skype informal support sessions. These sessions focused on helping parents to problem-solve challenges in helping their child to play the SAS computer game each week and to complete associated skills practice tasks ('Home Missions'), described in a brief program delivery guide. Computer game activities taught children how to recognise emotions and apply emotion regulation strategies when facing social challenges.
The CIA condition involved a comparable level of online/Skype group parent support provided by the same researcher, with parents helping their child to complete non-therapeutic activities from an online Central Intelligence Agency website for kids (described in a program delivery guide) over a 10 week period.

Results:

Intention to treat Mixed-Model ANOVAs showed that SAS participants made significantly greater improvements than CIA participants on parent report measures of emotion regulation and social skills (ERSSQ-P; $p < .0005$) and social skills (Spence Social Skills Questionnaire–Parent version (SSQ-P); $p<.0005$) from pre- to post-treatment. Children in the SAS group also showed greater improvements in their knowledge of anxiety management strategies than those in the CIA condition on a story-based task (James and the Maths Test; $p= .001$). There was no difference between SAS and CIA participants' improvements in knowledge of appropriate anger management strategies on a similar task (Dylan is Being Teased), however ($p =.18$). On teacher-report measures, there was no difference in the improvement made by participants in the SAS and CIA conditions ($p=.60$) on a measure of emotion regulation and social skills (ERSSQ-T). However, there was a greater improvement in teacher ratings on an independent social skills measure (SSQ-T) for the SAS group relative to the CIA group ($p = .04$). Results from analysing webcam footage of children's use of emotion regulation strategies when playing a frustrating computer game at pre- and post-treatment are pending, and will be presented.

Conclusions:

Results suggest that the parent-assisted gaming intervention may be an effective social-emotional skills training option for families of children with ASD who have limited access to services.

141 **145.141** Vocational Rehabilitation Service Use Among Youth and Young Adults with Autism: Comparing Students and Non-Students

J. Rast[1]*, P. Shattuck*[2] *and K. A. Anderson*[1]*, (1)A.J. Drexel Autism Institute, Philadelphia, PA, (2)A.J. Drexel Autism Institute, Drexel University, Philadelphia, PA*

Background: Vocational rehabilitation (VR) provides a wide array of services (such as rehabilitation counseling, job skills training and job placement) to help facilitate employment among people with disabilities, including those with autism. Studies suggest that an individual's probability of employment varies by the types of VR services he/she receives. The types of services that a client receives through VR may differ between individuals who are and are not enrolled in school. Because the use of specific services during VR is known to be associated with an employment outcome, studying the pattern of service use in different types of users is important. Understanding patterns of service use may lead to a better understanding of the interaction of the VR system with different groups of VR users.
Objectives: We aim to identify service use patterns in VR users with autism, classifying separately those who enter VR as high school students, other students, and non-students.
Methods: Data came from the federal Rehabilitation Services Administration (RSA) 911 database which contains records for cases closed by state VR agencies. We analyzed data for 8531 clients with autism under the age of 25 who received services and had a case closed in 2013. We used latent class analysis to identify classes of individuals with autism with differing service use patterns, separating high school students, other students, and non-students at the time of VR application.
Results: Half of clients with autism under the age of 25 apply for VR while they are a student and of those, almost 75% are high school students. Among students, there are four clear types of VR service users: light users who receive one or two services, light users who receive mostly VR counseling and one or two other services, medium users who receive VR counseling and practical job assistance (such as placement and supports), and heavy users that often receive five or more services. The main difference between high school students and other students is that high school students more often receive information and referral services than other students. There are more differences in service use patterns between students and non-students. Non-students fall into three classes of users which share general characteristics of student users: light users who use one to three services, users who receive few services but do get VR counseling, and heavy users who receive five or more services.
Conclusions: The different patterns of service use between high school students, other students, and non-students may be linked to practices in place for different types of applicants. However, the variability within a single group may be related to differing levels of need or levels of unmet need in some of the users. In addition to seeing the variability in type and number of services provided, the presence of a pattern of light service use in all three groups suggests there is room for intervention to improve VR provision for all clients.

142 **145.142** Workplace Social Skills Program Evaluation for Young Adults with Autism Spectrum Disorder

H. Thomas *and T. P. Gabrielsen, Brigham Young University, Provo, UT*

Background: Social skills are among the primary deficits of young adults with autism spectrum disorder (ASD). The outcome of such social impairments not only hinders peer and familial relations, but also creates a difficulty in obtaining and maintaining employment. Those with ASD find it difficult to interview for job positions, socialize appropriately with coworkers and the public as well as adapt to changes in normal work environments. A wide range of studies have focused on interventions to improve

social skills; however, very few have specifically addressed social skills in the workplace. Located in Utah, Easter Seals Goodwill Northern Rocky Mountains (ESGW) has created a nine-week transition program called Peer Connections, designed to help young adults with disabilities gain skills and independence, as a direct response to individual needs in the disability community. Peer Connections seeks to improve workplace social skills of individuals with high functioning autism or other social communication disorders who are transitioning to adulthood in accordance with the Individuals with Disabilities Education Improvement Act (IDEIA).
Objectives: This study examines the effectiveness of Peer Connections' supported experience with peers, adult coaching, feedback, and self-evaluation in a volunteer work environment. Participants were paired with typical peers as "co-workers" and assigned a work site (e.g., Museum of Natural Curiosity) to combine natural social supports with instruction and practice in working with the public and meeting the demands of a job. Because ESGW is not a research institution, Peer Connections has never been evaluated and therefore partnered with BYU to obtain objective evidence regarding its effectiveness.
Methods: Participants in the program were predominantly male between the ages of 15-24. Participants underwent eight hours of extensive preliminary assessments, provided by ESGW, before the interventions were implemented. These assessments were used as baseline data and were compared with end of program assessments. Both a peer and site facilitator observed participants during their public interface time each week and completed an ESGW feedback form. Additional social skills assessments and self-reported inventories were used on a weekly basis to guide skill development goals. Participant performance was measured periodically using the SRS-2, SRSS, and self-report (SRS-2) in addition to weekly on-site observations. Participant assessments from past years were also analyzed. Follow-up measures and observational generalization probes were performed.
Results: Preliminary results suggest observable changes in coping skills, conversation initiation, maintaining conversations, and eye contact. Post-intervention assessments by self-report typically declined compared to pre-intervention, possibly an indication of increased insight into areas for improvement. Social validity assessment indicates that participants liked the intervention, felt they had improved, would recommend it, and would do it again. Generalization probes are ongoing to determine maintenance effects outside of the training environment.
Conclusions: Peer support, adult coaching, feedback, and self-evaluation in a real work environment may positively increase social skills in the workplace for individuals with ASD. Separate from vocational training, this study will fill a gap in the literature and in practice on social skills intervention for workplace conditions.

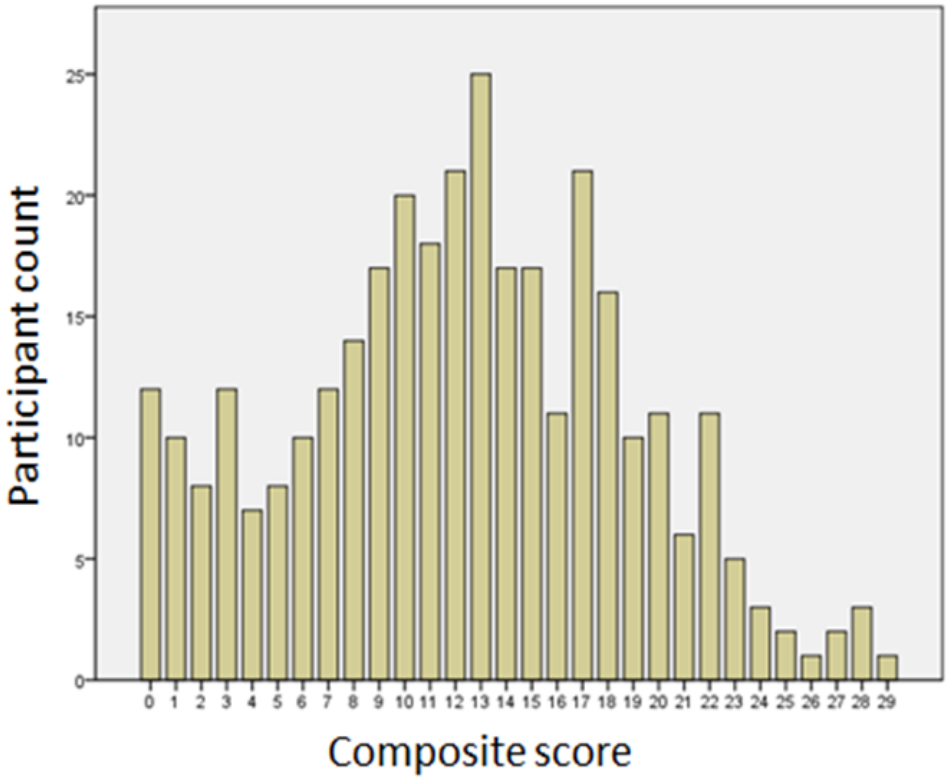
Poster Session
146 - Sensory, Motor, and Repetitive Behaviors and Interests
11:30 AM - 1:30 PM - Hall A

143 **146.143** A Parent-Report Measure of Restricted and Repetitive Behaviors for Early Childhood

J. J. Wolff[1], *B. Boyd*[2] *and J. T. Elison*[3], *(1)University of Minnesota, University of Minnesota, Minneapolis, MN, (2)University of North Carolina at Chapel Hill, Chapel Hill, NC, (3)University of Minnesota, Minneapolis, MN*

Background: Restricted and repetitive behaviors (RRBs) are defining features of autism spectrum disorder (ASD) which emerge early in life and may differentiate children who do and do not develop the disorder during toddlerhood (Wolff et al., 2014; Elison et al. 2014). These behaviors also occur as part of typical early development, supporting the acquisition of more complex and goal-directed behavior (Evans et al., 1997; Thelen 1979). Existing paper and pencil measures of RRBs are largely anchored in pathological features seen in older children and adults. As a result, they and are not intended to capture individual differences in restricted and repetitive behaviors among young children.
Objectives: Our goals were twofold: 1) To adapt the Repetitive Behavior Scale, Revised (RBS-R; Bodfish et al., 2000) for use among typically and atypically developing children during early childhood; and 2) To collect pilot data on the measure from a large cohort of typically developing children.
Methods: We developed the Repetitive Behavior Scale for Early Childhood (RBS-EC), a brief (~10 minute) parent report measure consisting of 34 items. The measure is comprised of 4 subscales constituting categories of repetitive behavior congruent with existing measures and theoretical constructs: repetitive motor, self-directed/self-injurious, restricted, and ritual/routine. Unlike most existing measures, the RBS-EC focuses on frequencies (rather than severity) of behavior and yields both subscale and total scores for frequency and behaviors endorsed. Content validation was performed through feedback from outside experts in repetitive behavior and child development. Initial beta testing and feedback was obtained from parents of both typically and atypically developing children (infants through early school age). We performed preliminary psychometric analyses of 330 data sets collected from parents of 18 to 25 month-old children. The data were ascertained from a quasi-epidemiological sample recruited from the Institute of Child Development's research registry as part of a larger study investigating quantitative phenotypes in young children.
Results: The distribution of total repetitive behavior endorsed scores is presented in Figure 1. Internal consistency for the total RBS-EC was excellent ($\alpha = 0.91$). For subscales, internal consistency ranged from adequate to excellent (repetitive motor: $\alpha = 0.94$; self-injurious: 0.74; restricted: 0.81; ritualistic: 0.78). Test-retest reliability for total and subscale scores were in the excellent range (ICC > 0.90).
Conclusions: Initial results suggest that the RBS-EC is sensitive to individual differences in repetitive behaviors among typically developing toddlers, providing highly dimensional behavioral data. This is in contrast to the floor effects seen in the application of more clinically-oriented and less developmentally appropriate measures of repetitive behavior to typically developing young children. Next steps include examining the RBS-EC factor structure and psychometric properties in our full sample of 800+ children as well as expanding our sample to include children of different ages and children who are developing atypically.

Figure 1. Distribution of total repetitive behaviors endorsed for n = 330 toddlers



144 **146.144** A Study of Assessments: A Comparison of Bsiq and RBS-R Reported Rrbs

S. M. Attar, *P. C. Hickey and E. Hanson, Developmental Medicine Center, Boston Children's Hospital, Boston, MA*

Background: Restricted and repetitive behaviors (RRBs) include a broad category of behaviors which are considered core characteristics required for a diagnosis of Autism Spectrum Disorder (ASD) according to the Diagnostic and Statistical Manual (DSM-V; American Psychiatric Association, 2013). Parents have often reported that RRBs can be the most stressful aspect of ASD (Bishop, Richler, Cain & Lord, 2007). RRBs can be subdivided into repetitive and sensory motor behaviors (RSM) and Insistence on Sameness behaviors (IS). This study analyzes the difference between RRB IS, RSM, and Total composite scores as measured by two assessments: the Behavior and Sensory Interest Questionnaire (BSIQ) (Hanson et. al. 2015) and the Repetitive Behaviors Scale – Revised (RBS-R) (Bodfish, Symons & Lewis, 2000).
Objectives: This study aims to assess if the BSIQ and RBS-R report the same number of presenting RRBs.
Methods: A sample of 513 children with ASD (82% male) was drawn from the Simons Simplex Collection and the Boston Autism Consortium. Participant ages were between 24-216 months, (mean=92.3, SD=45). ASD diagnosis was verified with the Autism Diagnostic Observation Schedule (ADOS) and Autism Diagnostic Interview-Revised (ADI-R). Parents were administered the BSIQ, designed to evaluate the number, type, and intensity of RRBs, by a trained clinician. The RBS-R, also designed to evaluate the number, type, and intensity of RRBs, is a parent report survey that parents completed independently. Preliminary analysis included descriptive statistics and a series of paired-T tests to determine if a significant difference exists between IS, RSM, and Total composite scores on the BSIQ and RBS-R within the same population. The severity scale on both measures (0-3) was collapsed to a Yes/No binary for all statistics.
Results: Preliminary analyses revealed a significant difference (.000) in the percent of behaviors reported on the BSIQ versus the RBS-R for RSM scores. 25% of respondents reported the presence of an RSM behavior on the BSIQ as compared to 29% on the RBS-R. Preliminary analyses revealed a marginally significant difference (.09) in the percent of behaviors reported on the BSIQ versus the RBS-R for IS scores. On average, 22% of respondents reported the presence of an IS behavior on the BSIQ as compared to 24% on the RBS-R. Preliminary analyses revealed that there is not a significant difference (.000) in the percent of overall behaviors reported on the BSIQ versus the RBS-R for Total Scores.
Conclusions: These preliminary analyses suggest that respondents are more likely to report a behavior on the RBS-R than on the BSIQ. It is possible that the BSIQ's specificity and clinical judgment results in less RRB quantity but a more accurate account of presenting RRBs and their severity. Further research should examine if a difference is reported specifically in the severity of behaviors on the RBS-R versus the BSIQ. As well, additional studies are required to determine which assessment method provides the most accurate measurement of presenting RRBs.

145 **146.145** An fMRI Investigation of Audiovisual, Auditory and Visual Processing in Autism Spectrum Disorder

P. Regener[1,2], *S. A. Love*[3], *K. Petrini*[4] *and F. E. Pollick*[5], *(1)School of Psychology, Glasgow University, Glasgow, United Kingdom, (2)Glasgow University, Glasgow, United Kingdom, (3)Institut de Neurosciences de la Timone, Marseille, France, (4)Department of Psychology, University of Bath, Bath, United Kingdom, (5)University of Glasgow, Glasgow, United Kingdom*

Background:
The ability to integrate auditory and visual information is crucial to everyday life. Behavioural results have predominantly shown that individuals with Autism Spectrum Disorder (ASD) have deficits in audiovisual integration. These findings have recently been supported by electroencephalography (EEG) studies (Brandwein et al., 2015).
Objectives:
There are limited data from functional magnetic resonance imaging (fMRI) studies investigating audiovisual processing in ASD. To address this issue and to reveal brain areas involved in audiovisual processing, the current fMRI study looked at audiovisual, unisensory auditory and unisensory visual processing in ASD. Two types of stimuli were used, complex social face-voice (FV) displays and simple non-social beep-flash (BF) displays.
Methods:
Participants included 13 adult males with ASD and age and 13 IQ-matched typically developed (TD) males. FV displays included an audiovisual condition of a face moving to say a single word and the voice saying the word, an auditory condition of a voice, and a visual condition a face moving to say a word. Similarly the BF displays included an audiovisual condition of a beep with a flashing circle, an auditory condition of a beep, and a visual condition of a flashing circle. The BOLD signal was obtained while participants were presented with blocks of audiovisual, auditory and visual conditions of FV and BF displays.
Results:
A random effects analysis contrasting groups revealed that processing of audiovisual as well as auditory and visual stimulus conditions in both the FV and BF displays was associated with reduced activation in ASD. Audiovisual, auditory and visual conditions of FV stimuli revealed reduced activation in ASD in regions of the frontal cortex, while BF stimuli revealed reduced activation in the lingual gyri. The inferior parietal gyrus revealed an interaction between sensory condition of BF displays and group.
A conjunction analysis was performed to show areas of audiovisual processing and revealed that the bilateral superior temporal cortex (STC) was sensitive to audiovisual information in ASD and TD for both types of displays. However, the activation regions of the STC were smaller in the ASD group. Additionally a superior frontal area was shown to be sensitive to audiovisual FV displays in the TD group, but not in the ASD group.
Conclusions:

Overall this study indicated differences in brain activity for audiovisual, auditory and visual processing of social FV and non-social BF displays in ASD compared to TD. These results were mainly characterized by the ASD group showing less activation than the TD group in auditory, visual and audiovisual regions. In addition, differences were found in frontal cortex for FV displays.

146 **146.146** Analyzing How Autism Severity Affects Motor and Social Skills: An Exploration Using the SFARI Base Dataset

A. M. Colombo-Dougovito[1] *and R. E. Reeve*[2]*, (1)University of Virginia, Charlottesville, VA, (2)University of Virginia, Earlysville, VA*

Background: Social skill deficits and repetitive behaviors are the defining features evaluated during autism spectrum disorder (ASD) diagnostic assessments. Assessment tools, such as the Autism Diagnostic Observation Schedule, 2nd Edition (ADOS-2; Lord, Rutter, Di Lavore, & Risi, 2002; Lord et al., 1989), evaluate the level of impairment within these two characteristics to provide an understanding of the extent of the disorder. In addition to the typical deficits associated with ASD, a growing body of research suggests that gross motor deficits are also present in most children with ASD (Liu & Breslin, 2013; Lloyd, MacDonald, & Lord, 2013; Staples & Reid, 2010). However, little is known about the effect of severity has on social and gross motor skills in children with ASD.

Objectives: The purposes of this study are to determine: (1) What effect does the level of severity have on the motor skills and social skills in children with ASD?, and (2) If a difference exists between severity groups, which dependent variable has the greatest effect?

Methods: Utilizing a sub-sample from the SFARI base dataset, a MANOVA was used to understand differences among the multivariate means of social skills and gross motor skills of 483 children with autism and autism spectrum disorder. The present sample was divided into two groups based on ADOS-2 severity output: (a) those diagnosed with autism (i.e., more severe, $N = 444$), and (b) those diagnosed with autism-spectrum (less severe, $N = 39$). Average age of the participants was 66.27 months or about 5.6 years of age. Mean for participants diagnosed with autism was 66.48, and mean for participants diagnosed with autism-spectrum was 63.92 (group differences were non-significant, $t_{(481)}=1.152$, $p = 0.250$).

Results: Wilk's criterion indicated the combined dependent variables were non-significantly affected by severity of the autism diagnosis, multivariate $F_{(2, 480)} = 1.640$, $p = 0.195$. Analysis of the between-subject effects univariate test further revealed a non-significant difference between the groups on gross motor scores, $F_{(1, 201.883)} = 1.303$, $p = 0.254$. Participants in the less severe group (autism-spectrum) scored arithmetically higher ($M = 83.31$) than those in the more severe (autism) group ($M = 80.93$). This non-significant difference was also seen in the social skill univariate evaluation, $F_{(1, 4535.986)} = 2.242$, $p = 0.135$. While the less severe group ($M = 70.62$) again scored higher in social skills than the more severe group ($M = 59.37$), as would be expected, differences were non-significant. Effect sizes further demonstrate a weak association between the gross motor and social skill of the groups, partial $\eta^2 = 0.003$ and partial $\eta^2 = 0.005$ respectively.

Conclusions: Results suggest that little difference exists between severity groups on gross motor and social skills; however, results may be limited to the age range of the participants (about 5.6 years of age). Differences in groups may become greater as children age. This analysis suggests that at a young age (about 5 years of age) there is little difference between severity groups within ASD and the severity of gross motor and social skills.

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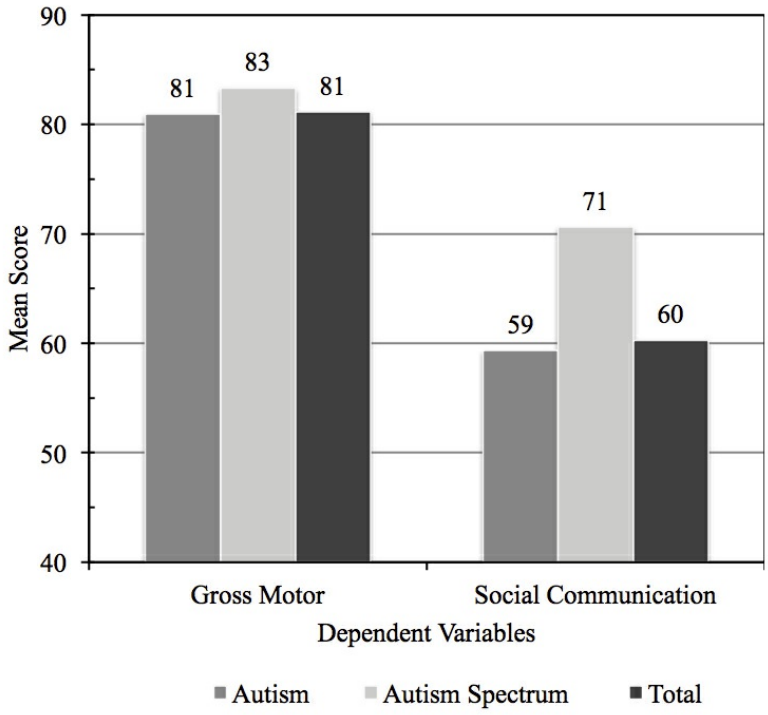
Figure 1: Sample Means by Group



147 **146.147** Anticipatory Gaze during Action Observation: Impact of Social Training on Children with ASD

J. L. Haworth[1], *K. Libertus*[2] *and R. Landa*[1], *(1)The Kennedy Krieger Institute, Baltimore, MD, (2)University of Pittsburgh, Pittsburgh, PA*

Background:
Anticipatory gaze in the context of goal directed hand actions are typically observed in children by their second year of life (Falck-Ytter, 2006; von Hofsten, 2004). Though, previous findings suggest that children with ASD tend to focus on mechanical properties of motion, with deficiency in social perception and attention to social activities (von Hofsten, 2009; Shic, 2011). With current intervention efforts to encourage social skills development (Kasari, 2012; Landa et al., 2011), it remains to be seen how goal-directed gaze is impacted by newly developed attentional biases (Chawarska, 2010).
Objectives:
Determine whether targeted social skills intervention improves social attention, without detriment to goal-directed attention and understanding of others' object interaction.
Methods:
Eighteen children with ASD participated in 5-months of parent-training (n=10), or 'combined'-training (n=8) where parent-training was augmented with classroom training to promote social interaction with targets including (a) face-processing: attention to faces, face recognition; (b) social-anticipation: attention to human motion, action and intention understanding; and (c) imitation: recognition of being imitated, imitation of others' actions. Groups were similar on age, ADOS combined severity score, and Hollingshead (*ps*>.05, independent-samples-t-test).
We examined children's anticipatory gaze while viewing a social agent (14-month-old toddler) moving a series of blocks across a table, with a cross-body motion, to a clear

bowl. In trial1 (movement of first block), the actor looked at the bowl immediately upon touching the block. In trial2, a social gaze occurred where the actor first looked to the left – away from the target bowl. Children viewed this video-sequence in a dimly lit room, monitored by remote eye-tracker (Tobii X-120). Arrival of participants' gaze to the bowl (target) in relation to arrival of the actor's hand was measured in milliseconds, to assess their ability to anticipate the outcome of the actor's action. Aggregate percentage of fixation times at the face and hand areas of interest (AOI) also were measured.
A three-way mixed ANOVA (Trial*Time*Group) assessed differences in anticipation times, with separate three-way mixed ANOVA (Time*Group*AOI) assessing differences in fixations to hand and face AOIs.
Results:
Missing data (T1Pre=1; T2Pre=2; T1Post=3; T2Post=4) was replaced by multiple-imputation with 10-iterations. We found a significant Trial*Time*Condition interaction, across all imputations (mean p=.011±0.0097). The Time*Group*AOI interaction was also significant (p=0.022, η_p^2=0.285).
Conclusions:
The Combined-training group progressed from a pre-intervention strong tendency to allocate attention to the moving hand in the scene to a post-intervention allocation of attention to socially relevant stimuli (the actor's face). This, without losing awareness of the actor's relocating of the blocks from the table to the bowl as indicated by preserved goal-directed anticipatory gaze. Thus, increased social interest does not impede the ability of children in the Combined-training group to attend to the task-relevant features in the dynamic scene (i.e., they still afforded attention to the bowl at the appropriate time to observe the block arrival). The Parent-training only group demonstrates *decreased* interest in the face AOI and *increased* attention to the hand from pre- to post-intervention, and increased degree of anticipatory gaze to the bowl from pre- to post-intervention.

Figure 1. Images to illustrate the Action Anticipation task

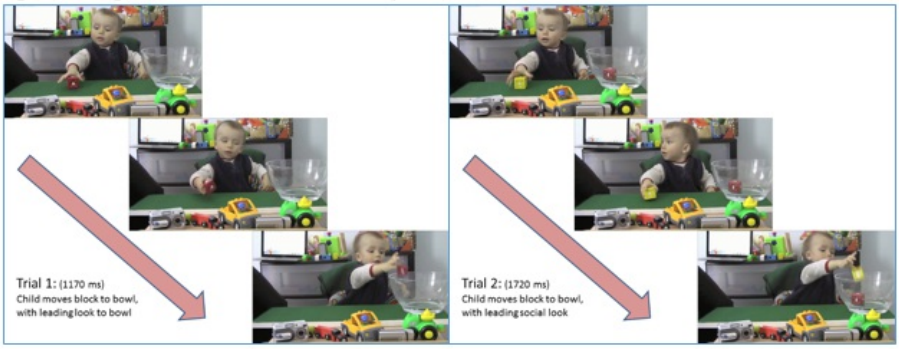
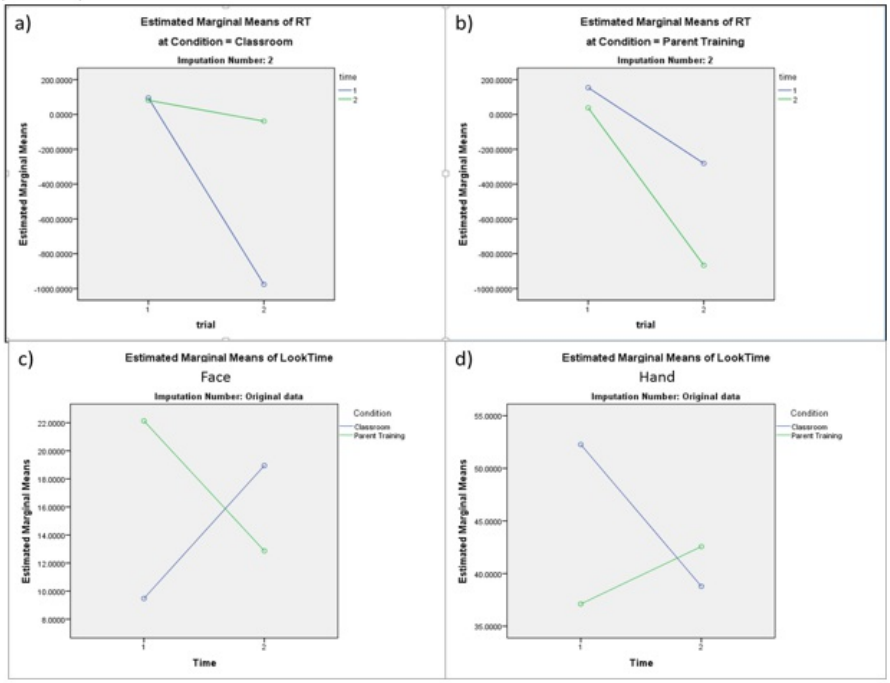


Figure 2. Gaze arrival to target location relative to block arrival (anticipatory look time), in milliseconds. More negative numbers indicate earlier arrival of gaze to the target, preceding block arrival. Pre-Post group means on trials 1 & 2 are plotted separately, and on separate plots for a) Combined-training and b) Parent-training only groups. Percent of time looking at each defined area of interest, c) Face and d) Hand during the Action Anticipation eye tracking task, plotted separately for each treatment group at pre- and post-intervention.



148 **146.148** Are Sensory Problems in ASD Really Sensory?

M. Zinni[1,2], M. Westerfield[3], L. E. Mash[1,4], S. Wee[1], L. Chukoskie[3] and ***J. Townsend***[1]*, (1)Department of Neurosciences, University of California, San Diego, La Jolla, CA, (2)Neuroverse, Inc., San Diego, CA, (3)The Institute for Neural Computation, University of California, San Diego, La Jolla, CA, (4)SDSU/UC San Diego Joint Doctoral Program in Clinical Psychology, San Diego, CA*

Background: Abnormal sensory responses are a commonly reported clinical feature of autism spectrum disorder (ASD). Sensory symptoms are assessed by a number of standardized questionnaires; studies based on these second-hand, self- or observational reports find increased rates of sensation seeking and/or sensation avoidance in all sensory modalities in ASD. Despite the general consensus that abnormal sensory function is an important clinical feature of autism, there is little or no understanding of the underlying mechanisms. Further, because the vast majority of evidence regarding these symptoms is based solely on behavioral descriptions, it is not clear if these symptoms are truly sensory in nature or if alternatively, they reflect abnormalities in general arousal or attention. Because our previous work suggests that abnormal sensory processing in ASD may be driven by impaired control of attention and arousal, we suggest that what appears to be abnormal sensory function in ASD may result from interactions of attention and arousal with sensory processing.
Objectives: Our goal was to investigate underlying sources of sensory symptoms by assessing critical components of sensory processing (e.g., sensory habituation and neural refraction) and the influence of attention and physiological arousal on sensory responsiveness.
Methods: Study participants were adults with ASD and a typically developing (TD) adult comparison group. Participants completed three experiments utilizing behavioral, event-related brain potential (ERP) and heart-rate (HR & HRV) measures to examine neural sensory responses to: auditory stimulation; changes in intensity of auditory stimulation; repeated auditory stimulation (refractory and habituation responses). During these experiments, we also examined the effects of physiological arousal and attention on brain responses to sensory stimulation.
Results: Adults with ASD reported significant sensory problems on the Sensory Profile Questionnaire (Brown & Dunn, 2002), suggesting that sensory difficulties persist

throughout the lifespan. Physiological measures, however, did not support a true sensory origin of these symptoms. ERP responses to auditory stimuli of varying intensity were similar in amplitude between ASD and TD groups. Also, ASD adults, like TD adults showed the expected refractory response to a repeated sensory stimulus (i.e., the sensory response to the second of a pair of stimuli was smaller). However, gradual habituation over time was atypical in ASD, but only when sensory stimulation was unattended. That is, response to irrelevant background sounds did not diminish over time in ASD adults; in TD adults there was little sensory response to these repeated background stimuli after only several minutes. Additionally, baseline arousal differed between groups as measured by HR & HRV, and greater arousal was observed in the ASD group during the presentation of auditory tones.
Conclusions: These findings suggest that in adults with ASD, sensory difficulties that are experienced in daily life may be a function of differences in the modulation of general arousal and the effects of attentional state rather than abnormalities in basic sensory response. Understanding the nature of sensory abnormalities and the processing level (sensory, arousal, attention) at which sensory behavior is perturbed can guide development of more specific treatment of these troublesome symptoms.

149 **146.149** Association of Somatosensory Difficulties with Behavioral Problems in Children with Autism Spectrum Disorder

W. Overcast[1], *A. Shui*[2], *A. R. Narayanan*[3], *J. Walton*[4] *and D. L. Coury*[3], *(1)The Ohio State University College of Medicine, Columbus, OH, (2)Massachusetts General Hospital, Boston, MA, (3)Nationwide Children's Hospital, Columbus, OH, (4)Pediatrics, Nationwide Children's Hospital, Columbus, OH*

Background: Somatosensory difficulties manifest as hyper- or hypo-reactivity across the senses and are found in the large majority of children with Autism Spectrum Disorder (ASD). Previous studies have demonstrated a relationship between sensory difficulties and problem behaviors. We sought to expand on these studies by examining multiple problem behavior measures and using a large cross-sectional sample.
Objectives: We sought to determine the relationship between somatosensory difficulties and problem behaviors in children with ASD, including investigation of the relation of individual somatosensory domains with specific problem behaviors.
Methods: This retrospective study used data collected through member centers of the Autism Speaks Autism Treatment Network. Our study included 6,902 children and adolescents under the age of 18 years who had been diagnosed with ASD. We analyzed the Short Sensory Profile (SSP) total score and subscale scores as measures of somatosensory difficulties and their associations with problem behaviors as measured by the total and subscale scores of the Child Behavior Checklist (CBCL) and Aberrant Behavior Checklist (ABC) and the Autism Diagnostic Observation Schedule (ADOS) Tantrums, Aggression, Negative or Disruptive Behavior item., Linear regression and polytomous logistic regression were used for continuous and categorical behavioral problems, respectively, adjusting for gender, age, DSM-IV diagnosis, IQ, race, ethnicity, primary caregiver education level, insurance status, any psychological problem status, taking stimulant, and taking SSRI. A Bonferroni correction was applied to account for analyzing multiple behavioral problems variables for each somatosensory domain.
Results: The majority of children in the sample were male, Caucasian, and had an IQ of 70 or more. Baseline psychological problems (ADHD, anxiety, disruptive behavior, other psychiatric problem) were reported in 15.5%. The mean age at informed consent was 6.2 years. After controlling for covariates, there were significant associations between behavioral and somatosensory problems. Children with fewer somatosensory symptoms had fewer behavioral problem symptoms as measured by CBCL and ABC. For each unit increase in SSP Tactile Sensitivity score (=less sensitivity), ABC Irritability score were lower (=less irritable) by 0.76 units. Hyperactivity and total aberrant behavior were higher in children with lower auditory filtering difficulties (ß=-1.11 and -2.94, respectively). Of the sensory difficulties, for each unit reduction in sensation seeking, rule breaking behavior score were lower by 0.05 unit. Lower conduct problems are associated most with higher auditory filtering and sensation seeking (ß=-0.05 for both). Average levels of aggressive behavior were higher among children with higher scores on tactile sensitivity, movement sensitivity, auditory filtering and sensation seeking (ß=-0.06 for all).
Conclusions: Our study demonstrates a strong relationship between somatosensory difficulties and problem behaviors in a cross-sectional sample of children with ASD. Our characterization of the relationship between individual sensory and behavioral domains may aid targeting of sensory therapies, with subsequent behavioral problem improvement.

150 **146.150** Attention Training in Children with Sensory Processing Disorder

J. A. Anguera[1], *A. Brandes-Aitken*[2], *C. Rolle*[3], *B. Wu*[4], *E. Martucci*[5], *J. Bower*[5], *A. Gazzaley*[6] *and E. J. Marco*[2], *(1)Neurology, UCSF SNAP, San Francisco, CA, (2)University of California in San Francisco, San Francisco, CA, (3)Stanford University, Palo Alto, CA, (4)Neurology, UCSF SNAP, San Francisco, CA, (5)Akili Interactive, Boston, MA, (6)Neurology, UCSF, San Francisco, CA*

Background:
Sensory Processing Disorders (SPD) negatively affect a child's ability to process incoming stimuli and can disrupt cognitive and social development. It has been estimated that 40% of children with SPD will meet diagnostic criteria for Attention Deficit and Hyperactivity Disorder (ADHD). Previously, we have documented baseline deficits in response time variability on measures of sustained attention in our SPD cohort.

Objectives:
In the current study, we aimed to determine if training with an interactive digital game-like tool (Project: EVO^{TM}, or EVO) would improve attention in children with SPD relative to age-matched controls.
Methods:
We recruited 19 neurotypical children (12 female; mean age 9.6 +/- 1.4), 17 children with SPD+ADHD traits (6 female; mean age 10.0+/- 1.5) and 13 children with SPD-only (6 female, mean age 10.5 +/- 1.5) through the UCSF Sensory Neurodevelopment and Autism Program. All children played EVO at least 20 times over a one-month period for approximately 30 minutes each session. During these sessions, children were required to steer their avatar through complex river-like paths while simultaneous shooting at targets while ignoring distractors. Pre and post play, we assessed measures of attention on a game-like platform (NeuroRacer), a well-recognized lab based assessment of attention (TOVA), a neurophysiological measure of cognitive control (Midline Frontal Theta using EEG), and a parent report measure of inattention (Vanderbilt).

Results:
Using an ANOVA analysis, we found a significant main effect by visit (pre and post training) for response time on NeuroRacer and response time variability on the TOVA (F= 21.46 p<.000 and F=6.04, p=.017, respectively), but no Group by Visit interaction. Midline frontal theta (MFT) power during NeuroRacer play did show a significant group by visit interaction, with follow-up tests revealing that only the children with SPD and ADHD traits showed increased MFT power following the month long training (F=5.72, p=.007). On the parent report measure of inattention (Vanderbilt), we also found a significant group by visit interaction (F=6.40, p=.004), with follow-up tests revealing that only the SPD+ADHD children demonstrated a reduction in symptoms of inattention. Critically, we observed a significant relationship between increased MFT power and improved inattention via the Vanderbilt measure (r=.427, p=.015).
Conclusions:
In conclusion, the Project: EVO^{TM} training study supports the benefit of dedicated attention based training for some children with SPD, with evidence of brain plasticity and impact on real world function. It highlights the importance of detailed cognitive assessment of attention in children with SPD and other neurodevelopmental conditions in order to personalize a treatment approach with cognitive training tools.

151 **146.151** Baseline Respiratory Sinus Arrhythmia Predicts Restricted Repetitive Behavior Severity

E. E. Condy *and B. H. Friedman, Virginia Polytechnic Institute and State University, Blacksburg, VA*

Background: Respiratory sinus arrhythmia (RSA) is a physiological phenomenon that indexes parasympathetic influence on cardiac activity. The *neurovisceral integration model* (Thayer & Friedman, 2004) posits that higher levels of RSA promote flexible behavior and better adaptive functioning, which are both impaired in autism spectrum disorder (ASD). The social communication deficits and restricted repetitive behaviors characteristic of ASD are inflexible by nature, paralleling the behaviors described by the neurovisceral integration model. For this reason, RSA could be valuable in assessing ASD symptomatology. Although studies have shown baseline RSA is lower in children with ASD than their typically developing peers, RSA has seldom been examined in relation to more specific symptoms. In the literature, higher baseline RSA has been associated with better social functioning in ASD (Patriquin, Scarpa, Friedman & Porges, 2013), but few studies have examined RSA in relation to restricted repetitive behaviors.
Objectives: This study aimed to replicate the between-group differences in baseline RSA seen in previous studies, and to establish a relationship between baseline RSA and the two symptom domains integral to an ASD diagnosis: social communication deficits and restricted repetitive behaviors.
Methods: A three minute baseline was collected in 10 children (ages 5-8; 9 male) with an ASD diagnosis (n = 5) and in typically developing children (n= 5). Parents completed the Social Responsiveness Scale-2 (SRS-2) and the Repetitive Behavior Scale-Revised (RBS-R). A Mann-Whitney U test was used to assess the difference in baseline RSA between groups, and correlations using the social communication index (SCI) score from the SRS-2 and the total RBS-R score were conducted to see how baseline RSA related to social communication and repetitive behaviors.
Results: A one-tailed Mann-Whitney U test revealed that children with ASD had lower baseline RSA (Mdn = 6.46) compared to their typically developing peers (Mdn = 8.86), U = 4.00, p = .048. One-tailed Spearman's correlations showed that baseline RSA was related to total restricted repetitive behavior severity on the RBS-R, $\rho(8)$ = -.644, p = .022; however, the relationship between baseline RSA and the SRS social communication index score did not reach significance, $\rho(8)$ = -.529, p= .058.
Conclusions: Group level differences in baseline RSA between children with ASD and their typically developing peers that characterize the literature and were replicated in this study. These differences can subsequently be related to specific symptoms seen in ASD. Specifically, lower baseline RSA was associated with more severe restricted

repetitive behaviors. The relationship between these should be further explored to determine whether RSA and parasympathetic functioning might be a possible mechanism of repetitive behaviors, whether differences in RSA relate to specific repetitive behavior subtypes, and if biofeedback paradigms utilizing RSA measurement can be developed to address repetitive behaviors in ASD.

152 **146.152** Brain System Abnormalities Associated with Reduced Control of Sustained and Repetitive Motor Behaviors

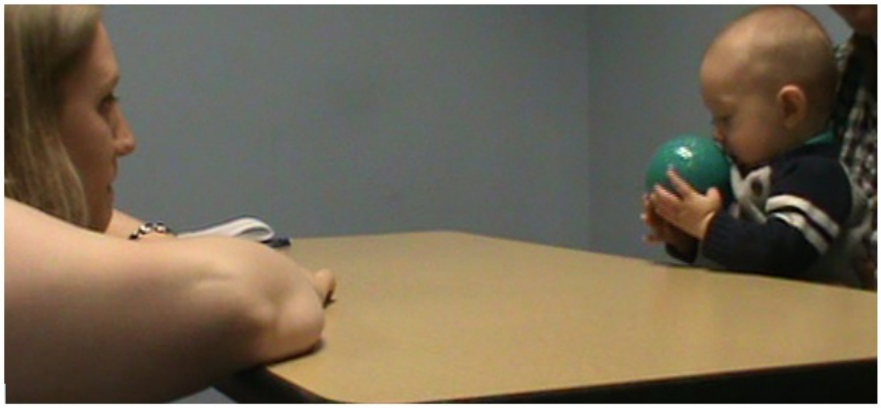
M. W. Mosconi[1], *L. M. Schmitt*[2], *S. P. White*[2] *and J. A. Sweeney*[2], *(1)University of Kansas, Lawrence, KS, (2)Center for Autism and Developmental Disabilities, University of Texas Southwestern, Dallas, TX*

Background:
A diverse set of sensorimotor impairments has been documented in autism spectrum disorder (ASD). We have found that patients show reduced control of manual motor behaviors when they attempt to maintain a constant level of force (sustained force), and when they produce rapid, repetitive action sequences (repetitive force). The severities of these two types of sensorimotor impairments are relatively independent across affected individuals. In the present study, we used functional MRI (fMRI) to identify brain systems contributing to sustained and repetitive motor impairments in ASD.
Objectives:
To identify the neural system abnormalities associated with dysmetria of sustained sensorimotor behaviors and repetitive sensorimotor behaviors in ASD.
Methods:
Twenty individuals with ASD and 15 healthy controls matched on age, IQ and handedness completed fMRI tests of precision grip force. During the sustained force test, participants pressed with their thumb and index finger on a force transducer while viewing a white FORCE bar on a screen that moved upwards with increased force toward a fixed green TARGET bar. Participants were instructed to maintain the FORCE bar at the level of the TARGET bar for 24 seconds. During the repetitive force test, participants completed 24 second blocks consisting of six repeated sequences in which they pressed on the transducer for 2 seconds and then relaxed for 2 seconds. Blocks for both tests were alternated with 24 sec rest blocks. Participants completed three blocks of each test at both 20 and 60% of their maximum force (12 force blocks total). The order of tasks and force level (20 and 60% of maximum force) were counterbalanced across participants.
Results:
Preliminary analyses were consistent with our published work (Mosconi et al., 2015; Wang et al., 2015) and indicated that individuals with ASD show increased force error relative to controls during the sustained force test, and less accurate initial force pulses compared to controls during the repetitive force test. During the sustained force test, individuals with ASD showed less activation in left superior temporal gyrus, bilateral posterior parietal cortex, supplementary motor cortex and bilateral cerebellum. During the repetitive force test, individuals with ASD showed less activation in supplementary motor cortex, contralateral primary motor cortex, right inferior parietal lobule and bilateral putamen.
Conclusions:
We report evidence that reduced accuracy of sustained motor behaviors in ASD is associated with reduced activation of parietal-cerebellar brain systems involved in transforming visual feedback into reactive motor adjustments. In contrast, reduced control of repetitive motor actions in ASD appears to reflect underactivity of frontal-striatal brain systems involved in initiating and terminating dynamic motor behaviors. These findings indicate that the diverse sensorimotor impairments that are evident in the majority of individuals with ASD reflect multiple distinct motor control and brain mechanisms. Our results also identify new brain targets for treatment development efforts aimed at reducing sustained sensorimotor dysmetria and repetitive behaviors in ASD. Further, this study shows that both cerebellar and striatal disruptions may represent significant components of the neurodevelopmental processes that cause ASD.

153 **146.153** Breadth and Continuation of Object Exploration Are Impacted By ASD Risk and Motor Ambition

M. B. Nebel[1,2], *J. L. Haworth*[3] *and R. Landa*[3], *(1)Department of Neurology, Johns Hopkins School of Medicine, Baltimore, MD, (2)Center for Neurodevelopmental and Imaging Research, Kennedy Krieger Institute, Baltimore, MD, (3)The Kennedy Krieger Institute, Baltimore, MD*

Background:
School-age children with Autism Spectrum Disorders (ASD) exhibit particular difficulty with hand-eye coordination and appear to be less sensitive to visual feedback during motor learning. Estes et al. (2015) note that differences in sensorimotor behavior at 6-months-of-age between infants at high (HR) and low (LR) for autism are informative of continued developmental trajectory and later expressed autism phenotype. This echoes the importance of identifying early fine and gross motor deficits in children with ASD (Landa, 2008). Typically, self-initiated reaching leads to longer exploration of, more interest in, and more multimodal engagement with objects (Needham, et al., 2002). Motor deficits in infancy impacting self-initiated actions affect the extent of learning and growth which occurs during the active interaction (Gibson & Pick, 2000), in part because this quality of the interaction determines the kind of information (e.g., shape, texture, or weight) that can be obtained about the object (Bushnell & Boudreau, 1993).
Objectives:
Evaluate continued interest in object exploration expressed over trials of a novel ball catching task, assessed against autism risk and motor ambition (determined as anticipating ball arrival).
Methods:
Six-month-old infants (n=107, 64 HR and 43 LR) participated in the study. Video recordings of the ball rolling sub-task from the Autism Observation Scale for Infants (AOSI) were coded for the following object exploration behaviors: attempt to grasp, lift, anticipation of mouthing, mouthing (after lift or by leaning down), shaking, patting, banging, rolling, hand transfer, and dropping ball on table or floor. For each of 3-trials, we counted object exploration (OE, the total # of behaviors) and new behaviors (NB, those not previously performed). Anticipation was coded according to whether any manual action was expressed in response to the approaching ball on the first trial. A 3-way mixed-model MANOVA (Trial × Risk × Anticipation) was performed, with pairwise comparisons to identify where differences occurred (alpha=0.05).
Results:
No differences were found in the total number of OE behaviors, for any factor or interaction. For NB, a main effect of Trial was identified ($F_{2,206}$=40.0, p<0.001, η_p^2=0.280), with follow-up indicating fewer new behaviors on subsequent trials. Additionally, Risk × Anticipation ($F_{1,103}$=6.26, p=0.014, η_p^2=0.057) and Trial × Anticipation ($F_{2,206}$=5.24, p=0.006, η_p^2=0.048) interactions were found. Follow-up to the Trial × Anticipation interaction suggests that non-Anticipators showed more new behaviors on the second trial compared to Anticipators and then much fewer on the third. Follow-up to the Risk × Anticipation interaction indicates that HR non-Anticipators showed the fewest NB.
Conclusions:
Six-month-old infants sought to develop a robust repertoire of exploratory behaviors and continued to take advantage of new object exposures by adding new strategies on subsequent trials. However, across all children, the number of new strategies declined with each new opportunity. HR and LR infants who anticipated the ball displayed similar object exploration behavior across trials and showed more OE on the first trial than did non-anticipators. Interestingly, non-anticipating LR infants demonstrated more NB than anticipatory infants on the second trial, while non-anticipatory HR infants demonstrated consistently fewer new behaviors, especially on the first trial.



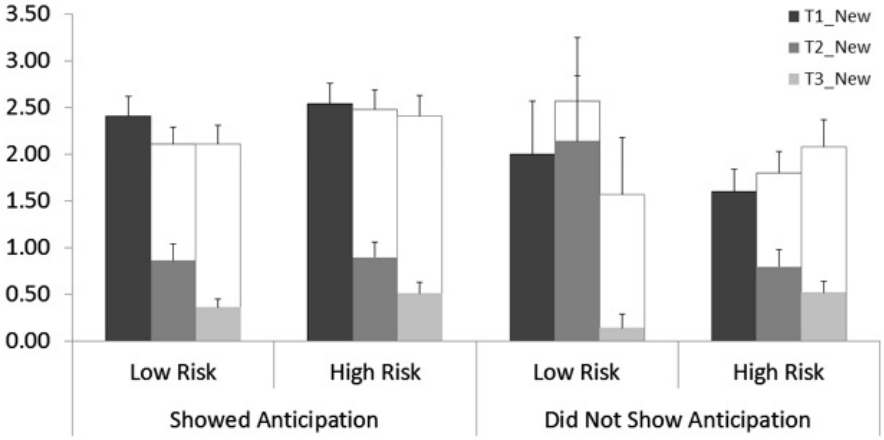


Figure 1: Mean count of expressed behavior across each of three trials, between risk group and whether anticipation behavior was observed. New behaviors (those not observed on any previous trial) are represented by filled-grayscale, and are overlain on the total count of behaviors (those observed on that given trial) which are represented by the gray-bounded bars. Error bars represent standard error.

154 **146.154** Can Timing Tasks Successfully Differentiate Children with ASD from Those with SLI?

ABSTRACT WITHDRAWN

Background: A perinatal disruption in cerebellar development has been proposed to be a direct cause of autism spectrum disorder (ASD; Wang, Kloth, & Badura, 2014). Adults with cerebellar lesions exhibit timing deficits, as indicated by increased timing variability on a finger tapping task (Schlerf, Spencer, Zelaznik, & Ivry, 2007). Much like children with ASD, children with specific language impairment (SLI) show deficits in language, and also motor development. However, discrete timing is not implicated, since children with SLI do not show deficits in variability during single-effector timing tasks (Zelaznik & Goffman, 2010). Timing tasks that involve coordination of multiple effectors (e.g., clapping) are impaired in SLI (Vuolo, Goffman, & Zelaznik, in review). Because of the overlap in symptoms, there has been some debate as to whether ASD and SLI are distinct developmental disorders (e.g., Bishop, 2010). We predicted that timing tasks, such as tapping and clapping, might be able to differentiate children with ASD from those with SLI.

Objectives: The goal of our study was to determine whether children with ASD perform more similarly to an individual with cerebellar dysfunction or SLI on timing tasks with one and two-effectors. If children with ASD show impaired single-effector timing, the results would support the hypothesis of cerebellar dysfunction in children with ASD. If children with ASD do not show impaired single-effector timing, but do show bimanual (multi-effector) coordination difficulties on timing, then the results would indicate that ASD is more similar to SLI.

Methods: Eleven children with ASD and 4 age-matched children with SLI (to date) participated in a tapping and a clapping task. Hand movements were recorded. Participants were trained to tap and clap to a 600 ms tone presented by a metronome, and to continue tapping and clapping at the same rate for 32 continuation intervals after the metronome disengaged. Six trials were completed for each task. The within-trial, within-participant variability (CV%) of the interval durations was calculated to provide a measure of timing precision. All children also completed the Movement Assessment Battery for Children – Second Edition to index general gross and fine motor skills.

Results: (Preliminary) The children with ASD (M = 13.29CV%, SD = 8.57) were more variable than their peers with SLI (M = 10.83CV%, SD = 3.96) on the single-effector, finger tapping task, but equally variable on the multi-effector clapping task (ASD, M = 15.30CV%, SD = 6.21; SLI, M = 15.00CV%, SD = 6.07). The children with ASD also performed more poorly on the standardized test of gross and fine motor skills (M = 4.73, SD = 2.49) than their peers with SLI (M = 8.57, SD = 2.22).

Conclusions: Unlike children with SLI, children with ASD exhibited a decrement in timing precision on the single-effector timing task. This finding lends support to the cerebellar sensitive period hypothesis of ASD put forth by Wang and colleagues (2014). It also highlights the role of timing tasks, and potentially fine and gross motor tasks, in differentiating children with ASD from those with SLI.

155 **146.155** Can't Tone It Down? Auditory Habituation in ASD

N. Top[1], *K. G. Stephenson*[1], *S. Luke*[1] *and M. South*[1,2], *(1)Brigham Young University, Provo, UT, (2)Psychology and Neuroscience, Brigham Young University, Provo, UT*

Background: Improved understanding of the mechanisms that underlie unique manifestations of anxiety in autism spectrum disorders (ASD) may provide targets for etiological research as well as for better treatment specificity. Recent studies using either psychophysiological measures or fMRI have shown atypical reversal learning and extinction in ASD during fear conditioning tasks. However, it is unclear if these abnormalities in ASD are due to a failure to learn new associations, a failure to extinguish previous associations, or an inability to habituate to novel stimuli.

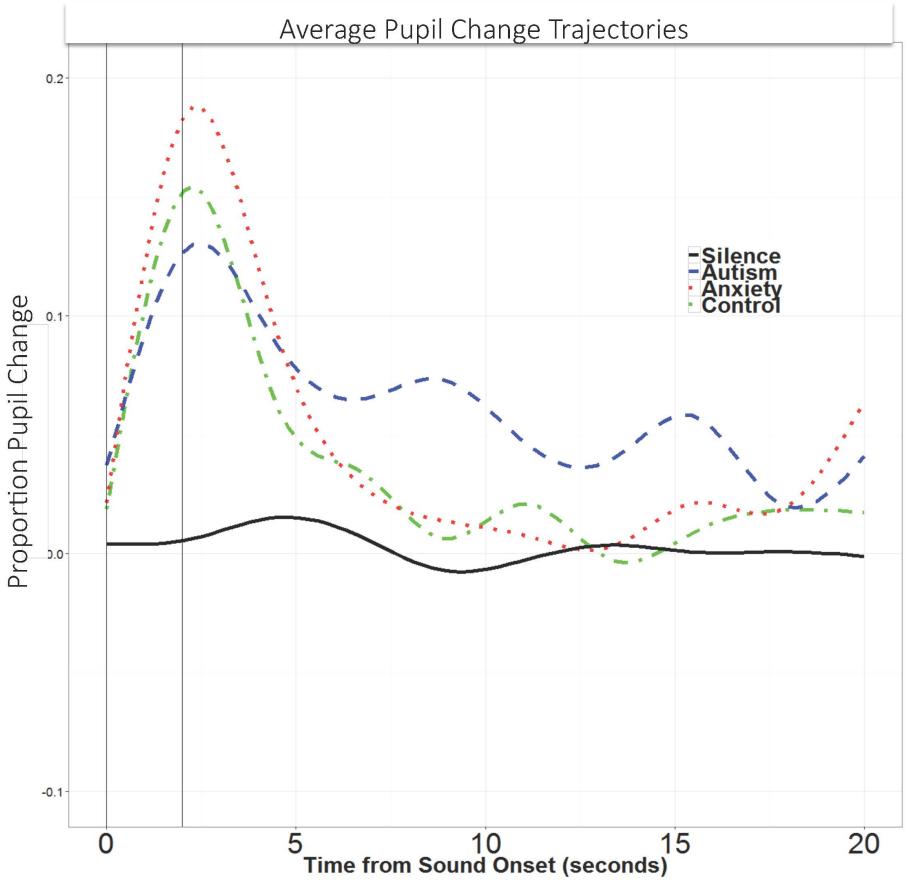
Objectives: We report findings from an auditory habituation study including adults diagnosed with ASD, compared to typical and to anxious adults. In conjunction with previous studies in our lab regarding fear conditioning and extinction, we hypothesized that pupil dilation—a sensitive index of autonomic nervous system activity--would reflect delayed habituation in ASD and may serve as a mechanism underlying anxiety in ASD.

Methods: Twenty-eight adults ages 18-29 diagnosed with ASD (ASD group) were compared to 1) age-matched adults with high levels of anxiety in treatment at a university counseling center (ANX group); and 2) healthy adults with no known psychopathology (HC group). The habituation task consisted of three blocks (silence, 60db sine wave tone, 80db sawtooth wave tone) with 10 trials per block in which the tone was played for an average of two seconds with a jittered, ~20 second inter-trial interval. Pupil dilation was measured using SR Research Eyelink 1000 Plus eye tracker. We used Hierarchical Linear Modeling (HLM) to track average percent change in pupil dilation trajectories across all three groups.

Results: HLM analyses reveal that the ANX group had significantly higher physiological reaction to the tones than the ASD and HC groups. Both the ANX and HC groups follow a similar habituation trajectory, showing a return to baseline around 6 to 10 seconds after sound offset. However, the ASD group did not return to baseline until approximately 15-20 seconds after tone onset (see attached figure). Trial-by-trail analysis showed delayed habituation to the tones in the ASD group, but not in the HC or ANX groups.

Conclusions: Sensitive pupillometry measures suggest that habituation to even simple sensory stimuli may be delayed in ASD. After multiple exposures the ASD group showed atypically higher arousal during the recovery periods, indicating that they were not able to “calm down” from initial shock of these mild noises. These delays support

previous finds of delayed fear extinction in ASD and suggests the possibility that this failure to habituate may be a prominent factor underlying anxiety as well as difficulties with change and transition. Exposure therapy and other treatment approaches for anxiety in ASD will likely take more time and would benefit from a focus on integrating internal and external stimuli.



156 **146.156** Continuous and Extreme Autistic Trait Ratings Are Associated with Avoidance of Alcoholic Beverages

S. Chaturvedi[1], *G. Wallace*[2] *and N. L. Zucker*[3], *(1)Speech and Hearing Sciences, The George Washington University, Washington, DC, (2)The George Washington University, Washington, DC, (3)Duke Center for Eating Disorders, Duke University, Durham, NC*

Background: Selective (i.e., 'picky') eating is common in autism spectrum disorder (ASD) with as many as 70% of individuals exhibiting this behavior. Prior reports suggest that although preference for particular foods and drinks is highly idiosyncratic, broader patterns emerge across children with ASD. For example, studies suggest that children with ASD have generally less varied diets, including eating fewer vegetables, salad, and fresh fruit, as well as less sweets and fizzy drinks (Emond et al., 2010; Pediatrics) than typically developing controls. The vast majority of studies to date have been conducted with children. While selective eating is persistent and extends into adulthood in ASD (Kuschner et al., 2015, Res Autism Spectr Disord) and it is more common than previously believed within the general population of adults, very little is known about specific food/drink preferences (including alcohol consumption) and their associations with ASD-like behaviors during this developmental window.
Objectives: Examine food/drink preferences as a function of continuous and extreme autistic trait ratings within a large sample of adults.
Methods: A large group of 1,992 adults (1,445 females) completed online surveys including questions about how often they avoided various food/drink classes (e.g., fruits/vegetables, juices, alcoholic beverages, salty and sweet crunchy bread products, salty and sweet soft bread products, meats, and dairy products) on a scale of 1 (never) to 5 (always) as well as self-ratings of autistic traits utilizing the original 50-item Autism-Spectrum Quotient (AQ).
Results: Correlational analyses revealed that as self-ratings of autistic traits (using the AQ total score) increased the likelihood of trying alcoholic beverages decreased (r=.14 , p<.01). Autistic social traits (from the Social Skills subscale) was the component of the AQ most strongly correlated with a general avoidance of alcoholic beverages (r=.18, p<.01). When submitted to regression analyses, autistic social traits predicted significant additional variance (F=58.80, p<.001; ΔR^2=.03) above and beyond the influence of food neophobia and aversions to smells, each of which contributed its own significant variance (ts>2.36, ps<.02), to the likelihood of trying alcoholic beverages.
Conclusions: This study provides further evidence linking ASD-like behavior with food/drink preferences, albeit among a relatively large population of adults. The food/drink that was most strongly related to subclinical ASD behavior was alcoholic beverages. This finding is perhaps unsurprising given prior research finding highly reduced rates of alcohol use and abuse among adolescents and adults with ASD (Fortuna et al., 2015, J Gen Intern Med; Mangerud et al., 2014, J Adolesc). Moreover, ASD-like social traits, in particular, were most strongly linked with avoidance of alcoholic beverages, and these influences were independent of generalized food neophobia and sensory aversions to smell, consistent with the notion of limited 'social drinking.'

157 **146.157** Correlates of Restricted and Repetitive Behaviours: The Role and Anxiety and Intolerance of Uncertainty. Insights Directly from Young People with ASD

J. Rodgers[1], *E. Honey*[2] *and C. Joyce*[3], *(1)Newcastle University, Newcastle Upon Tyne, United Kingdom, (2)CNDS, Northumbria Tyne and Wear NHS Foundation Trust, Newcastle Upon Tyne, United Kingdom, (3)Newcastle University, Newcastle, United Kingdom*

Background: Restricted and Repetitive Behaviours (RRB) such as repetitive movements, routines, restricted interests, and resistance to change can interfere with the ability to learn new skills and take part in daily living. Despite their ubiquity in ASD, research into RRB is relatively neglected in comparison to other features of the disorder. In order to reduce the potential negative consequences of RRB, research is required which provides information about the motivators for and correlates of RRB to inform the development of effective and targeted interventions. Some research suggests a relationship between RRB and anxiety and intolerance of uncertainty (IU) in ASD. This research is based on parental report of these phenomena with no research investigating these relationships by gaining information directly from people with ASD.
Objectives:
This study aimed to further current understanding about the experience of RRB and how these behaviours may relate to uncertainty and anxiety in ASD by gaining information directly from young people with ASD and their parents.
Methods: Nineteen families participated. Young people with ASD were aged between 13 and 20 (mean age 16 years 8 months). Young people with ASD and their parents completed the Repetitive Behaviour Questionnaire 2 (RBQ2), Spence Child Anxiety Scale (SCAS) and the Intolerance of Uncertainty Scale (IUS-12). Ten of the young people also took part in a novel semi-structured interview. The goal of the interview was to explore motivations for engagement in and cessation of a self-selected example of an RRB.
Results:

Significant correlations were found between both parent reported (r = .670, p = .002) and young person self-reported (r = .570, p = .042) RBB and anxiety. Parent reported young person intolerance of uncertainty and RBB were also significantly correlated (r = .560, p = .013). Thematic analysis of the interview data identified five themes (Insight into RRB, experience of RRB, motivating factors anxiety and uncertainty).
Conclusions:
This study is the first to date to collect self-report information from young people with ASD about their RRB. This is important in two respects; firstly it provides evidence in support of existing findings that have previously only been evidenced through parent report and secondly it provides evidence that young people can self-report, providing support for such practices in ASD research. The results support and extend previous findings, demonstrating a significant positive relationship between parent reported RRB and anxiety. Further support is also provided for the centrality of the role of uncertainty to the relationship between anxiety and RRB in ASD. This study has a number of implications for clinical practice, suggesting that consideration should be given the role of anxiety and IU in understanding RRB. Young people's responses to the interview provide insight in to how clinicians can potentially engage young people in talking about their RRB.

158 **146.158** Directly Measured Physical Activity of 4 Year Old Children with Autism Spectrum Disorder

E. Bremer[1] *and M. Lloyd*[2]*, (1)Infant and Child Health Lab, Department of Family Medicine, McMaster University, Hamilton, ON, Canada, (2)Faculty of Health Sciences, University of Ontario Institute of Technology, Oshawa, ON, Canada*

Background: Engagement in physical activity (PA) is critical to maintain good health and can also provide important behavioural benefits to children with autism spectrum disorder (ASD) (Bremer, Crozier, & Lloyd, In Press). It is recommended that preschool aged children (3-4 years of age) engage in 180 minutes of PA each day (Tremblay et al., 2012), which equates to approximately 9,000 steps/day (Vale, Trost, Duncan, & Mota, 2015). To date, the PA of preschool aged children with ASD has not been evaluated.
Objectives: The objectives of this pilot study are 1) To explore the PA levels of 4 year old children with ASD; 2) To examine the correlations between PA, motor skills, and adaptive behaviour in this population; and 3) To examine the potential feasibility of measuring PA in preschool aged children with ASD via pedometers.
Methods: Fourteen children that were 4 years of age with ASD participated in this study as part of a larger intervention study. Participants were assessed using the following measures: Vineland Adaptive Behavior Scales-2 (VABS-2) and Peabody Developmental Motor Scales-2 (PDMS-2). Height and weight were directly measured and BMI was calculated. Demographic information was obtained from the participant's parents. Each participant was given a time-stamped pedometer to wear for 7 consecutive days to measure PA. Pedometer data was analyzed for validity using the following criteria: worn 3 days for at least 10 hours/day. Average steps/day was calculated for participants with valid data. Pearson correlations were used to explore the relationships between PA, motor skills, and adaptive behaviour. T-tests were used to explore baseline differences in behaviour, motor skills, BMI, and socioeconomic status between those participants with and without valid pedometer data.
Results: Participants (n=9) who wore their pedometer for at least 10 hours/day for 3 days took an average of 10,044 steps/day. Participants (n=3) who did not wear their pedometer for the necessary time but, had at least one valid day of data (i.e. wore it for at least 10 hours on 1 day) took an average of 8,195 steps/day. Average steps/day were positively correlated with the VABS-2 adaptive behaviour composite standard score (r=0.682, p=0.015) but, not with any of the PDMS-2 outcomes. The only difference between the participants with and without valid pedometer data was in BMI with those participants who wore their pedometer having a lower BMI than those who did not wear it [t (12) = 3.452, p = 0.005]. Anecdotally, parents reported sensory issues as the main factor preventing their child from wearing the pedometer.
Conclusions: On average, participants in this study were meeting the recommended PA guidelines for preschool-aged children. Future research should further examine the relationship between adaptive behaviour and physical activity, particularly as a mode of intervention. Further research with larger, representative samples of children with ASD is also needed to determine their PA levels and the reliability and validity of using pedometers in this population.

159 **146.159** Early Sensory Hyporesponsivity Predicts Later Deficits in Language Understanding in Infants at High Risk for Autism Spectrum Disorder

T. Woynaroski[1]*, C. R. Damiano*[2,3]*, C. J. Cascio*[4]*, W. L. Stone*[5]*, L. V. Ibanez*[5]*, S. M. Bowman*[6] *and A. Morgan*[6]*, (1)Vanderbilt University, Thompsons Stn, TN, (2)Carolina Institute for Developmental Disabilities, University of North Carolina School of Medicine, Chapel Hill, NC, (3)Department of Psychiatry and Behavioral Sciences, Duke University School of Medicine, Durham, NC, (4)Vanderbilt University School of Medicine, Nashville, TN, (5)Department of Psychology, University of Washington, Seattle, WA, (6)Vanderbilt University, Nashville, TN*

Background:
Individuals with autism spectrum disorder (ASD) often show atypical responses to sensory stimuli, even as early as infancy. A pattern of hyporesponsivity (characterized by absent or reduced responding to sensory stimuli) in particular seems most prevalent in, and specific to, ASD. It has been proposed that reduced responsivity to sensory stimuli early in life may produce cascading effects on higher level abilities, such as language, in individuals with ASD. Past work has found that sensory hyporesponsivity covaries with *concurrent* language in *preschool* and *school-age* children with ASD. However, to date no study has evaluated whether hyporesponsivity in infancy predicts future language in younger children with ASD. A primary obstacle to this work is our inability to diagnose ASD in infancy. One way to overcome this challenge is to prospectively study infants who are known to be at high risk for ASD, such as infant siblings of children diagnosed with ASD (Sibs-ASD).
Objectives:
This pilot project, carried out at Vanderbilt University and the University of Washington, specifically sought to determine (a) whether Sibs-ASD differed from infants with a typically developing older sibling (Sibs-TD) in early sensory hyporesponsivity and (b) whether early hyporesponsivity predicted later language, at least in Sibs-ASD.
Methods:
Sensory hyporesponsivity of 14 Sibs-ASD, as well as 18 Sibs-TD was assessed at 18 months using the Sensory Experiences Questionnaire. Receptive and expressive language was assessed at 24 months using the Vineland Adaptive Behavior Scales. An independent samples t-test was used to evaluate mean differences in early hyporesponsivity between Sibs-ASD and Sibs-TD, and bivariate correlational analyses were used to examine predictive associations between early hyporesponsivity and later language abilities for Sibs-ASD and Sibs-TD.
Results:
We found several anticipated effects, including a trend towards higher hyporesponsivity—reduced responding to sensory stimuli— at 18 months in the Sibs-ASD group relative to the Sibs-TD group (d = .64). Hyporesponsivity at 18 months was strongly predictive of receptive language at 24 months in the Sibs-ASD group (r = -.82), but not the Sibs-TD group (r = -.26). Associations between early hyporesponsivity and later expressive language were non-significant. Further analyses for an expanded sample (anticipated total N = 50) will be presented at IMFAR.
Conclusions:
Results provide increased support for the proposal that early sensory differences may produce cascading effects on higher-level abilities, such as language, in children at high risk for ASD. Findings specifically suggest that sensory hyporesponsivity may be a valuable predictor of later deficits in receptive language in this population. Implications for practice and needs for future research will be discussed.

160 **146.160** Epilepsy and Repetitive Behaviors in ASD

G. D. Glinos[1]*, J. M. Lee*[2]*, E. R. Martin*[3]*, J. R. Gilbert*[2]*, M. A. Pericak-Vance*[2] *and* ***M. L. Cuccaro***[4]*, (1)John P. Hussman Institute for Human Genomics, Miami, FL, (2)John P. Hussman Institute for Human Genomics, University of Miami, Miami, FL, (3)John P Hussman Institute for Human Genomics, University of Miami, Miami, FL, (4)University of Miami, Miami, FL*

Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder with a variable phenotype. Approximately 8-21% of individuals with ASD have epilepsy. Differentiating the complex ASD phenotype based on co-occurring symptom patterns may provide meaningful subgroups. Epilepsy and repetitive behaviors are present in ASD and may yield meaningful subgroups when examined in tandem. Understanding the ASD-epilepsy relationship has implications for identifying a genetic etiology of ASD and improving care.
Objectives: To determine whether repetitive behavior profiles among individuals with ASD are associated with frequency of epilepsy.
Methods: This is a cross-sectional study of symptom patterns of individuals with ASD from the Simons Simplex Collection (SSC). The SSC is a well-characterized collection of individuals with ASD from simplex families (i.e., one individual with ASD in the family). Data were collected at multiple clinics across the US using standard procedures. Our dataset consisted of 2683 participants with ASD from the SSC.
Participants were between 4-18 years of age at enrollment. The sample was predominantly male (86%) and white (79%). All procedures were approved by the respective local institutional review boards. The primary measures were derived from the Autism Diagnostic Interview-Revised (ADI-R), a semi-structured caregiver interview that assesses ASD symptoms, and medical history. Our analyses used 13 ADI-R items, which assess repetitive behaviors (RRBs) common to ASD (e.g., repetitive use of objects) and a measure of epilepsy from the ADI-R and medical history.
Results: We identified 145 (5.4%) individuals with epilepsy using previously published criteria. Across individual RRB items the frequency of epilepsy ranged from 5.1%-6.7%. For four RRB items, *compulsions*, *unusual sensory interests*, *hand and finger mannerisms*, and *unusual attachments*, the frequency of epilepsy was significantly higher among those with these RRB. Using a two-step clustering approach with previously identified RRB factors (Repetitive Sensory Motor Behavior, Insistence on Sameness) as inputs, we identified four high quality clusters of individuals. Among these clusters, the frequency of epilepsy ranged from 4.2% to 7.2%. While these differences were not statistically significant (p = 0.13), the group with the highest frequency of epilepsy was the most socially and behaviorally impaired.
Conclusions: The frequency of epilepsy is ASD does not differ significantly among groups of individuals with different RRB profiles. However, at the item level, epilepsy was more frequent among individuals with compulsions and hand and finger mannerisms. Further study is needed to develop subtypes among individuals with ASD for genetic

studies.

161 **146.161** Evaluating the Role of Social and Motor Engagement for Reducing Restrictive and Repetitive Behaviors in Autism

A. Lampi[1], *P. Fitzpatrick*[2], *V. Romero*[3], *J. Amaral*[3], *M. Richardson*[3] *and R. Schmidt*[4], *(1)Psychology, Assumption College, Worcester, MA, (2)Psychology Department, Assumption College, Worcester, MA, (3)University of Cincinnati, Cincinnati, OH, (4)College of the Holy Cross, Worcester, MA*

Background:
Restrictive and repetitive behaviors (RRBs) are some of the most common and most stigmatizing symptoms of ASD. Research has found that motor engagement can reduce RRB presentation without affecting academic ability (Celiberti, Bobo, Kelly, Harris, & Handleman, 1997; Rosenthal-Malek & Mitchell, 1997); while other research has found that social engagement also reduces RRB presentation (Enloe & Rapp, 2014; Lee, Odom, & Loftin, 2007). While both of these research areas have found that different forms of engagement reduce the levels of RRB presentation in children with autism, few if any studies have looked at the joint effect of social and motor engagement. Additionally, many of the previous studies had a small sample of participants.
Objectives:
This research intended to evaluate the impact of social and motor engagement on RRB presentation in children with autism. In particular, we were interested in whether diagnosis affected RRB presentation levels, if differences in presentation were based on RRB type, if type of engagement differentially influenced RRB presentation, and if RRB presentation was related to other measures of symptoms of autism.
Methods:
A sample of 91 children (46 ASD, 45 Control) was coded over four tasks that varied in the levels of both social and motor engagement. Frequency coding was conducted using video analysis software (Interact, Mangold Inc.) for four different types of RRBs: motor-based RRBs, nonverbal-oral RRBS, oral-motor RRBs, and vocal/verbal RRBs. We also correlated the frequency measures to clinical measures of social skill: the RBSR, CBCL-ADHD, ADOS, and SRS; as well as to measures of social cognition: theory of mind, initiating joint attention, and responding joint attention.
Results: A 2X2X2X4 ANOVA with independent variables of diagnosis, motor engagement, social engagement, and RRB type revealed a significant four way interaction between all independent variables ($F(3,267)=4.75, p<.001$, $h_p^2=.05$). This interaction meant that for the children diagnosed with autism, an environment with both high social and motor engagement had the greatest impact on reducing certain RRBs more than others, namely the motor and vocal/verbal based RRBs. We also found significant main effects for all independent variables, as well as significant two-way and three-way interactions between all combinations possible between variables. We found significant positive correlations between frequency of RRBs and clinical measures of social skill, and significant negative correlations between the dependent variable and measures of social cognition.
Conclusions:
These findings suggest that a combined effect of social and motor engagement has the greatest possibility to reduce the number of RRBs in children with autism. Observed frequencies were also related to clinical measures of social skill and measures of social cognition. These findings are important because they demonstrate a potential for future research to examine how to best utilize combined forms of engagement in ways that improve the social skills and education of children with autism, while simultaneously reducing the most stigmatizing behaviors of the disorder.

162 **146.162** Examining the Relationship Between Restricted and Repetitive Behavior Type and Internalizing and Externalizing Behaviors

E. Hanson[1], *D. Peterson*[2] *and* ***A. K. Walsh***[2], *(1)Children's Hospital Boston, Boston, MA, (2)Developmental Medicine Center, Boston Children's Hospital, Boston, MA*

Background: Restricted and repetitive behaviors (RRBs) are a core diagnostic feature of Autism Spectrum Disorders (ASD) and are often difficult to evaluate without a comprehensive tool (DSM-V; American Psychiatric Association, 2013). The Behavior and Sensory Interest Questionnaire (BSIQ) is a newly published continuous dimensional instrument designed to meet these needs (Hanson et. al., in press). The BSIQ comprehensively evaluates type, frequency, and intensity, age of onset and duration of RRBs. The BSIQ also separates the two types of RRBs, Repetitive Sensorimotor (RSM) behaviors and Insistence on Sameness (IS) behaviors. This present study looks to further understand RSM and IS behaviors in relation to internalizing (i.e., anxious, depressive, and over-controlled) and externalizing (i.e., aggressive, hyperactive, noncompliant, and under-controlled) behaviors using the Child Behavior Checklist (CBCL) (Farmer & Aman, 2011).
Objectives: N/A
Methods: 185 ASD affected participants (149 male) with both BSIQ and CBCLs were examined. Ages of participants ranged from (24-201 months) (mean=69.4, SD=40.2). BSIQs were evaluated with CBCL internalizing and externalizing behavior scores. Correlations between IS and RSM behaviors and internalizing and externalizing behaviors were examined using Pearson correlations in SPSS.
Results: Pearson correlations were run to compare CBCL Internalizing behaviors and externalizing behaviors to RSM and IS behaviors. Preliminary analyses demonstrated that of individuals exhibiting IS behaviors, there was a larger positive correlation between Internalizing behaviors (r=0.522, p=0.000) than externalizing behaviors (r=0.358, p=0.000). Similar to the IS results, those participants exhibiting RSM behaviors also found a larger positive correlation between Internalizing behaviors (r=0.462, p = 0.000) than externalizing behaviors (r=0.391, p =0.000).
Conclusions: As a result, both RSM and IS behaviors have a strong positive relationship to CBCL internalizing behaviors and moderate positive relationships to externalizing behaviors. Future research is needed to determine what specific internalizing behaviors may be more strongly correlated to RSM and IS behaviors.

163 **146.163** Examining the Relationship of Specific Repetitive and Restricted Behaviors on Adaptive Functioning of Children with ASD

K. Loftus Campe*, S. M. Attar, D. Peterson and E. Hanson, Developmental Medicine Center, Boston Children's Hospital, Boston, MA*

Background: Restricted and repetitive behaviors (RRBs) include a broad category of behaviors which are considered core characteristics required for a diagnosis of Autism Spectrum Disorder (ASD) according to the Diagnostic and Statistical Manual (DSM-V; American Psychiatric Association, 2013). RRBs can be subdivided into repetitive and sensory motor behaviors (RSM) and Insistence on Sameness behaviors (IS). In previous studies, researchers found significant negative correlations between IQ and RSM behaviors and positive correlations between IQ and IS behaviors (Richler et al. 2010). Also, parents have often reported that RRBs can be the most stressful aspect of ASD (Bishop, Richler, Cain & Lord, 2007). This study uses a newly standardized measure, the Behavior and Sensory Interest Questionnaire (BSIQ) to classify a wide range of RRBs. Previous studies using the BSIQ have found negative correlations between RSM behaviors and overall adaptive functioning. Yet, no study has detailed which specific RRBs provide the most interference within the various domains of adaptive functioning. This study attempts to identify specific RRBs that are highly correlated with domains of adaptive functioning to help specify behaviors to be targeted for intervention when aiming to improve socialization skills amongst the ASD population.
Objectives: Using a newly standardized measure, this study aims to delve deeper into the relationship between RRBs and adaptive behavior to identify specific RRBs that highly coorleate to domains of adaptive functioning.
Methods: A sample of 503 children with ASD (82% male) was drawn from the Simons Simplex Collection and the Boston Autism Consortium. Participant ages were between 24-216 months, (mean=92.3, SD=45.75). ASD diagnosis was verified with the Autism Diagnostic Observation Schedule (ADOS) and Autism Diagnostic Interview-Revised (ADI-R).Parents were administered the BSIQ, designed to evaluate the number, type, and intensity of RRBs, by a trained clinician, as well as the Vineland Adaptive Behavior Scale (VABS), which measures adaptive skills in multiple subdomains. Preliminary analysis included Pearson Correlations and descriptive statistics.
Results: Analyses revealed significant negative correlations between RSM behaviors and all three Subdomains of the Socialization Domain on the VABS, Interpersonal Skills, Play and Leisure Time, and Coping Skills. Specifically, RSM behaviors such as Flapping (-.329, p≤0.001), Repetitive Throwing (-.352, p≤0.001), and Toe Walking (-.310, p≤0.001) displayed the strongest negative correlation. No significant trend was revealed of age on IS behaviors, reconfirming previous studies. All analyses were controlled for IQ, age and gender.
Conclusions: Expanding on previous research, we have analyzed the relationship between RRBs and the socialization skills of children with ASD to a more specific level. We found significant effects of RSM but not IS behaviors on socialization skills, including Interpersonal Skills, Play and Leisure Time, and Coping Skills. By providing an understating of which repetitive behaviors are most strongly correlated with areas of socialization, we can begin to understand the impact of RRB's on the functioning of children with ASD and apply this knowledge in adapting interventions for children with ASD. Future research should focus on if there are specific behaviors driving the RSM impact on adaptive skills.

164 **146.164** Examining the Time Course of Repetitive and Restricted Behaviors of Children with ASD throughout Childhood and Adolescence. Taxonomy for Parents and Providers

S. M. Attar*, K. Loftus Campe and E. Hanson, Developmental Medicine Center, Boston Children's Hospital, Boston, MA*

Background: Restricted and repetitive behaviors (RRBs) include a broad category of behaviors which are considered core characteristics required for a diagnosis of Autism Spectrum Disorder (ASD) according to the Diagnostic and Statistical Manual (DSM-V; American Psychiatric Association, 2013). Parents of children with ASD have often reported that RRBs can be the most stressful aspect of raising their child (Bishop, Richler, Cain & Lord, 2007). Earlier research on RRBs may be difficult to generalize, since those studies tended to focus on a limited number of RRBs, measured predominantly by tools designed for assessing ASD and not RRBs per se. While previous studies have subdivided RRBs into Repetitive and Sensory Motor behaviors (RSM) and Insistence on Sameness behaviors (IS), no study has provided a comprehensive taxonomy of the most commonly presenting RRBs by age group.

Objectives: This study uses a newly standardized measure, the Behavior and Sensory Interest Questionnaire (BSIQ) (Hanson et. al. 2015) to classify a wide range of RRBs. Furthermore, by aggregating data by age from a large sample size, a proposed timeline of RRBs emergence has been created.
Methods: A sample of 503 children with ASD (82% male) was drawn from the Simons Simplex Collection and the Boston Autism Consortium. Participant ages were between 24-216 months, (mean=92.3, SD=45.75). ASD diagnosis was verified with the Autism Diagnostic Observation Schedule (ADOS) and Autism Diagnostic Interview-Revised (ADI-R). Parents were administered the BSIQ, designed to evaluate the number, type, and intensity of RRBs, by a trained clinician. Preliminary analysis of behavior frequency determined top presenting RRBs in seven different groups. Groups were determined by age of participant.
Results: Preliminary analysis reveals three primary patterns of prevalence of RRBs in children with ASD. Repetitive motor behaviors often remain consistent in their prevalence across ages, for example, more than 33% of children with ASD present with flapping throughout their development. Sensory seeking behaviors generally showed decline with age, such as seeking deep pressure, which presented between 48-55% for children under the age of nine, but drops as low as 30% for children above the age of nine. In contrast, Insistence on Sameness behaviors are not as prevalent (26-36%) in 2-7 year olds, and instead increase with age, up to 44% in children 9-12 years of age.
Conclusions: Research has shown the impact of RRBs on adaptive functioning, so it is important to document the prevalence across childhood development. Further analysis will reveal the significance of RRB patterns of emergence and frequency. This information will produce a comprehensive taxonomy that is useful for families, clinicians, and researchers in the diagnosis and treatment of children with ASD.

165 **146.165** Extent and Burden of Auditory Hypersensitivity Issues in Children with ASD

E. Rubenstein[1], *J. K. Law*[2], *A. R. Marvin*[3] *and P. H. Lipkin*[4], *(1)Department of Epidemiology, University of North Carolina, Chapel Hill, NC, (2)Interactive Autism Network, Baltimore, MD, (3)Painter Bldg 1st Fl, Kennedy Krieger Institute, Baltimore, MD, (4)Kennedy Krieger Institute, Baltimore, MD*

Background:
Sensitivity issues are strongly associated with the autism spectrum disorder (ASD) phenotype. Research suggests 30-90% of people with ASD either over or under react to sensory stimuli. Auditory hypersensitivity is reported to be the most common, affecting 30-50% of children with ASD, and is highly concerning due to the often-unpredictable nature of the stimulation, and the potential to lead to avoidant or challenging behaviors.
Objectives:

- To describe the extent and burden of auditory hypersensitivity issues (AHI) in a sample of children aged 3-17 with at least one AHI in the previous six months.
- To determine whether sound type, emotional response to sound, and physical response to sound load into factors that may help identify subgroups based on response to auditory stimuli.

Methods:
The Interactive Autism Network (IAN), a large, well-validated, US-based autism research registry, invited participating families of children with ASD aged 3-17 years to complete a survey about their child's current and past AHI, and how AHI affects their child behavior and impacts their family.
Results:
497 children had a completed survey; 400 children (80.5%) had AHI in the six months prior to completing the survey, while 97 did not and were excluded from analysis. The sample was a majority male (83.0%), white (90.3%) and mean age was 11.1 years (standard deviation: 3.5).
Most common frequency for AHI was 'a few times a week' (30.0%) and 'a few times a month' (21.2%). Common specific sounds were yelling (80.3% react at least sometimes), crying (67.6%), and vacuuming (80.3%). Responses to sound often caused at least a somewhat unsafe situation (41.4%), with 14.4% of children physically injuring themselves and 25.5% hurting others. After AHI, parents noted increased anxiety (89.4%), fear (70.9%), impulsivity (65.6%) and difficulty to control (71.5%). Increased behaviors after AHI included covering ears (86.3%), yelling (58.4%), outbursts (82.6%), and escape (57.2%). AHI often led to frequently (25.4%) or sometimes (38.7%) missing school, family, or community activities. Parents most often indicated that management of AHI was minimally (39.2%) to moderately (39.9%) difficult. Exploratory factors were calculated to determine potential subgroups based on sound types that cause issues, and emotional and physical responses to those sounds. Two-factor solutions were found to explain variance in emotional response (fear and aggression factors), physical response (hyperactive/injury and avoidance factors) and sound type (high pitch and low pitch factors).
Conclusions:
AHI occur frequently among children with ASD. These issues lead to safety concerns, increase in challenging behaviors, and loss of opportunities which impacts schooling and ability to experience public life. Preliminary factor analyses suggest that there are different responses types that may help us understand more about the nature of AHI. Better understanding the manifestation of AHI will help lead to effective therapies and prevent AHI which will reduce their negative impacts. Results of this study will inform parents and care providers about management of AHI in the community and its potential impact on child behavior and safety.

166 **146.166** Gait Analysis, Physical Activity and Motor Coordination in Children with Autism Spectrum Disorders and Developmental Coordination Disorder

D. Kindregan[1], *L. Gallagher*[2] *and J. Gormley*[1], *(1)Physiotherapy, Trinity College Dublin, Dublin 8, Ireland, (2)Psychiatry, Trinity College Dublin, Dublin, Ireland*

Background:
Children with Autism Spectrum Disorder (ASD) may demonstrate motor stereotypies such as pacing, jumping/hopping, skipping and spinning and it has been suggested that these may be considered restricted and repetitive behaviours. Studies examining gait in children with ASD suggest a tendency to augment walking stability with a wider base of support and decreased range of motion, which may imply a motor deficit. To date, no study has investigated gait in children with Developmental Coordination Disorder (DCD). Furthermore, children with ASD or DCD may be less physically active than typically developing peers, and no study has compared physical activity in the two groups or a group with a dual-diagnosis of both conditions.
Objectives:
To describe gait patterns, physical activity and motor coordination in children with ASD when compared to children with DCD and typically developing peers.
Methods:
Children with a diagnosis of ASD and/or DCD aged 6-14 years with no other conditions altering gait patterns were included. Height, weight, bodyfat and leg dimensions were measured. Gait analysis was carried out using the Codamotion system on a treadmill at preferred speed and a set speed of 3k/h. Actigraph GT3X tri-axial accelerometers measured physical activity. Motor coordination was assessed using the Movement Assessment Battery for Children, 2nd Edition (MovementABC-2). One-way ANOVA evaluated between-group differences.
Results: (Preliminary)
Thirty four children were recruited into four groups: ASD-only (n=8), DCD-only (n=10), Dual-diagnosis ASD&DCD (n=8), and typically developing (TD) controls (n=8). There were no between-group differences in age or height and no gender effects ($p>0.05$). A larger proportion of children with neurodevelopmental disorders were overweight/obese than controls (ASD: 50%; DCD: 30%; ASD&DCD: 50%; TD: 12.5%).
Children with ASD-only spent a significantly shorter period of time in single stance than the other groups ($p=0.0454$). Knee extension was reduced in the ASD-only, DCD-only and dual-diagnosis groups compared to controls, with a p-value approaching significance ($p=0.054$).
The percentages of time spent in sedentary activity, light activity and the combined moderate-to-vigorous physical activity (MVPA), the total time spent in MVPA, number of Freedson bouts (bouts of MVPA lasting at least ten minutes) and the total duration of these bouts did not show any between-group differences.
The control group scored significantly higher than the other groups in the three categories of the Movement ABC-2 (Manual Dexterity $p=0.000489$, Aiming & Catching $p=0.018992$, and Balance $p=0.034859$). Controls also ranked highest in total test score percentiles at 44.75, DCD group at 7.6, ASD group at 6.2125 and the dual-diagnosis group at 5.825 ($p=0.00001$).
Conclusions:
Preliminary findings suggest that children with ASD and/or DCD may have different physical attributes to typically developing peers, but it is unclear whether children with ASD have defining physical and movement characteristics which may be useful in diagnosis and treatment planning. Children with ASD seem to have poorer coordination than their typically developing peers, as has been noted in published research (Ghaziuddin & Butler, 1998; Fournier et al., 2010). Further research with larger sample size may have implications for clinical practice in areas such as physiotherapy or occupational therapy.

167 **146.167** Gait and Balance Assessment in Children with Genetic Neurodevelopmental Disorders with and without Autism Spectrum Disorders

S. Goldman[1], *S. Dunaway Young*[1], *C. Mueller*[2], *A. K. Boehme*[1], *G. Sherwood*[1], *A. Stahl*[1], *A. Zoeller*[2], *L. D. Abbruzzese*[3], *A. K. Rao*[1] *and J. Montes*[1], *(1)Columbia University Medical Center, New York, NY, (2)Columbia University, New York, NY, (3)Physical Therapy, Columbia University, New York, NY*

Background: Neurodevelopmental disorders are frequently associated with motor impairments including locomotion. The lack of objective measures combined with the challenges inherent in studying children with neurodevelopmental disorders, hinder valuable quantitative motor assessments. The cerebellum controls gait and balance and has shown the most consistent neuroanatomical alterations in Autism Spectrum Disorders (ASD). The basal ganglia has also been implicated in ASD and plays an important role in repetitive behaviors, control of movements, and is associated with aspects of social and emotions processing. Gait and balance are amenable to quantitative methods and may help to refine the motor phenotype in neurodevelopmental disorders. Furthermore, several genetically determined conditions such as 16p11.2 and 1q21.1 are known to be associated with ASD yet their motor phenotype has not been detailed. Motoric measures help characterize locomotion and permit comparisons amongst

neurodevelopmental conditions and as such can provide insight into neural pathway dysfunction.
Objectives: To determine the feasibility and sensitivity of quantitative gait assessments in children with neurodevelopmental disorders.
Methods: Thirty eight children (23 probands with 16p11.2 or 1q21.1 mutation and 15 unaffected siblings) mean age: 8.5 years (range 3.2–15.4), and 55.3 % male were enrolled. Among the probands, 23% carried a diagnosis of ASD and were all male. Gait assessments included: six-minute walk test (6MWT), 10 meter run/walk test (10MRW), timed-up-and-go test (TUG) and spatio-temporal measurements of preferred and fast-paced walking. The Pediatric Evaluation of Disability Inventory-Computer Adaptive Tests (PEDI-CAT), a caregiver-reported functional assessment was administered. Measures of balance were calculated using *Percent Time in Double Support* and *Base of Support*. Subsequently, the locomotion data from the 6 children diagnosed with ASD were compared with 6 age-matched non-ASD genetic probands and 6 non-ASD sibling controls.
Results: All but 2 of the youngest children completed the protocol. Probands had significantly lower scores than sibling controls on 6MWT (p=0.040), 10MRW (p=0.012), and TUG (p=0.005). Group differences were identified in *Base of Support* (p=0.003). Probands had significantly lower PEDI scores in all domains including the mobility scale (p<0.001). In the fast-paced condition, all participants increased velocity on average from 114.7 to 189.2 cm/sec by increasing both stride length and cadence. As for balance measures, the ASD group did not demonstrate the expected concurrent reduction in *Double Support* time during the fast-paced condition which was observed in the two age-matched non-ASD groups. In addition, only the ASD group presented with upper limb stereotypies.
Conclusions: Our motor assessment provides quantifiable results in children with 16p11.2 or 1q21.1 mutation as well as detailed characterization of locomotion performance. Differences in *Base of Support* highlight a balance impairment during locomotion activities in children with neurodevelopmental disorders with and without ASD. However, only the children with ASD had a blunted response to *Double Support* time in the fast-paced condition. This finding may contribute to their greater functional impairment. Our results confirm motor dysfunction including balance in children with known genetic neurodevelopmental disorders. The ability to characterize the motor phenotype in all children with ASD may help identify the neurological underpinnings of the disorder.

168 **146.168** Heightened Attention to Nonsocial Images Is Not Driven By Feature Salience in Children with Autism

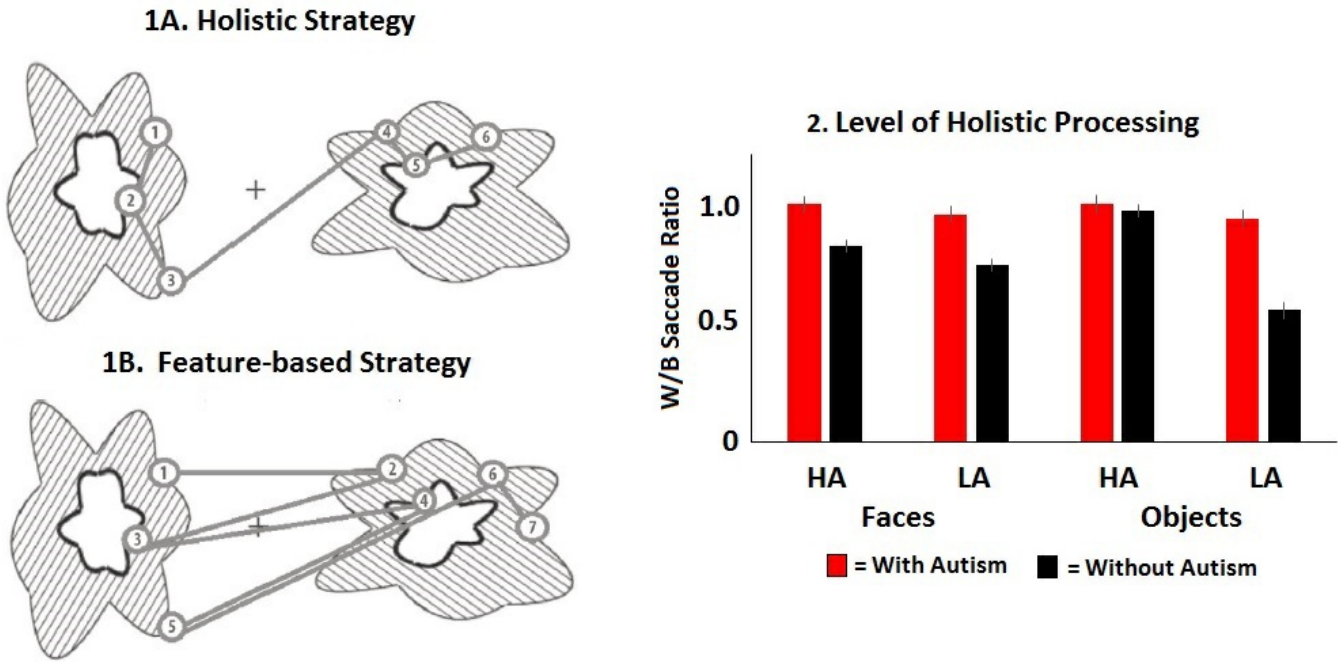
R. L. Shafer[1], *K. Unruh*[1], *J. P. Noel*[1] *and J. W. Bodfish*[2], *(1)Vanderbilt University, Nashville, TN, (2)Vanderbilt University School of Medicine, Nashville, TN*

Background: Circumscribed interests are one form of the diagnostically relevant restricted, repetitive behavior observed in autism spectrum disorders (ASD), and they are characterized by an intense, narrow interest in a given subject area or object type. It is not known how circumscribed interests in ASD may be influencing or influenced by the social deficits that are also characteristic of ASD. Eye-tracking studies have assessed attention to social and non-social stimuli in ASD and have shown that individuals with ASD show a preference for looking at non-social images (e.g., objects) over social images (e.g., faces); however, there is little understanding of what is driving attention to non-social stimuli relative to social stimuli in individuals with ASD.
Objectives: Our study aimed to determine if low-level features of the images could be driving the preferential looking to non-social stimuli (in particular, stimuli that are of high interest to people with ASD) over social stimuli in ASD.
Methods: We used gaze data from a paired-preference viewing task, whereby; typically developing children and children with ASD were presented with images of faces paired with either an image of an object of high interest to individuals with ASD (HAI) or an object of low interest to individuals with ASD (LAI). Gaze data (proportion of look time, average fixation duration, and first fixation duration) were analyzed in relation to the low-level visual features of the image (color, intensity, and orientation).
Results: Our results indicated that all low-level features of the images were predictive of look time to the HAI images for the typically developing children (Color: R = -.124, p = .019; Intensity: R = .234, p < .001; Orientation: R = .230, p <.001; Composite: R = .213, p < .001), but only the composite score for the children with ASD (R = .124, p = .020). There was very little relationship between the low-level features and look time for the LAI images and faces in both the typically developing children and the children with ASD. For typically developing individuals, low-level features were predictive of average fixation duration (Color: R = .180, p = .002; Intensity: R = .180, p = .002; Orientation: R = .130, p = .017; Composite: R = .233, p < .001) and first fixation duration (Color: R = .213, p < .001; Intensity: R = .216, p = .021; Orientation: R = .117, p = .028; Composite: R = .190, p = .001) only for faces that were paired with LAI images, but low-level features were not predictive of average fixation duration or first fixation duration in individuals with ASD.
Conclusions: Given that low-level visual features were minimally predictive of gaze patterns in individuals with ASD regardless of image type, our results suggest that preferential looking to non-social stimuli in ASD is likely due to more cognitively directed attention rather than stimulus-driven attention.

169 **146.169** Holistic Processing of Unfamiliar Faces and Novel Objects in Autism

R. A. Stevenson[1], *S. Ferber*[1], *L. K. Yeung*[1], *N. D. Hazlett*[2], *A. Philipp-Muller*[1], *K. R. Black*[1], *Z. Y. Wang*[1] *and M. D. Barense*[1], *(1)Department of Psychology, University of Toronto, Toronto, ON, Canada, (2)Occupational Therapy, University of Toronto, Toronto, ON, Canada*

Background:
Numerous studies have suggested that individuals with autism may have difficulties perceiving items (e.g. faces) as single, unified percepts (holistic processing), instead defaulting to perceiving the item's components as discrete parts (feature-based processing). There is some debate as to whether this perceptual difficulty in autism is specific to faces, which are typically processed holistically, or if this difficulty extends to visual processing in general.
Objectives:
1) Used a novel eye-tracking paradigm to assess the degree to which typically developing (TD) individuals holistically process unfamiliar faces and novel objects.
2) Investigate holistic processing difficulties in autism, and determine whether they are specific to faces or generalizeable to visual object stimuli.
Methods:
Twenty-eight individuals to date (data collection ongoing; ages 8-21 years) with and without autism have completed an eye-tracking paradigm in which participants were presented with pairs of stimuli from different viewpoints and responded as to whether the two stimuli were the same or different. Four types of stimulus-pairs were presented: low-ambiguity faces (50% morphs), high-ambiguity faces (80% morphs), low-ambiguity novel objects (highly distinct), and high-ambiguity novel objects (highly similar). 72 trials of each condition were presented, and pilot studies matched accuracies across stimulus types.
This eye-tracking paradigm was developed specifically to compare holistic and feature-based perceptual strategies. By comparing the number of *within-item* saccades (holistic strategy) to *between-item* saccades (feature-based strategy), one can assess the extent to which an individual relies on a particular visual processing strategy (see Figure 1). Thus, the ratio of within-item saccades to between-items saccades was calculated for each individual with each stimulus type (W/B-ratio), and used as an index of holistic processing. Higher ratios were indicative of greater use of holistic processing strategies.
Results:
W/B-ratio scores (Figure 2) were compared across stimulus types and diagnostic groups in a three-way ANOVA (diagnostic group x stimulus type x ambiguity level). A main effect of ambiguity was observed (F=9.28, p=0.005), as was a trend towards a main effect of diagnosis (F=2.70, p=0.11). No main effect of stimulus type was observed (F=0.10, p=0.75). Two-way interactions between stimulus type and ambiguity (F=7.95, p=0.01) as well as diagnosis and ambiguity (F=4.94, p=0.04) were observed, but no interaction between diagnosis and stimulus type (F=0.28, p=0.60). Finally, a significant three-way interaction between diagnosis, stimulus type, and ambiguity was observed (F=6.47, p=0.02).
Conclusions:
We confirmed that TD participants processed faces holistically, regardless of ambiguity level. In contrast, for novel objects, they applied a holistic processing strategy when the objects were high-ambiguity, but used feature-based processing when the objects were low-ambiguity. This faces versus objects difference was not observed in individuals with autism. While individuals with autism exhibited a numeric decrease in their holistic processing from high- to low-ambiguity stimuli, this change did not vary according to stimulus domain, suggesting that while TD individuals process faces differently than objects, individuals with ASD did not switch between processing styles based on ambiguity or stimulus type. Instead, their viewing patterns for all stimulus classes reflected an attempt at a holistic strategy.



170 **146.170** How Sensory Experiences Affect Adolescents with an Autistic Spectrum Condition within a Classroom at School

F. E. Howe *and S. D. Stagg, Psychology, Anglia Ruskin University, Cambridge, United Kingdom*

Background: Sensory processing difficulties have been consistently found amongst individuals with an autistic spectrum condition (ASC). These sensory abnormalities have a significant impact on an individual's ability to function in everyday life. Attending school is a normal part of a child's life but for a child with ASC this comes with multiple difficulties, including sensory problems. There is at present a limited amount of research conducted specifically on the effect of sensory difficulties whilst at school, and work on sensory processing in general tends to rely on observer reports. More research employing self-report and autobiographical accounts is needed in this area, in order to understand how sensory issues affect the schooling experience of children with ASC.
Objectives: The current research sought to establish how adolescents with ASC perceive sensory processing abnormalities to be affecting their learning experiences within the classroom.
Methods: The Adolescent/Adult Sensory Profile, a self-report measure, was used to establish objectively whether the participants had sensory issues. A qualitative questionnaire designed by the researcher was then used to investigate the participant's individual sensory experiences whilst in a classroom. The participants were 16 adolescents with a diagnosis of ASC with no co-morbid diagnosis of any learning disability. The participants were drawn from mainstream schools in the east of England.
Results: The participants in the current study showed processing difficulties in at least one of the sensory profile quadrants, and 86% scored outside the normal range on two or more of the quadrants. The participants were aware of their sensory issues, and all reported difficulties in the classroom within at least one sensory domain. Hearing was rated as being the sense that particularly affected the participants followed by touch, smell and vision. Content analysis revealed that the participants considered sensory sensitivity to affect their learning to some extent and that their sensory experiences within a classroom were largely negative. Despite similarities between the participants' sensory experiences, significant variations were found. This highlights the importance of considering adolescents with ASC as having individual experiences.
Conclusions: Sensory experiences vary between participants, highlighting how individual these can be for those with ASC and the need for schools to create sensory profiles specifically for each pupil. This could lead to more appropriate interventions that help children with ASC access the same level of education and schooling experience as neurotypical children.

171 **146.171** How Should We Measure Repetitive Behaviors in Infants and Toddlers with Autism Spectrum Disorder?

P. Towle[1] *and J. Cross*[2]*, (1)Westchester Insitute for Human Development, Valhalla, NY, (2)Developmental Pediatrics, Weill Cornell University School of Medicine, New York, NY*

Background:
There has been increased interest in restrictive and repetitive behaviors (RRBs) in individuals with autism spectrum disorder (ASD), since this symptom domain has been neglected compared to social-communication. This interest has recently applied to very young children with ASD, since the age of reliable diagnosis has been extended downward to 24 months and younger. It will be important to understand if infants and toddlers show the same forms of RRBs as older children, whether there are developmentally younger versions, or if there is discontinuity from RRBs shown in infancy to older children. These issues also have clinical implications, since reduced recognition of RRBs in infants and toddlers could potentially lead to fewer early diagnoses using the reconstructed DSM-5 criteria. Recently RRBS have been investigated in young children using the Repetitive Behavior Scale-Revised and the Repetitive Behavior Questionnaire. However, it is important to consider the implications of extending RRB descriptions and frameworks that were initially created for older individuals to infants and toddlers. Others have reported on early RRBs using the ADOS2 and ADOS-T, as well as other structured play tasks (Harrop et al., 2015); however, the RRB categories and exemplars have been predetermined, are potentially narrow, and do not allow for what children may show in other settings and at home. This study addressed these concerns by starting with a large set of behaviors observed and reported across settings for infants and toddlers diagnosed with ASD, matching them to categories that previous and current research has suggested, and creating a format to record those both observed by clinicians and reported by parents.
Objectives: To 1) Review currently available instruments and methods of measuring RRBs in young children with ASD. 2) Describe development of an instrument for measuring RRBs in infants and toddlers.
Methods: 1) Eight screening and assessment instruments for RRBs in very young children with ASD were reviewed for frameworks and consistencies in defining RRBs. 2) An exhaustive list of RRBs was developed by the first author to create the Infant-Toddler RRB Inventory (IRBBI). Item categories, based on previous research using factor analysis and other construct validity strategies include: Repetitive Behavior (Motor and Visual Stereotypies, Repetitive Play), Insistence on Sameness, Restricted Interests/Areas of Unusual Ability, and Sensory Behaviors. The exemplars were drawn from both existing instruments and extensive clinical experience with infants through preschoolers with ASD. The checklist was refined through review by highly experienced evaluators (n=5), piloting during diagnostic evaluations with 48 young children, and coding the checklist using 75 previous evaluation reports.
Results: The review of instruments showed more disagreement than agreement on what both the major categories of RRBs should be and what exemplars should operationalize them. The IRRBI was developed, piloted, and refined until it accommodated symptoms reported in clinical charts and during evaluations by experienced clinicians; the resulting categories, subcategories, and exemplars are presented.
Conclusions: There is currently little agreement on how and what to measure as RRBs in infants and toddlers. A new instrument developed from a combination of research frameworks and clinical experience/observation is described.

172 **146.172** Increased Force Variability in Autism Reflects Reduced Modulation of Motor Neuron Pool Beta Oscillations

M. Kwon[1]*, S. Mohanty*[2]*, K. Conroy*[2] *and M. W. Mosconi*[1,2]*, (1)Schiefelbusch Institute for Life Span Studies and Clinical Child Psychology Program, University of Kansas, Lawrence, KS, (2)UT Southwestern Medical Center, Dallas, TX*

Background: Sensorimotor impairments are common in individuals with autism spectrum disorder (ASD). We recently demonstrated that patients exhibit amplified force variability during precision gripping. The neurophysiological mechanisms associated with these impairments are not well understood. Recording of activity of the motor neuron pool represents a promising approach for understanding brain mechanisms as motor unit activity represents the final pathway of the voluntary command from the brain to the muscle. Here, we used surface electromyography (EMG) and specialized surface electrodes to record multiple motor units during a test of manual force control.
Objectives: To determine the neuromuscular mechanisms that contribute to impaired force control in ASD during isometric index finger abduction.

Methods: Seventeen individuals with ASD and 13 healthy controls matched on age, gender, IQ and handedness performed an isometric index finger abduction task at 20, 40 and 60% of their maximum force. Participants pressed with their index finger against a precision load cell while viewing visual feedback on a monitor in front of them. As they increased force against the load cell, a force cursor on the monitor increased in height. They were instructed to press against the load cell so that the force cursor reached the height of a target line for 27 seconds. To determine individuals' ability to modulate motor neuron pool activity, we used an EMG decomposition system To determine individuals' ability to modulate motor neuron pool activity, we used an EMG decomposition system to identify and record action potentials from multiple motor units. A specialized electrode was placed along the fibers of the first dorsal interosseous muscle to record neuromuscular activity. Participants performed 2 trials at each force level interleaved with 1 min rest blocks.
Results: Individuals with ASD exhibited greater force variability compared to healthy controls across force levels. Mean force was not different between groups at any force level. Mean discharge rate of the motor neuron pool decreased with increasing force levels. Individuals with ASD exhibited an increased mean discharge rate compared to healthy controls. Frequency analyzes showed that the majority of the modulation of motor neuron pool activity related to force control was in the beta range (10-35 Hz). Individuals with ASD showed reduced modulation of the motor neuron pool in the beta range compared to healthy controls.
Conclusions: Our findings show that amplified force variability in individuals with ASD reflects altered activation of the motor neuron pool. Increased firing rate of the motor neuron pool in ASD suggests that larger motor units recruited redundantly to produce force may impair force control in patients. We also found decreased motor neuron pool oscillations in the beta range (10-35 Hz) in ASD suggesting that neuromuscular activity associated with central commands involved in ensuring stable motor output are compromised in ASD. These results indicate that brain mechanisms involved in precisely stabilizing motor output are disrupted in ASD and may be promising targets for treatment and biomarker discovery research.

173 **146.173** Insistence on Sameness Behaviours Selectively Associate with Reported Childhood Pretend Play in Adults with ASD

***S. L. Barrett**, C. Jones and S. R. Leekam, School of Psychology, Cardiff University, Cardiff, United Kingdom*

Background: Research with children with ASD shows that restricted and repetitive behaviours (RRB) reliably group into two subtypes: repetitive sensory and motor (RSM) and insistence on sameness (IS) and that high levels of RRBs in general are associated with lack of play (Honey et al., 2007). The present study tests whether RSM and IS subtypes are found in adults with ASD, and whether these subtypes are associated with childhood pretend play.
Objectives: 1) Assess the RRB subgroups found in adults using the Adult Repetitive Behaviours Questionnaire–2 (RBQ-2A; Barrett et al., 2015), the first published self-report measure of RRBs for adults. Its component structure has not yet been assessed in adults with ASD.
2) Test whether there are any difference in RRBs between participants who played pretend as a child and those who did not play pretend.
Methods: The RBQ-2A was administered to UK participants (N = 787) in an online survey, along with open-ended questions about their childhood pretend play (quantified for the present analysis). Analyses were only conducted on complete datasets from participants who reported either a clinical diagnosis of ASD or no diagnosis of any kind (i.e. neurotypical [NT]). Participants in the final sample (N = 583) were aged 18-66 years (M = 36.51, SD= 11.67), 219 were male and 317 participants reported a clinical diagnosis of ASD. The RBQ-2A data were analysed using principal components analysis (PCA) with direct oblimin rotation to allow for correlation between components. The Autism-Spectrum Quotient (AQ; Baron-Cohen et al., 2001) was also completed.
Results: The final rotated PCA solution explained 45.36% of the total variance and resulted in the two predicted components, RSM and IS. Participants with ASD scored significantly higher in terms of total AQ score, mean total RBQ-2A score and mean RBQ-2A subscale scores. Fifty percent of the ASD group and 76% of the NT group reported playing pretend games as children. For both groups, participants who did not play pretend as a child scored higher on the imagination subscale of the AQ, supporting the role of pretend play as a predictor for imagination. In the ASD group, participants who did not play pretend as a child scored significantly higher on the IS subscale than those who did play pretend (p < .001), whereas no significant differences depending on pretend play were found for the NT group on either of the RBQ-2A subscales.
Conclusions: The component structure of the RBQ-2A was assessed for the first time in a sample that includes adults with ASD. As in previous research with children, we identified two reliable subscales comprising RSM and IS, with expected group differences across the total score and its subscales. The second objective was to test whether childhood pretend play has an effect on later RRBs and we found an ASD-specific effect for IS only. This is the first evidence that childhood pretend play may be associated with RRBs in adulthood. Further attention should be given to the importance of the relationship between imagination and RRBs in ASD.

Table 1: Pattern matrix for principal components analysis, and percentage of variance explained and internal consistency for each component

Rotated item loadings:	Component 1 Repetitive Sensory and Motor Behaviours	Component 2 Insistence on Sameness
1. Like to arrange items in rows or patterns?	**.406**	.268
2. Repetitively fiddle with items?	**.708**	.026
4. Rock backwards and forwards, or side to side, either when sitting or when standing?	**.748**	.119
5. Pace or move around repetitively	**.544**	.078
6. Make repetitive hand and/or finger movements?	**.737**	.057
7. Have a fascination with specific objects?	.357	**.430**
8. Like to look at objects from particular or unusual angles?	**.549**	.155
9. Have a special interest in the smell of people or objects?	**.543**	.009
10. Have a special interest in the feel of different surfaces?	**.661**	.022
11. Have any special objects you like to carry round?	**.435**	.293
12. Collect or hoard items of any sort?	.217	**.527**
13. Insist on things at home remaining the same?	.122	**.845**
14. Get upset about minor changes to objects?	.102	**.796**
15. Insist that aspects of daily routine must remain the same?	.044	**.806**
16. Insist on doing things in a certain way or re-doing things until they are "just right"?	.017	**.719**
17. Play the same music, game or video, or read the same book repeatedly?	.293	**.455**
18. Insist on wearing the same clothes or refuse to wear new clothes?	.251	**.478**
19. Insist on eating the same foods, or a very small range of foods, at every meal?	.080	**.567**
Percentage of variance explained:	37.02%	8.34%
Internal consistency (Cronbach's alpha):	.83	.88

174 **146.174** Insistence on Sameness in Parents and Their Children with ASD

***A. N. Esler**, S. T. Stronach and S. Jacob, University of Minnesota, Minneapolis, MN*

Background: Previous research has established the existence of the broader autism phenotype (BAP) (e.g., Piven et al., 1997), but work is emerging on its relationship with specific child ASD features. Insistence on sameness (IS) may be a heritable feature of ASD due to its relative independence from mediating variables, such as verbal IQ. It has been suggested that subtyping based on degree of IS to create more homogeneous groupings of individuals may increase the ability to detect genetic factors (Hus et al., 2007).
Objectives: Characterize IS in parents of children with ASD and examine its relationship with child IS. We hypothesized a positive association between parent and proband IS.
Methods: Participants were 2760 families who participated in the Simons Simplex Collection. Parent IS was measured using the Broader Autism Phenotype Questionnaire (BAPQ). A factor analysis was conducted to create an IS scale from BAPQ items. BAPQ-IS scores were divided into groups of the lowest and highest 25% and middle 50% (25-50-25). Proband IS was operationalized using subsets of items from the ADI-R and the RBS-R. Linear regression models were used to examine the relationship between parent IS and proband IS. Potential predictors were entered into a structured hierarchical regression model, in which Block 1 included proband verbal IQ, sex, and age (which are known to affect the expression of ASD and other psychological symptoms), and Block 2 included father and mother BAPQ-IS raw scores. Significant predictors were then entered into Forward Stepwise models to determine the relative contributions of these individual variables to proband IS.
Results: Our factor analysis generated a BAPQ-IS scale consisting of a subset of eight items from the original BAPQ-Rigid scale. Rigid items involving keeping things the same and disliking changes in routine were retained in our IS factor, and items involving disliking new or unfamiliar things were excluded. Our empirically derived BAPQ-IS factor differed only slightly from a previous BAPQ-IS scale generated through clinical consensus (Levin-Decanini et al., 2014); it contained the six items identified by Levin-Decanini et al. plus two additional items. Parent IS and proband IS were minimally related, although results reached statistical significance. Only proband RBS-R-IS scores had more than 2% of its variance explained by parental IS once significant proband variables were accounted for, and in all cases, parent IS explained the smallest amount of variance in each proband IS variable.
Conclusions: The relative lack of association between parent IS and proband IS was surprising given the literature documenting positive correlations between parental rigidity and BAP characteristics and proband ASD (Losh et al., 2008; Piven et al., 1997). Although sample size was large, it was a simplex family sample, which may have resulted in a weaker relationship between parent and child IS compared to previous studies of multiplex families (e.g., Piven et al., 1997). Scale and measurement differences (e.g. characterization of adult versus child IS symptoms) may contribute to these results. Further research is needed on the validity and reliability of measuring IS and BAP features over the course of development.

175 **146.175** Insistence on Sameness, Anxiety, and Social Motivation in Children with Autism Spectrum Disorder

R. S. Factor[1], *E. E. Condy*[2], *J. P. Farley*[3] *and A. Scarpa*[1,3], *(1)Psychology, Virginia Polytechnic Institute and State University, Blacksburg, VA, (2)Virginia Polytechnic Institute and State University, Blacksburg, VA, (3)Virginia Tech Center for Autism Research, Blacksburg, VA*

Background: Restricted repetitive behaviors (RRBs) are a key feature of autism spectrum disorder (ASD; American Psychiatric Association, 2013). While the function of RRBs in ASD is currently unclear, RRBs have been identified as a possible anxiety reduction strategy (Joosten et al., 2009). Anxiety is prevalent in individuals with ASD (White et al., 2009), and anxiety triggers in ASD include social interaction and the disruption or change of routines (Ozsivadijan, Knott, & Magiati, 2012), which clearly intersect with the insistence on sameness (IS) domain of RRBs. RRBs can also affect socialization by decreasing the likelihood of positive peer interactions (Nadig, Lee, Singh, Bosshart, & Ozonoff, 2010) and interference with daily life (South, Ozonoff, & McMahon, 2005). Further, social skills training for children with ASD has been shown to increase social interactions and reduce RRBs (Loftin et al., 2008).
Objectives: The present study attempts to link low social motivation and anxiety to RRBs, specifically IS, by examining the mediating role of social motivation between anxiety and RRBs in children with ASD. Examining these relationships may provide guidance on intervention strategies for children with ASD.
Methods: Participants were part of an ongoing assessment database of individuals with and without ASD. At the time of analysis, the database had 81 participants. Unaffected controls ($n = 25$) were not included. After removing participants due to incomplete data, the sample used included 44 participants from 2 to 17 years ($M = 6.91$, $SD = 3.64$), were 80% male ($n = 35$), and race/ethnicities were reported as 84.1% White ($n = 37$), 6.8% Black ($n = 3$), 4.5% Asian ($n = 2$), and 4.5% Other ($n = 2$). At the assessment appointment, clinical interviews and behavioral assessments were completed and ASD diagnosis was determined by the assessment team and a licensed clinical psychologist, based on DSM-5 criteria.
Results: The Baron & Kenny (1986) approach was used as a preliminary evaluation of the proposed mediation model. Anxiety was positively associated with the proposed mediator, social motivation deficits ($\beta = 0.49$, $p < 0.01$), as well as the outcome variable, sameness behavior ($\beta = 0.46$, $p < 0.01$), such that higher anxiety was related to increased social motivation deficits and increased sameness behaviors. When both the mediator and the outcome variable were included, the total effect remained significant (*adjusted* $R^2 = 0.30$, $F(2,41) = 10.35$, $p < 0.01$). Furthermore, there was a significant direct effect ($\beta = 0.33$, $p = 0.03$), indicating partial mediation. To verify the indirect effect, a bootstrapping simulation using 1000 samples was performed. Results indicated social motivation partially mediated the relationship between anxiety and IS as evidenced by a significant indirect effect ($M = 0.13$, 95% CI [0.02, 0.27]).
Conclusions: These findings suggest a relationship between anxiety, RRBs, and social motivation. In particular, anxiety was positively related to IS, which was partially accounted for by deficits in social motivation. The results shed light on how these ASD features are linked and suggest that intervention for sameness behaviors should address both social motivation and anxiety.

176 **146.176** Integrating Behavioral and Electrophysiological Assessments of Sensory Reactivity in ASD

P. M. Siper[1], *J. L. George-Jones*[1], *S. M. Lurie*[1,2], *J. Zweifach*[1,2], *A. T. Wang*[1], *A. Kolevzon*[3], *J. D. Buxbaum*[1] *and T. Tavassoli*[1], *(1)Psychiatry, Seaver Autism Center at Mount Sinai, New York, NY, (2)Ferkauf Graduate School of Psychology, Yeshiva University, Bronx, NY, (3)Psychiatry, Seaver Autism Center for Research and Treatment at the Icahn School of Medicine at Mount Sinai, New York, NY*

Background: Sensory reactivity is now recognized as a symptom of autism spectrum disorder (ASD) in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5). Previous literature indicates that sensory symptoms are present across the lifespan and affect individuals at all levels of functioning. In addition, greater sensory symptoms have been reported in more severely affected children. Obtaining quantifiable measures of sensory reactivity is particularly important for individuals who are unable to describe their own sensory experiences. While there is a clear need to objectively measure sensory reactivity, these symptoms have historically been described on the basis of caregiver report. The current study combines a direct observation and corresponding caregiver interview with an electrophysiological assessment in an effort to develop outcome measures that may be sensitive to change in response to treatment, while gaining insight on the underlying neurobiology of sensory symptoms in ASD.
Objectives: To examine whether observed and reported sensory reactivity is correlated with neural measures of sensory processing.
Methods: This study included minimally verbal children between the ages of 2 and 7 with a diagnosis of ASD. Diagnoses were established using DSM-5 criteria, the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2), and the Autism Diagnostic Interview-Revised (ADI-R). All participants received the Seaver Sensory Assessment for Neurodevelopmental Disorders (SSAND), which consists of a standardized clinician-administered observation and corresponding caregiver interview that characterizes sensory reactivity symptoms based on DSM-5 criteria for ASD. The SSAND provides an overall total score (observed + reported), scores by sensory modality (visual, auditory, tactile), and scores by DSM-5 symptom domain (hyper-, hypo-reactivity, seeking). Visual evoked potentials (VEP) were collected using single-channel EEG recording over the occipital cortex. A contrast revering checkerboard pattern consisting of 32 x 32 checks (check size = 18.75 minarc) contrast reversed with a 1-Hz square-wave signal (100% contrast) was used to elicit transient VEPs.
Results: Results to date indicate a relationship between sensory reactivity symptoms and neural responses. Specifically, P100 amplitudes were negatively correlated with both SSAND total scores and SSAND visual domain scores. P100 reflects inhibitory (GABAergic) activity and therefore the smaller the inhibitory response, the greater were the number of behavioral sensory symptoms. Importantly, there were no correlations between P100 amplitude and auditory or tactile domain scores, confirming the specificity of this finding. Activity in several frequency bands was also correlated with overall SSAND scores and visual domain scores (observed and reported), indicating that greater sensory reactivity at the behavioral level was associated with weaker VEP signal power.
Conclusions: Our results suggest that there is a relationship between observed and reported visual reactivity symptoms and electrophysiological responses. Future directions include examining whether auditory evoked potentials are correlated with auditory domain scores on the SSAND. Ultimately, the goal is to develop outcome measures that combine information from behavioral and neural testing and to examine whether these measures are sensitive to change in the context of clinical trials.

177 **146.177** Interpersonal Sensory-Motor Synchronization in Adults with and without ASD during a Joint Improvisational Mirror Game

ABSTRACT WITHDRAWN

Background:
Recent research on Autism Spectrum Disorders (ASD) suggests that individuals with autism may have a basic deficit in synchronizing with others, and that this difficulty may lead to more complex social and communicative deficits (Marsh et al., 2013). The current project aims to conduct an in-depth investigation of interpersonal sensory-motor synchrony in ASD, using an innovative experimental paradigm - the Mirror Game (MG, Fig 1) – that allows high-resolution temporal and spatial motion tracking in an open-ended joint improvisation game (Noy et al., 2011).
Objectives : To investigate the ability of adults with ASD, as compared with typically developing (TD) adults, to synchronize their movements with another person.
Methods:
Participants: data from 25 participants with high-functioning ASD was compared with that of 25 TD adults.

MG procedure: two players face each other holding handles which can move along parallel tracks, and are told to “imitate each other, create synchronized and interesting motions, and enjoy playing together” (Fig 1a,b). All participants played against the same expert improviser. Participants were instructed to first lead the motion (Leader), then follow the experimenter’s motions (Follower), and then engage in Joint Improvisation (JI), with no designated leader; in 3-minute trials. The motion of the two handles is sampled at 50 HZ (Fig 1c,d).

Data analysis: Players’ synchronization was measured using the mean relative difference in velocity (*dV*) and the timing differences between zero-velocity events (*dT*). Periods of synchronized, co-confident (CC) motion (Fig 1d) were defined as periods of nonzero motion longer than 2sec with minimal jitter (i.e., in which the Fourier rms power in the 2-3 Hz band of the difference between the players’ velocities is less than 10% of their mean velocity (Noy et al., 2011)).

Results:

We found that individuals with autism *can* attain co-confident (CC) motion when playing the Mirror Game with an expert improviser. Interestingly, we found an interaction effect of diagnostic group (ASD, TD) by Round (Leader, Follower, Joint Improvisation), such that individuals with ASD had significantly reduced levels of CC compared to TD participants when following the experimenter ($t(33)=4.44$, $p<.01$), but not when leading or jointly improvising with them.

Conclusions:

These data provide the first evidence, to our knowledge, that individuals with autism can attain highly-synchronized, co-confident motion, when playing with another player in an open-ended joint improvisation game. Further data collection and analysis are currently underway to determine whether ASD participants differ from TD participants in their patterns of interpersonal synchronization, and whether these interpersonal motion patterns are associated both with background characteristics such as autism severity, IQ, motor coordination, and imitation ability and with more complex, everyday social and communication abilities.

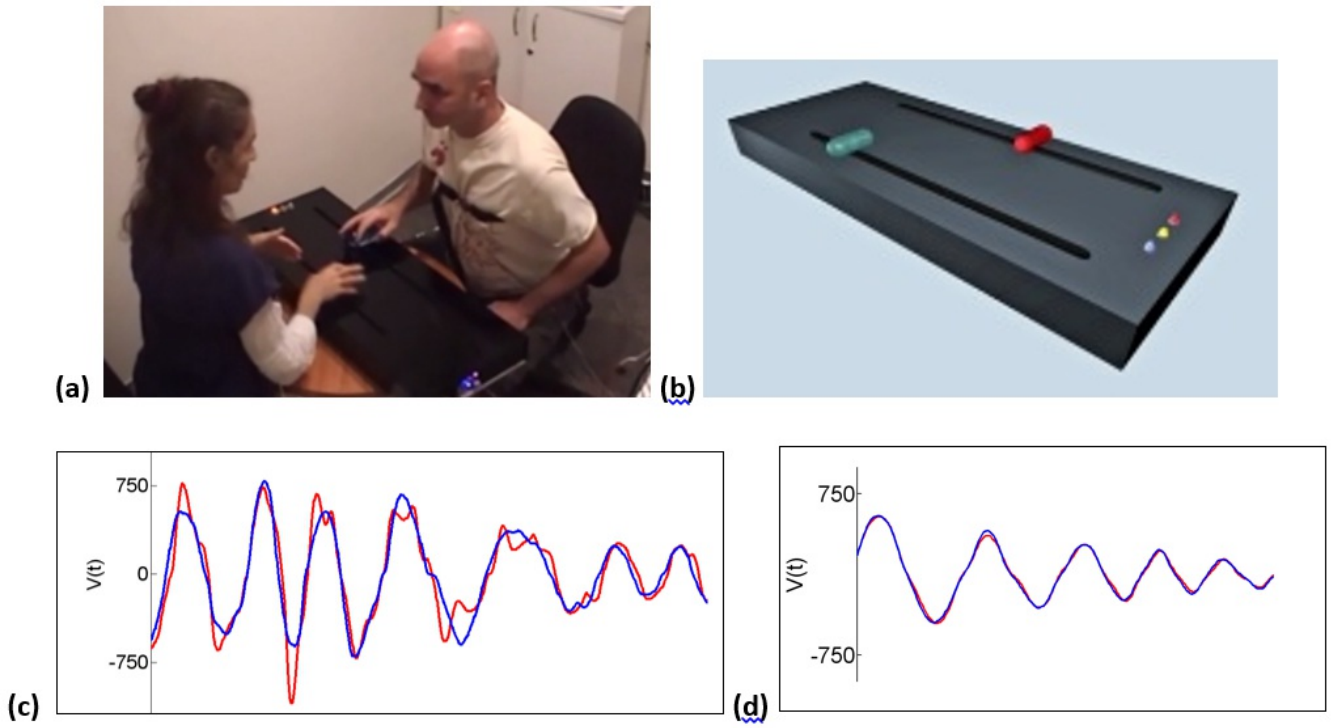


Figure 1: (a) Two players mirror each other, producing jointly synchronized motion, on **(b)** the mirror game measurement system. Players are instructed to: “imitate each other, create synchronized and interesting motions, and enjoy playing together.” **(c)** *Leader-follower pattern*: the follower (red) shows 2-3Hz oscillations around the leader’s (blue) smooth trajectory. **(d)** *Co-confident pattern*: two highly synchronized smooth motion tracks, with no jitter.

178 **146.178** Is There a Relationship Between Sleep Problems and Motor Impairment in Children with Autism Spectrum Disorder?

S. J. Thomas[1], *T. Hinkley*[2], *L. Barnett*[3], *T. May*[1,4], *N. Papadopoulos*[1], *J. McGinley*[5], *A. Timperio*[6], *H. Skouteris*[1], *J. A. McGillivray*[1], *J. Salmon*[6] *and N. J. Rinehart*[1], *(1)School of psychology, faculty of health, Deakin University, Burwood, Australia, (2)Centre for Exercise and Nutrition Research, Deakin University, Burwood, Australia, (3)Health and Social development, Deakin University, burwood, Australia, (4)Royal Children's Hospital, Parkville, Australia, (5)department of physiotherapy, University of Melbourne, Parkville, Australia, (6)Centre for Exercise and Nutrition, Deakin University, Burwood, Australia*

Background: Two of the main neurological problems children with Autism Spectrum Disorder (ASD) are faced with are; motor impairment, and sleep problems. Sleep problems have been reported to occur in up to 83% of children with ASD and have both behavioural and neurological underpinnings (Cortesi et al., 2010). Motor impairment has been reported to occur in up to 79% of children with ASD (Green et al., 2002). Both sleep problems and motor impairment have been linked to dysfunction in specific cortical and subcortical structures such as the fronto-straital circuits (Maski & Kothare, 2013). Previous studies have linked sleep deprivation to problems with motor movements in healthy adolescents and adults (Maski & Kothare, 2013). To date, no studies have investigated the possible association between sleep problems and impaired motor proficiency in children with ASD. It is plausible that impaired motor function will be associated with greater sleep problems as a result of disruption to similar underlying brain circuitry.

Objectives: The current study aimed to investigate the association between motor proficiency and behavioural sleep problems in children with ASD.

Methods: Participants aged 4-6 years (n=30, 80% male, 80% without Intellectual Disability) with a current ASD diagnosis were recruited from the larger Active Kids study, a study investigating physical activity, sleep and motor impairment in children with ASD. Level of motor proficiency was measured using the Movement Assessment Battery for Children (MABC-2) subscales (manual dexterity, ball skills and balance and coordination) and total score. Behavioural sleep problems were measured using the subscales and total scores Children’s Sleep Habits Questionnaire (CSHQ; sleep onset delay, sleep duration, bedtime resistance, sleep anxiety, night waking, parasomnias, sleep disordered breathing, daytime sleepiness). Correlations investigated associations between the subscales and total MABC-2 and with the subscales and total CSHQ.

Results: There were moderate negative correlations between sleep onset delay and poorer motor proficiency as measured by the MABC-total ($r = -.49$, $p = .008$), manual dexterity ($r = -.60$, $p=.001$), ball skills ($r = -.41$, $p=.03$, and balance and coordination ($r = -.40$, $p=.03$). Moderate negative correlations between sleep duration and motor proficiency as measured by the MABC total score ($r = -.41$, $p=.03$) and manual dexterity ($r = -.41$, $p=.03$) were also found. There were no further associations between the other subscales of the CSHQ and the subscales or total MABC-2.

Conclusions: The findings confirm the presence of a relationship between motor proficiency and sleep in children with ASD. Further research to investigate the overlap in brain circuitry between sleep problems and motor proficiency and directions of these relationships (i.e. to determine whether behavioural sleep problems influence children’s motor impairment or whether motor impairment predicts behavioural sleep problems) is required. Such research will set the scene for informing the development of assessments and novel interventions that seek to promote healthy outcomes in individuals with ASD such as improving sleep patterns and motor proficiency.

Table 1 Correlations between motor proficiency and sleep problems in children with ASD

	M-ABC Total Score	Manual dexterity	Ball skills	Balance and coordination
Sleep onset delay	-.49**	-.60**	-.41*	-.40*
Sleep duration	-.41*	-.41*	-.29	-.35
Sleep anxiety	-.20	-.20	-.14	-.09
Night waking	-.14	-.10	-.09	-.15
Parasominas	-.30	.07	.01	-.11
Sleep Disordered Breathing	.02	.18	-.02	-.13
Daytime sleepiness	-.23	-.31	-.05	-.24
Bedtime resistance	-.22	-.22	-.20	-.17
CSHQ Total	-.27	-.24	-.16	-.26

Note: ** correlation significant at the .01 level; * correlation significant at the .05 level; *M-ABC* Movement Assessment Battery for Children; *CSHQ* Child Sleep Habits Questionnaire.

179 **146.179** Key Individual Characteristics Related to Circumscribed Interests in Youths with ASD

C. E. Brown[1], *T. N. Takahashi*[2] *and S. M. Kanne*[3], *(1)University of Missouri Columbia, Columbia, MO, (2)University of Missouri Thompson Center for Autism & Neurodevelopmental Disorders, Columbia, MO, (3)Thompson Center for Autism & Neurodevelopmental Disorders, Columbia, MO*

Background: Circumscribed interests (CI) are a specific type of repetitive behavior that commonly occurs in youths with autism spectrum disorder (ASD), involving intense focus on a narrow range of topics (e.g., collecting objects, memorizing facts). Youth invest considerable time in activities involving these interests, often at the expense of prosocial activities. Interfering with these interests can be an antecedent for disruptive behaviors (e.g., physical aggression), often leading parents to describe these interests as their child's most impairing symptom. Though studies have examined prevalence and delineated categories of CI, less research has examined phenotypic characteristics associated with types of CI.

Objectives: The current study aimed to examine key phenotypic characteristics (e.g., youth intelligence, ASD core symptoms) in relation to types of CI in a large, well-

characterized sample of youths with ASD. This study explores possible links between individual characteristics and CI as reported by parents.
Methods: The sample consisted of caregivers (n = 186) who completed the Autism Diagnostic Interview - Revised (ADI-R) as part of the Simons Simplex Collection. Caregiver responses on the "circumscribed interests" and "unusual preoccupations" items of the ADI-R were transcribed. Only participants who endorsed pervasive or disruptive interests on these items were included. Using qualitative methodology, transcriptions were coded by selecting dialogue that described CI (e.g., "obsessed with Pokémon cards") and placing responses into categories (e.g., Collecting). Categories were derived from examination of the responses and considering existing measures of youth interests (e.g., The Interest Scale, Cambridge University Obsession Questionnaire). Individual phenotypic data were then associated with the various categories to examine characteristics of individuals with the purported interest.
Results: Interests were grouped into 31 categories, which were consistent with those found in other studies (e.g., Bodfish, 2003; Klin et al., 2007).. Caregivers reported their child's interests falling into an average of 2.8 categories. The most frequent interests reported were Strong Attachment to Fictional Characters (12%) and Televisions/Movies (10%). The least frequent reported were Mechanical Systems (0.4%) and Religion/Occult (0.6%). Youth with mean IQs in the average or above average range endorsed interests such as Building/Construction, Factual Information, and Biology, whereas youth with mean IQs in the impaired range endorsed interests in Rocks/Geology. Those with a high degree of core ASD symptoms by parent report had interests ranging from Religion/Occult, to Fictional Universes, Collecting, and Weather/Natural Disasters. Those with a high degree of core ASD symptoms by clinician report had interests ranging from the Signs, to Mechanical Systems, Reading/Writing, and Music. Older youth endorsed interests in Japanese Culture, Rocks/Geology, and Factual Information, whereas younger youth endorsed interests in Words/Letters and Math/Counting.
Conclusions: Youth with ASD endorse a broad range of CI. Specific interests are endorsed more frequently than others and certain types of interests appear to be associated with level of intelligence and core ASD symptoms, though this may differ based on parent or clinician observation. Further understanding of the etiology and types of CI and how interests relate to phenotypic characteristics will contribute to better evaluating and reducing impairment for individual youth.

180 **146.180** Latent Constructs Underlying Sensory Subtypes: An Independent Components Analysis

B. Hand[1], *S. J. Dennis*[2], *E. J. Marco*[3] *and A. E. Lane*[4], *(1)The Ohio State University, Columbus, OH, (2)School of Psychology, University of Newcastle, Callaghan, Australia, (3)University of California in San Francisco, San Francisco, CA, (4)School of Health Sciences, University of Newcastle, Callaghan, Australia*

Background: Sensory features (SF) are atypical responses to sensory stimuli that influence the functioning of children with neurodevelopmental disorders (NDD) including Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactive Disorder (ADHD). Due to the heterogeneous nature of SF, there is a need to define clinically meaningful subtypes, which may differentially respond to intervention. Sensory features are highly relevant to the ASD population due to their recent inclusion in diagnostic criteria. Distinct sensory subtypes have been identified in children with ASD through parent responses on the Short Sensory Profile (SSP) (Lane et al., 2014). Clinical profiles led to the hypothesis that two sensory dimensions underlie SF: 1) sensory reactivity (the intensity of a response to a stimulus), and/or 2) multisensory integration (the ability to process multiple concurrent stimuli). The use of Lane et al.'s sensory subtypes facilitates systematic examination of behavior and symptom profiles associated with each subtype. It is necessary, however, to have a sound understanding of the theoretical basis underlying the subtypes before they can be adopted confidently in clinical settings. As a next step to validate this schema, we performed independent component analysis (ICA) to elucidate the latent constructs underlying sensory subtype classification.
Objectives: To determine the latent constructs that underpin sensory subtype classification.
Methods: Two datasets were analyzed in the present study. The first is a sample of 228 children with ASD aged 2-10. The second included 155 children aged 4-10 years with ADHD, Sensory Processing Disorder or ASD and typically developing controls.
Parents of study participants completed the SSP, which measures behaviors associated with responses to everyday, environmental sensory stimuli in children aged 3–10 years. Parents respond to each item using a 5-point ordinal scale, with higher scores indicating more typical performance.

Independent component analyses (ICA) were conducted via a multistep process using z-scores from the seven SSP domains and item-level data. First, our hypothesis of a two-component structure was tested on domain z-scores. Next, z-scores were analyzed using model-fitting software to determine if any model had superior model fit than the hypothesized solution. The optimal number of components was determined, balancing interpretability with model fit. Lastly, item-level data were analyzed via ICA to determine which specific items on the SSP contribute most to the underlying latent constructs.

Results: A three-component model best explained the data for both samples, each with major contributions from one of the following domains: 1) taste/smell sensitivity, 2) low energy/weak, and 3) underresponsive/seeks sensation and auditory filtering. Key items from those domains that heavily contributed to the corresponding latent components were identified.
Conclusions: We propose that components one and two represent specific *foci* of SF, vis a vis taste/smell sensitivity and low energy/weak. Component three represents the construct of *severity*. Indeed, the Lane et al.'s sensory subtypes can be mapped onto these components in a conceptually meaningful way. The present study asserts a novel conceptual framework of constructs (*focus* and *severity*) that underlie sensory subtypes to guide future research and clinical practice on SF in ASD.

181 **146.181** Less Efficiency in Execution and Observation, but Not Imitation, of Actions in High-Functioning Young Adults with an Autism Spectrum Disorder

M. Vanvuchelen[1], *K. Cuypers*[1,2], *L. Van Schuerbeeck*[1], *M. A. Braeken*[1], *V. Ross*[3], *E. M. Jongen*[4], *R. L. Meesen*[1] *and C. Beelen*[1,5], *(1)Faculty of Medicine and Life Sciences - Rehabilitation Research Center (REVAL), Hasselt University, Diepenbeek, Belgium, (2)Department of Biomedical Kinesiology - Motor Control Laboratory - Research Center for Movement Control and Neuroplasticity, Katholieke Universiteit Leuven, Leuven, Belgium, (3)Transportation Research Institute (IMOB)-School for Mobility Sciences, Hasselt University, Diepenbeek, Belgium, (4)Transportation Research Institute (IMOB)- School for Mobility Sciences, Hasselt University, Diepenbeek, Belgium, (5)Faculty of Psychology and Educational Sciences - Parenting and Special Education, Katholieke Universiteit Leuven, Leuven, Belgium*

Background: Autism spectrum disorders (ASDs) are often accompanied by problems in planning and execution of goal-directed actions. The concept of planning movements in order to attain comfort at completion, though sacrificing initial comfort, is known as end-state comfort (ESC) (Rosenbaum et al., 1990). Hence, the application of ESC points to efficient action planning. The bar-transport paradigm is a simple, but very effective measurement tool for providing valuable information on the application of ESC and the efficiency of a persons' motor planning skills (Rosenbaum et al. (1990). Several studies suggest that persons with ASD are impaired in the spontaneous application of ESC (Hughes, 1996; Conson, et al. 2013, Gonzalez et al., 2014), but not when they are allowed to imitate this application (Hamilton, Brindley & Frith, 2007; Jiménez, Lorda, & Méndez, 2014). To the best of our knowledge, there are no studies which have investigated the understanding and prediction of efficient goal-directed actions applying ESC.
Objectives: The present study investigated the efficiency of goal-directed actions in the domains of action execution, imitation and prediction in young adults with an ASD compared to typically developing peers.
Methods: A cross-sectional study was conducted containing 21 persons with ASD and 26 typically developing persons (TDP) between 17 and 29 years of age. In the first experiment, action efficiency was investigated by analyzing the spontaneously application and imitation of ESC in addition with speed and timing of actions. In the second experiment, the prediction of efficient actions was studied.
Results:
Experiment 1 showed that participants with ASD were less able to spontaneously perform efficient actions compared to TDP ($U = 98.5$; $Z = -2.14$; $p = .03$). Results of a mixed model analysis with group, trial and their interaction as fixed factors and individual participants as random factor showed that the timing ranging from stimulus onset to action start ($F1,35 = 2.2$; $p = .14$) and from action start to lifting the bar ($F1,35 = 3.2$; $p = .08$) did not differ between both groups. In contrast, participants with ASD were significantly slower than TDP in the executive part ($F1,35 = 5.2$; $p = .03$; $\beta 0$ ASD = .91; $\beta 0$ TDP =.91-.04; $\beta 1 = -.005$). This was no longer true when their actions were visually guided online in the imitation condition ($F1,34 = .03$; $p = .86$; $F1,34 = .5$; $p = .47$; and $F1,34 = 2.9$; $p = .10$, respectively). Furthermore, in this condition both groups did not differ in their application of ESC when imitating the actions ($U = 149.5$; $Z = -.35$; $p = .72$).
Experiment 2 showed that participants with ASD were less able to predict ESC when they observe efficient actions compared to TDP ($U = 177.5$; $Z = -2.06$; $p = .04$). In contrast, according to mixed model analysis both groups did not differ in their reaction times towards observed actions ($F1,45 = 1.5$; $p = .23$).
Conclusions: Persons with ASD were less able to spontaneously execute and predict efficient actions, although they were able to imitate them.

182 **146.182** Motor Ability and Oculomotor Function in Children with an Autism Spectrum Disorder

E. Sumner[1] *and E. L. Hill*[2], *(1)Department of Psychology, Goldsmiths, University of London, London, United Kingdom, (2)Goldsmiths, University of London, London, United Kingdom*

Background: Eye movements provide a window into cognitive processing. Deficits in oculomotor control (i.e. suppressing reflexive saccades) have been shown to relate to language ability in ASD. In addition to language problems, an increasing number of studies have highlighted motor difficulties in this population. Of note, research supports a link between motor skill and aspects of oculomotor control, such as smooth pursuit (e.g. the ability to track an object); as reported in a population of children with a core motor impairment. However, at present, very little is known about the relationship between motor and oculomotor function in ASD.
Objectives: The present study set out to measure motor ability and the integrity of the oculomotor system in ASD. The study aimed to determine if eye movements can differentiate between children with ASD and controls; and to investigate the relationship between motor skill and oculomotor function.
Methods: Twenty-two children with ASD, aged 7-10 years, were compared to 22 typically-developing children matched by age. ASD diagnosis was confirmed using the Autism Diagnostic Observation Schedule (ADOS-2), and Full Scale IQ (WISC-IV) and motor competency were assessed (using the Movement Assessment Battery for Children, MABC-2). Children completed four short tasks designed to assess oculomotor function: fixation, smooth pursuit, pro- and anti-saccades. Eye movements were

recorded using the Eyelink 1000 (SR-research).
Results: Preliminary analyses reveal that children with ASD demonstrated poorer fixation stability and made more drifts away from the visual target than their peers. Children with ASD were comparable to their peers on the slow speed measure of smooth pursuit, but demonstrated lower pursuit gain than the controls in a faster pursuit task. Reflexive eye movement (pro-saccades) were similar across the two groups. However, children with ASD had more difficulty with the anti-saccade task, making many errors. Individual case analyses revealed that those children with ASD that had poorer motor skills also performed worse on the measures of fixation and smooth pursuit.
Conclusions: The findings are the first demonstration of a link between motor and oculomotor difficulties in children with ASD. Further examination of oculomotor dysfunction in this population may help to identify neural mechanisms involved in this disorder. Moreover, the findings highlight the need to examine co-occurring difficulties, such as poor motor skill, when interpreting eye tracking data.

183 **146.183** Motor Differences in Children with Autism Engaged in Ipad Gameplay

*A. Anzulewicz[1], K. Sobota[2], M. Ferrara[3] and **J. T. Delafield-Butt**[3,4], (1)Psychology, Jagiellonian University, Krakow, Poland, (2)Harimata, Krakow, Poland, (3)University of Strathclyde, Glasgow, United Kingdom, (4)St. James Road, University of Strathclyde, Glasgow, United Kingdom*

Background:
One of the early markers of autism spectrum disorder (ASD) are abnormalities in the development of intentional movements. However, very few studies directly addressed the question of whether children suffering from ASD can be distinguished from typically developing ones solely on the basis of analysing how they make intentional movements. Individuals diagnosed with ASD should display abnormalities in prospective planning and execution of movements, thus we hypothesised that their movement patterns while using mobile device should be different from patterns found in typically developing individuals.
Objectives:
The aims of the study were the following: (1) To determine whether or not motor information could differentiate children with autism from children developing typically; (2) To determine the kinds of movements responsible for differentiating between children with autism and children developing typically.
Methods:
45 children aged 3 to 6 years old and clinically diagnosed with Childhood Autism (n=42) were included in the 'Autism' group of the study. Of these, 12 were female. 45 children age-matched and gender matched typically developing children were included in the 'Control' group. All the participants had normal or corrected-to-normal vision and no other sensory or motor deficits that could make engaging in tablet gameplay difficult. For the purpose of investigating movement patterns, iOS tablets (iPad minis) were used. The children were asked to use two educational applications: *(1)* 'Sharing' where the main gameplay was to divide a piece of food (e.g. an apple) and distribute it evenly among four children present on the screen. *(2) Creativity where* the game open and unstructured and involved colouring pictures of toys and animals. During gameplay, data from tablets' inertial sensors (tri-axial accelerometer, gyroscope and magnetometer) and data from its touch screen were collected. 262 features were selected and subsequently analysed using the Regularized Greedy Forest (RGF; Johnson, Zhang, 2014) machine learning algorithm with 10 repetitions of 10-fold cross-validation with pre-selected features.
Results:
The RGF algorithm with classified movement patterns as related to ASD with up to 83% sensitivity and 85% specificity based solely on motor features, suggesting that movements of children diagnosed with ASD can be distinguished from those displayed by typically developing ones. In the Sharing game, 4 out of 10 of the most salient (greatest difference between ASD and control group) features were those derived from the inertial sensors (accelerometer and gyroscope), while the other 6 features were measures of the finger swipe kinematic. In the Creativity game, 10/10 of the most salient features were derived from the inertial sensors.
Conclusions:
The analysis of movements could add significant value to the process of early diagnosis of ASD and could be used as a biobehavioural marker of the disorder. The results indicate that it is the increased force of impact onto the screen made during a touch, or maintained during a swipe, that is specific to children with ASD. Finger swipe kinematics are another distinctive feature of the disorder. Altogether, motor assessment made during iPad gameplay proves to be an accessible and enjoyable paradigm for autism research and assessment.

184 **146.184** Motor Kinematic Differences in Children with ASD: Ecological Gameplay with a Sensorised Toy

***M. Ferrara**[1], V. C. Zuccala[2], F. Cecchi[3], C. Laschi[3], J. T. Delafield-Butt[4] and G. Passetti[3], (1)University of Strathclyde, Glasgow, Scotland, United Kingdom, (2)University of Pisa, Pisa, Italy, (3)Scuola Superiore Sant'Anna, Pisa, Italy, (4)University of Strathclyde, Glasgow, United Kingdom*

Background:
Trevarthen and Delafield-Butt (2013) proposed that one of the early markers of ASD are abnormalities in the development of intentional movements. A growing body of literature demonstrates kinematic and action patterns differences in children and adults with ASD. However, these experiments typically require laboratory-based optical motion tracking systems. Here, we developed, sensorised wooden cubes for motor assessment of children's play and report on the kinematic and action pattern differences of the children with autism compared to children developing typically.
Objectives:
A description of ASD-specific action patterns and kinematics using sensorised toys.
Methods:
Participants. Children 3 to 5 years with ASD (n = 15) recruited from the Scottish Centre for Autism, Glasgow, UK. Children 3 to 5 years old developing typically recruited from nurseries in Glasgow, UK. Adults 20 to 25 years old without ASD recruited from Glasgow, UK. In children with ASD, pre-screening with Vineland-II, AQ-Child and Leiter-R Brief IQ was performed.
Procedure. The children were seated at a table and instructed to play two simple games that involved moving the cube from one position to another: a Serially Organized Action (SOA) game and a Single Repetitive Action (SRA) game. The first required complex motor sequencing and engagement with the experimenter, while the second consisted of a simple repetitive movement. An electronic board inside the cubes was equipped with tri-axial magnetometer, gyroscope and accelerometer wirelessly transferred the cube's motion data to a laptop. The signal (raw motion data) was extracted through a Matlab-based platform and analysed.
Data Analysis. Kinematic features of movement duration; maximum value of acceleration, velocity, and jerk during each movement; time to maximum value; % duration to maximum value; and the acceleration, velocity, and jerk action patterns profiles were calculated.
Results: The jerk profile of children with ASD showed increased maximum jerk, reduced time to maximum value and duration to maximum value, and lower variability than typically developing children. Further, movement duration was shorter compared to age-matched typically developing children, and maximum velocity was significantly higher in children with ASD compared to children developing typically.
Conclusions:
The increased jerk values and onset times in the ASD group are a particularly interesting finding that support new data appearing by other groups. It appeared, especially in the SRA game, that when moving the cube from one position to the next, the children with autism impacted on the surface of the table with greater velocity and typically included the resulting force immediately into to the next movement, giving it a greater jerk value in a shorter span of time that typically children. Typically developing children, on the other hand, paused for a moment (>100 ms) before commencing the next movement. The repetitive simplicity of the SOA game and its resulting jerk profile appears to report on a particular behavioural motor feature distinct to ASD, namely stopping an action and starting a new one, while also describing an underlying motor difference that may contribute to it.

185 **146.185** Multimethod Longitudinal Analysis of Repetitive Behavior Measures in Children with ASD

***C. Farmer**, L. Joseph, D. L. Mead and A. Thurm, Pediatrics and Developmental Neuroscience Branch, National Institute of Mental Health, Bethesda, MD*

Background: There are no systematic investigations of the consistency of results among the various methods used to measure restricted and repetitive behavior (RRB) in ASD, such as the Autism Diagnostic Interview, Revised (ADI-R), the Autism Diagnostic Observation Schedule (ADOS), and the Repetitive Behavior Scale, Revised (RBS-R) (Leekam, Prior, & Uljarevic, 2011). Further, there have been few longitudinal studies examining the unique predictive utility of these popular instruments (Honey, Rodgers, & McConachie, 2012).
Objectives: In the current study, we explore ADI-R, ADOS, and RBS-R scores in children with ASD, aged 2-7 years at the initial evaluation. Our first goal was to explore forms of measurement (observation, interview, questionnaire) using cross-sectional data. Our second goal was to characterize the relationships among initial ADI-R, ADOS, and RBS-R scores and follow-up scores on the same measures, 2 to 5 years later.
Methods: Participants were part of a natural history study of ASD (N=100; 81% male; mean age=4.5±1.6; mean nonverbal developmental quotient=58.9±18.6). Screening evaluation confirmed DSM-IV-TR Autistic Disorder, using the ADI-R, ADOS, and clinical judgment by expert clinicians. Data from screening and follow up were used in these analyses. Cross-sectional and longitudinal relationships between ADI-R (current algorithm), ADOS, and RBS-R scores in subjects with both timepoints (n=58) were first examined in a multimethod correlation matrix, and will be examined in a structural equation modeling framework to quantify the shared and unique measurement of RRB among methods (n=100) (Figure 1).
Results: The pattern of correlations suggested differential relationships between methods and across time (Table 1). Cross-sectionally, the ADOS was related to few other subscales, but many subscales of the RBS-R and ADI-R were moderately-to-strongly correlated. Longitudinally, the ADOS calibrated severity score and raw score were

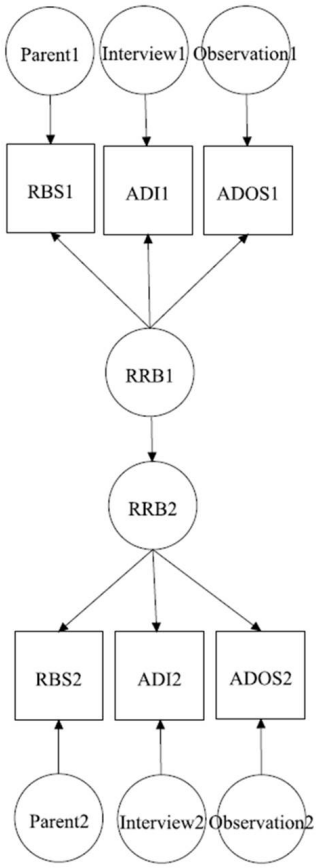
unrelated to themselves and to the other scales. Generally, the correlations observed cross-sectionally between the RBS-R and ADI-R persisted longitudinally. Conclusions: The RBS-R, ADI-R, and ADOS appear to measure different aspects of RRB, both cross-sectionally and longitudinally. Our results may be partially explained by method variance, as the scales with parental input were most strongly related. The longitudinal bifactor decomposition that we will present will shed light on this possibility. The content of the scales must also be considered, given that the early ADOS modules assess mostly lower-order RRB. Finally, it is possible that the behaviors did actually change over time; however, the relative stability of the RBS-R and ADI-R suggest that this is not sufficient explanation. In summary, the method used to quantify RRB appears to strongly influence characterization of symptom severity and change.

Table 1. Multimethod correlation matrix at Time 1 (below diagonal) and between Time 1 and Time 2 (above diagonal)

			RBS					ADOS		ADI-R				
			1	2	3	4	5	Total	CSS	C1	C2	C3	C4	Total
Cross-Sectional	RBS	1. Stereotyped		.46**	.23	.24*	.27*	.29*	.27*	.02	.00	.5**	.54**	.37**
		2. SIB	.27**		.41**	.32**	.18	.02	.06	-.06	.01	.16	.43**	.13
		3. Compulsive	.37**	.12		.59**	.34**	-.21	-.09	.06	.5**	.00	.16	.38**
		4. Ritualistic	.40**	.21	.45**		.42**	-.32**	-.15	.27*	.34**	.02	.07	.36**
		5. Restricted	.40**	.19	.45**	.55**		.00	.05	.36**	.17	.06	.17	.36**
	ADOS	RRB Total Score	.15	.27*	.03	.16	.20		.91**	-.26*	-.19	.43**	.27*	.14
		RRB Calibrated Severity Score (CSS)	.18	.22*	.06	.17	.19	.92**		-.28*	-.13	.35**	.17	.17
	ADI-R	C1: Encompassing preoccupation or circumscribed pattern of interest	.08	-.02	.23*	.16	.17	-.01	-.05		.21	-.07	-.04	.59**
		C2: Apparently compulsive adherence to nonfunctional routines or rituals	.03	-.02	.16	.21*	.27**	-.10	-.02	.07		-.01	.08	.6**
		C3: Stereotyped and repetitive motor mannerisms	.32**	.13	.04	.18	.07	.19	.19	-.28**	-.05		.38**	.45**
		C4: Preoccupation with parts of objects or nonfunctional elements of materials	.32**	.08	-.03	-.05	.14	-.02	.02	.00	-.13	.17		.54**
		Total C	.37**	.04	.32**	.32**	.37**	.10	.12	.54**	.46**	.32**	.45**	
			Time 2											
Time 1	RBS	1. Stereotyped	.52**	.13	-.03	.16	.17	.08	.06	-.10	-.02	.35**	.28*	.16
		2. SIB	.44**	.57**	.10	.15	.07	.14	.07	.01	-.06	.20	.13	.12
		3. Compulsive	.28*	.02	.52**	.32*	.23	.12	.11	.25	.23	-.14	.03	.35**
		4. Ritualistic	.16	.09	.27*	.59**	.32*	.13	.11	.24	.24	.01	-.03	.41**
		5. Restricted	.21	-.05	.24	.3*	.35**	.02	.01	-.04	.15	.08	.13	.18
	ADOS	RRB Total Score	.02	.16	-.27*	-.20	.02	.20	.23	-.07	-.23	.17	.18	-.04
		RRB Calibrated Severity Score (CSS)	.04	.16	-.21	-.17	.06	.12	.17	.01	-.16	.21	.13	-.01
	ADI-R	C1: Encompassing preoccupation or circumscribed pattern of interest	-.15	-.23	.17	.20	.01	-.01	.06	.08	.09	.07	-.07	.17
		C2: Apparently compulsive adherence to nonfunctional routines or rituals	-.04	-.15	.25	.12	.14	.01	.01	.34**	.28*	-.19	.00	.28*
		C3: Stereotyped and repetitive motor mannerisms	.22	.10	-.08	.13	.15	.17	.18	-.21	.04	.4**	.16	.16
		C4: Preoccupation with parts of objects or nonfunctional elements of materials	.39**	.10	-.08	-.04	.13	-.06	-.16	-.02	.00	.03	.24	.11
		Total C	.12	-.13	.18	.20	.19	.08	.08	.11	.19	.07	.13	.34**

Note:**<.01, *<.05. RBS=Repetitive Behavior Scale, Revised. ADI=Autism Diagnostic Interview, Revised. ADOS=Autism Diagnostic Observation Schedule. RRB=restricted and repetitive behavior. Correlations are Pearson's *r* except for pairs with ADI-R C1-C4, which are Spearman correlations. Cross-sectional correlations are on top (Time 1, below the diagonal; Time 2, above the diagonal). Longitudinal correlations are found in the bottom panel. Average time-to-follow-up was 3.2±0.4 (range 2-5 years). ADI-R scores are from the current algorithm.

Figure 1. Longitudinal bifactor decomposition of multimethod measurement of RRB



Note:RBS=Repetitive Behavior Scale, Revised. ADI=Autism Diagnostic Interview, Revised. ADOS=Autism Diagnostic Observation Schedule. RRB=restricted and repetitive behavior. Variables with the suffix 1 refer to Time 1, while those with the suffix 2 refer to Time 2. Squares represent observed variables; circles represent unobserved (latent) variables.

186 **146.186** Multisensory Contributions to Autism: Behavioral and Neural Evidence

M. T. Wallace[1], *R. A. Stevenson*[2] *and S. H. Baum*[3], *(1)Psychology, Psychiatry and Hearing & Speech Sciences, Vanderbilt University, Nashville, TN, (2)Department of Psychology, University of Toronto, Toronto, ON, Canada, (3)Vanderbilt Brain Institute, Vanderbilt, Nashville, TN*

Background:
In addition to deficits in social communication and the presence of restricted interests and repetitive behaviors, autism spectrum disorder (ASD) is characterized by changes in sensory function. These changes have been observed in a number of different sensory modalities, suggesting that it may be useful to think of these changes in a more multisensory framework. Indeed, the integration of information across the different sensory systems is essential for the construction of healthy perceptual and cognitive representations. Consequently, it is vitally important to understand the nature of the sensory and multisensory changes in ASD and their contributions to higher-order function.
Objectives: To characterize the nature of sensory and multisensory changes, and to examine associations with higher-order function, in children with ASD.
Methods:
A cohort of children with ASD ages 10-14 and a matched cohort of children who were typically developing (TD) were examined on a battery of tasks assessing various aspects of auditory, visual and audiovisual (i.e., multisensory) performance. The battery included tasks that are focused on general aspects of sensory and multisensory performance (i.e., speeded reaction times, sound-induced flash illusion, McGurk effect) as well as tasks that focus on temporal acuity within and across the sensory systems (i.e., temporal order judgments, simultaneity judgments). These measures of (multi)sensory function were compared with a battery of neuropsychological measures. In addition, neuroimaging (EEG and fMRI) was carried out on a subset of children in an effort to examine for differences in networks subserving sensory and multisensory function.
Results:
Children with ASD were found to differ from their TD peers on a number of measures within the sensory battery. The two most salient of these differences were in heightened trial-by-trial variability in their reaction times to sensory stimuli in children with ASD, as well as poorer audiovisual temporal acuity compared to children with TD. Measures of audiovisual temporal acuity were found to correlate with the magnitude of multisensory integration or “binding,” most notably for speech stimuli. Ongoing correlational analyses are focused on exploring the links between these changes in sensory function and changes on the neuropsychological tasks, and on differences in sensory networks and their relationship to networks supporting social communication.
Conclusions:
These results provide one of the first empirical characterizations of both sensory and multisensory function in a cohort of children with ASD, and demonstrate a pattern of sensory changes characterized by greater variability and poorer multisensory temporal function. Perhaps more important than the changes in sensory function is the putative formative role that these processing alterations are playing in the more established deficits seen in ASD (i.e., in the domain of social communication). Indeed, sensory and multisensory function forms the “building blocks” for perceptual and cognitive representations, and changes in (multi)sensory function appear to scaffold changes in these higher-order domains.

187 **146.187** Multisensory Temporal Integration Deficits in Sensory Processing Disorder

M. T. Wallace[1] *and S. H. Baum*[2], *(1)Psychology, Psychiatry and Hearing & Speech Sciences, Vanderbilt University, Nashville, TN, (2)Vanderbilt Brain Institute, Vanderbilt, Nashville, TN*

Background:
Sensory processing disorder (SPD) is a neurodevelopment disorder in which both the processing and integration of information across the various sensory modalities is affected. Despite a growing recognition of the prevalence and impact of SPD on activities of daily living, the neural bases for this disorder (or constellation of disorders) has remained elusive.
Objectives:
In the current study, we attempted to better characterize the nature of the sensory processing changes in a cohort of children with SPD (compared against an appropriate age-matched control group). The focus of the current work was on auditory, visual and combined audiovisual function, and with a preferential emphasis in better detailing the temporal acuity within which auditory and visual stimuli are integrated and perceptually “bound.”
Methods:
Children performed a battery of temporal order judgment (TOJ) and simultaneity judgment (SJ) tasks in which auditory, visual and combine audiovisual stimuli were presented with varied temporal structure.
Results:
On average, children with SPD were found to integrate audiovisual stimuli over longer temporal intervals when compared with control children, and perhaps more interestingly to show enormous individual variability in this series of measures. Ongoing neuroimaging work is attempting to better understand the neural circuits that underlie these differences, and ongoing psychophysical and neuropsychological assessments is attempting to better understand the contributions of altered (multi)sensory function to higher-order domains of dysfunction.
Conclusions:
These results suggest altered multisensory temporal acuity in children with SPD, and that these changes in multisensory temporal function may play an important contributing role in the constellation of sensory, behavioral, perceptual and cognitive symptoms seen in these children.

188 **146.188** Perceptual Inference in Autism Spectrum Disorders: Insights from Time-Order Effect in Tactile Discrimination

L. A. Sapey-Triomphe[1], *G. Sanchez*[2], *S. Sonié*[1], *C. Schmitz*[1] *and J. Mattout*[1], *(1)Lyon Neuroscience Research Center, Lyon, France, (2)Centre for Cognitive Neuroscience, Salzburg, Austria*

Background:
Perceptual decisions are known to be influenced by global context as much as by sensory evidence[1]. Computationally, this can be cast in Bayesian terms where behavior results from the optimal combination of acquired priors and incoming sensations, such that the more ambiguous the sensory input, the larger the influence of prior knowledge. In Autism Spectrum Disorders (ASD), it has been suggested that an imbalance in the way prior information and sensory evidence are trade could explain many of the symptoms.[2,3]
In a previous tactile study[4], we showed that people with ASD were able to build up priors in a stable learning context. However and against some current theories, we found that those priors would have a stronger effect in ASD than in neurotypical (NT) controls. We thus further hypothesized that people with ASD would have difficulties adapting their priors to a new context.
Objectives:
We used a very similar tactile task as before, so as to reveal the process of prior updating in ASD. We made use of the so-called time-order effect (TOE)[5], whereby the percept of the first stimulus appears to be strongly biased by contextual priors.
Methods:
We tested 20 NT adults and 17 adults with ASD (diagnosed according to the DSM V using their ADOS or/and ADI-R score) matched on age, gender and IQ. Non-painful electrical stimulations were delivered on their index finger. Participants were asked to compare the frequencies of two consecutive stimuli (F1, F2). In a first experimental phase, F1 was delivered at 30Hz. In the second phase, F1 varied from trial to trial, with a mean frequency of 26Hz. The first phase was used to induce a strong prior expectation of a fixed first stimulus at 30Hz, while the second phase, designed to elicit a TOE, was meant to trigger a process of prior updating. We recorded performances and used computational modelling to characterize perceptual inference in each group[6].
Results:
NT and ASD participants showed similar performances (75% and 73% correct discriminations on average, respectively). Both groups exhibited a TOE of similar amplitude. However, model comparison showed that contrary to NT, ASD subjects were slow in adapting their perceptual priors when changing the context. We also observed a trend in ASD participants such that the higher the Autistic Quotient, the slower the updating ($p = 0.052$). Importantly, this effect was not due to a difference in the precision of the encoding of sensory information.
Conclusions:
ASD people differ from NT in the way they update their perceptual expectations. They appear to be less flexible, which may point to a deficit in the way the relative weight of prior belief and sensory evidence is adjusted[7]. Further assessments should combine advanced computational models, informed task designs and neurophysiological measures in order to refine our understanding of ASD.
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189 **146.189** Physical Activity in Children with Autism Spectrum Disorders and Developmental Coordination Disorder

D. Kindregan[1], *J. Gormley*[1] *and L. Gallagher*[2], *(1)Physiotherapy, Trinity College Dublin, Dublin 8, Ireland, (2)Psychiatry, Trinity College Dublin, Dublin, Ireland*

Background:
Children with ASD typically have difficulty with social communication and restricted repetitive behaviours, which may in turn impact physical activity (PA). PA is known to have benefits on overall health, promotes psychological well-being and improves mood while reducing perceived-anxiety. Studies which have examined PA in children with ASD or developmental coordination disorder (DCD) have found a reduced amount of time spent in moderate-to-vigorous PA (MVPA) than typically developing peers. Children with ASD are 40% more likely to be overweight or obese than typically developing peers and children with DCD are also more likely to be overweight. The American College of Sports Medicine guidelines for PA state that children should participate in at least 60 minutes of moderate to vigorous PA every day.
Objectives:
The objectives of this study were to evaluate PA and sedentary behaviour across four groups – ASD, DCD, dual-diagnosis (ASD&DCD) and typically developing controls (TD).
Methods:
A parent-reported online survey was circulated via social media. School-going children with a diagnosis of ASD-only, DCD-only, ASD and DCD, and typically developing controls were included. The survey assessed children's PA during a typical school week – modes of to school, structured PA during and after school, and sedentary time. Chi-squared tests evaluated data proportions for significant differences.
Results:
Of 884 parental responses to the survey, 737 met inclusion criteria and were allocated into study groups. The sample was 75% male, 25% female. The Survey Demographics figure shows sample characteristics. There was no correlation between gender and activity levels in the groups, and no difference in mode of transport to school or time spent in PE class.
Children with ASD and/or dyspraxia spent significantly less time in structured PA than controls – 62% of children with ASD spent two hours or less; 33% of controls ($p<0.05$). All groups demonstrated a high percentage of children participating in less than six hours of PA per week ($p=0.0003$). Children with ASD and/or DCD were less likely to participate in group sports than individual sports than controls ($p=0.003$).
There was a significant difference in the time spent in sedentary-type behaviours (screen time or reading) - 61% of children with ASD&DCD spent more than six hours per week in sedentary behaviour, similar to ASD group at 58% and DCD group at 52% but significantly more than the controls at 38% ($p=0.009$) and 20% of all children with ASD and/or dyspraxia spent 14 hours or more each week in sedentary-type behaviours. Age from 11+ years was positively correlated with time spent in these behaviours.
Conclusions:
Results suggest that children with ASD spent more time in an average week in sedentary behaviour and less time in structured PA, and were less active compared to TD controls. A large proportion of all groups spent less than six hours per week in PA, not meeting recommended daily guidelines of at least 60 minutes of MVPA and suggesting an increased risk of health issues related to overweight or obesity. Further study involving activity monitoring may allow objective measurement of MVPA.

190 **146.190** Postural Control Mechanisms Underlying Reduced Stability in Autism Spectrum Disorder (ASD)

Z. Wang[1,2,3], *R. Hallac*[4], *K. C. Conroy*[5,6], *S. P. White*[7], *A. A. Kane*[8], *A. L. Collinsworth*[8] *and M. W. Mosconi*[2,9], *(1)Psychiatry, UT Southwestern Medical Center, Dallas, TX, (2)Schiefelbusch Institute for Life Span Studies and Clinical Child Psychology Program, University of Kansas, Lawrence, KS, (3)Center for Autism and Developmental Disabilities, UT Southwestern Medical Center, Dallas, TX, (4)Analytical Imaging and Modeling Center, Children's Medical Center, Dallas, TX, (5)Center for Autism and Developmental Disabilities, Dallas, TX, (6)Psychiatry, University of Texas Southwestern Medical Center, Dallas, TX, (7)Center for Autism and Developmental Disabilities, University of Texas Southwestern, Dallas, TX, (8)Analytical Imaging and Modeling Center, Children's Medical Center, Dallas, TX, (9)Dole Human Development Center, University of Kansas, Lawrence, KS*

Background: Postural stability has been repeatedly shown to be disrupted in autism spectrum disorder (ASD). Prior studies have quantified the amount of sway during standing, but examining postural stability at the individual level requires analysis of sway relative to each individual's postural limitation boundary, or the maximum extent to which they are able to lean in each direction without losing their balance. In the present study, we examined postural sway relative to each individual's postural limitation boundary in individuals with ASD and healthy controls using a novel virtual time-to-contact (VTC) approach.
Objectives: To examine center of pressure (COP) variability, the shared information of the COP time series for anterior-posterior (COP_{AP}) and mediolateral (COP_{ML}) directions, and spatiotemporal VTC in individuals with ASD and healthy controls during static and dynamic standing postures.
Methods: Twenty-two children with ASD (12.72 ± 3.64 yrs) and 21 healthy controls matched on age, gender and IQ completed tests of static and dynamic stances. Prior to testing, participants were instructed to stand with their feet shoulder width apart on a force platform. Their foot position was traced on the platform so that their starting position at the beginning of each trial was consistent. Participants' postural limitation boundary was determined by having them lean their body in each of four different directions (anterior, posterior, left and right) as far as they could without losing balance, and then fitting an ellipse to the COP maxima for each direction. COP measurements were derived from the force platform.
During *static* stance trials, participants were instructed to stand as still as possible. During *dynamic* stance trials, participants were instructed to continuously sway their body either front-back or left-right at a comfortable speed and magnitude. Participants completed three 30-sec trials for each stance. Each participant's VTC was derived by comparing the spatiotemporal relation between their postural sway relative to their own postural limitation boundary during each trial. The amount of shared information of COP_{AP} and COP_{ML} also was quantified.
Results: Individuals with ASD showed increased COP standard deviation and trajectory length during all conditions. Individuals with ASD showed increased shared information suggesting less independence of COP_{AP} and COP_{ML} sway mechanisms, especially during dynamic stances. In static stance, individuals with ASD were able to compensate for their increased postural sway variability by reducing their temporal VTC duration. In contrast, they were not able to show the same type of compensation during dynamic stances.
Conclusions: Individuals with ASD showed increased postural sway variability relative to controls, but the quality of this deficit varied across different postural conditions. In static stance, ASD patients' ability to compensate for internal perturbations was relatively intact. During dynamic stances, individuals with ASD failed to acquire spatial VTC information for postural stability. Their ability to utilize temporal VTC adjustment to compensate for increased sway also was compromised during dynamic but not static stance. These findings indicate that ASD patients are impaired when attempting to use spatiotemporal information to correct their sway during naturalistic stances similar to those they use during everyday activities.

191 **146.191** Postural Control Relates to Accuracy of Eye Movement in Autism Spectrum Disorder and Developmental Coordination Disorder

H. L. Miller[1], *P. Caçola*[2], *G. Sherrod*[3], *R. Patterson*[4] *and N. L. Bugnariu*[5], *(1)Physical Therapy, University of North Texas Health Science Center, Fort Worth, TX, (2)Kinesiology, University of Texas at Arlington, Arlington, TX, (3)University of North Texas Health Science Center, Fort Worth, TX, (4)Family Medicine, University of North Texas Health Science Center, Fort Worth, TX, (5)Physical Therapy; School of Health Professions, University of North Texas Health Science Center, Fort Worth, TX*

Background:
Autism Spectrum Disorder (ASD) and Developmental Coordination Disorder (DCD) share similar motor features, including difficulty maintaining postural stability and coordinating body movement. However, the specific overlap in symptoms between these two disorders remains unclear. Further, while there are known differences in visual information processing in ASD, this research question remains unanswered in DCD. *Visuomotor integration* – the use of visual information to guide motor behavior – may have a different impact on postural stability in ASD vs. DCD depending upon the influence of visual information processing.
Objectives:
To identify differences in visuomotor integration between individuals with ASD and DCD during tasks requiring the use of eye movement and visual information processing to maintain postural control.
Methods:
We conducted a preliminary investigation of visuomotor integration in 5 participants with ASD and 5 age-matched individuals with DCD. Data were collected from mobile eye-tracking, motion-capture, virtual reality, and force plate systems. Participants completed 30 seconds of quiet standing with eyes open and eyes closed as a baseline. They then completed two tasks in the virtual environment (Safe Zones, Disc Match) that required integration of visual information with motor plans. Participants controlled an object in the virtual space by shifting their Center of Pressure (CoP) or leaning to move a marker placed on the C7 vertebrae and the sacrum, in order to match the position of a static or moving target.
Results:
Individuals with ASD differed from those with DCD in their movement profiles during the three tasks. During quiet standing, individuals with DCD exhibited greater postural sway during both eyes open and eyes closed conditions. During the Disc Match task, both individuals with ASD and DCD struggled to match their CoP to the oscillating trajectory of a target, and their accuracy varied by frequency of oscillation. During the Safe Zones task, individuals with DCD had greater medial-lateral displacement in their

C7 and sacral marker positions.
Conclusions:
While DCD and ASD share similar functional movement symptoms, quantitative analysis of motor skills reveals key differences between the two disorders when tasks require integration of visual and motor information. Motor markers such as CoP may serve to differentiate between these two developmental disorders in a way that would inform intervention approaches. Preliminary analysis of the corresponding eye-tracking data supports the hypothesis that atypical eye saccadic and pursuit eye movements may influence the degree of difficulty that individuals with ASD, but not DCD, have with maintaining postural stability during tasks that require integration of visual information to plan and execute full-body movement.

192 **146.192** Postural Stability and Its Limits in Autism Spectrum Disorder Relate to Visual Context

H. L. Miller[1], *L. Mattingly*[2] *and N. L. Bugnariu*[3], *(1)Physical Therapy, University of North Texas Health Science Center, Fort Worth, TX, (2)Physician Assistant Studies, University of North Texas Health Science Center, Fort Worth, TX, (3)Physical Therapy; School of Health Professions, University of North Texas Health Science Center, Fort Worth, TX*

Background:
Many studies of ASD report behavioral and neural differences in visual and motor systems. However, few studies of Autism Spectrum Disorder (ASD) quantitatively examine *visuomotor integration* – the use of visual information to guide motor behavior – and its influence on postural stability. Postural stability is a critical building block of motor development with downstream influence on a wide array of functional skills (e.g., ambulation, gesturing, self-care, driving, playing physical games).
Objectives:
To define the relationship between postural stability, eye movement, and visual context in ASD.
Methods:
We conducted a preliminary investigation of visuomotor integration in 3 adolescent participants with ASD and 3 age-matched typically-developing (TD) controls. Data were collected in a community setting using mobile eye-tracking and a portable force platform. Participants completed the Clinical Test of Sensory Integration in Balance (CTSIB), which requires quiet standing with eyes open, with eyes closed, and with eyes open while wearing a translucent dome over the head. The dome condition tests stability when visual and proprioceptive systems are stimulated, but context-based visual information is unavailable. Participants also completed 3 runs of a Limits of Stability task, which requires participants to shift Center of Pressure (CoP) to reach each of 9 target positions displayed on a screen.
Results:
The ASD group had higher sway and stability indices than the TD group across all 3 conditions of the CTSIB (eyes open, eyes closed, dome) (Fig. 1). The ASD group also had greater increases in sway and stability indices between conditions of the CTSIB as difficulty increased. Standard deviations were considerably larger in the ASD across all variables. The ASD group had lower control than the TD group for 5 of the 9 Limits of Stability target positions (2, 3, 4, 6, 7), but higher control than participants in the TD group for 4 positions (1, 5, 8, 9), two of which required only lateral movement (1, 5) and one of which was the center position (9). Overall, the ASD group had lower average control than the TD group across all targets, and took longer to complete the test. Time to complete is a proxy for movement accuracy, since the task advances when participants meet hit criteria for each target. Again, standard deviations were considerably larger in the ASD group for most variables.
Conclusions:
Results from postural stability data support our hypothesis that individuals with ASD would have greater postural instability than TD controls. When visual context was eliminated (CTSIB dome condition), individuals with ASD had markedly greater impairment in stability, suggesting that integration of context-based visual information into motor plans may have greater influence than visual or proprioceptive information alone. Further, when limits of stability were tested, individuals with ASD had greater difficulty maintaining postural control during a CoP shift, especially for more difficult target positions. Preliminary examination of eye movement data also suggests that atypical gaze patterns relate to impairments in postural stability, and postural stability is significantly impacted by the presence or absence of visual context (i.e., CTSIB condition) in ASD.

193 **146.193** Predictors of Parent Responsiveness to One-Year-Olds at-Risk for ASD

J. Kinard[1], *J. Sideris*[2], *L. R. Watson*[3], *G. T. Baranek*[4], *E. Crais*[3], *L. Wakeford*[5] *and L. Turner-Brown*[6], *(1)University of North Carolina at Chapel Hill, Cary, NC, (2)Frank Porter Graham Child Development Institute, Chapel Hill, NC, (3)University of North Carolina at Chapel Hill, Chapel Hill, NC, (4)UNC Chapel Hill, Chapel Hill, NC, (5)University of North Carolina at Chapel Hill, Morrisville, NC, (6)UNC TEACCH Autism Program, University of North Carolina at Chapel Hill, Carrboro, NC*

Background: Parent responsiveness is critical to child development of cognition, social-communication, and self-regulation. When parents are “responsive,” they provide quick, meaningful responses to a child, based on the child’s focus of attention. Parents may respond differently, depending on the child’s initial characteristics. In children with and without risk for ASD, higher social-communication skills tend to elicit more parental responses. Research has also found associations between hyperresponsiveness in infants and lower maternal responsiveness. However, no research has examined how parent responsiveness is associated with sensory characteristics of children at-risk for ASD. It is essential to understand factors that influence parent-child relationships, specifically parent responsiveness, so that professionals and families can use this information to inform early interventions targeting parent-child relationships.
Objectives: For the current study, we examined the extent to which child social-communication and sensory response patterns (i.e., hyper- and hypo-responsiveness) predicted parent responsiveness to one-year-olds recently identified as at-risk for ASD.
Methods: The sample included 97 parent-infant pairs. Infants were at risk for an ASD diagnosis, based on parent responses to the First Year Inventory 2.0 at 12 months of age. Data were collected on the following child variables: nonverbal cognitive level (“Visual Reception” subscale on the Mullen Scales of Early Learning); social-communication (Communication and Symbolic Behavior Scales-Developmental Profile: Behavioral Sample [CSBS-DP-BS] and Caregiver Questionnaire [CSBS-DP-CQ]); and sensory response patterns (“hyporesponsiveness” and “hyperresponsiveness” scores on the Sensory Experiences Questionnaire [SEQ] and Sensory Processing Assessment for Young Children [SPA]). Parent responsiveness was measured via a 10-minute parent-child free-play video, and was later coded using an interval coding system. Parent responsiveness was calculated using a proportion: the numerator included 5-second intervals with a parent response and the denominator included the total 5-second intervals. We ran hierarchical regression models with parent responsiveness as the dependent variable and child behaviors as independent variables.
Results: Hyporesponsiveness consistently added power to predict variance in parent responsiveness across multiple models, whereas hyperresponsiveness did not consistently do so. The addition of either hyporesponsiveness measure increased the predictive power, regardless of which child communication measure was included in the baseline model. All models that included a combination of child communication (CSBS-DP-CQ or CSBS-DP-BS) and hyporesponsiveness (SPA or SEQ) significantly predicted: (a) 13 – 21% of the variance in single play responses (i.e., parents tended to play without talking when children demonstrated more hyporesponsiveness and lower communication skills); and (b) 8 – 12% of the variance in single follow-in responses (i.e., parents tended to talk without playing when children demonstrated less hyporesponsiveness and higher communication skills).
Conclusions: Among a community sample of infants at-risk for ASD, a combination of child communication and sensory hyporesponsiveness was the most robust predictor of parent responsiveness. Specifically, parents tended to use fewer verbal responses and more physical play responses when their child demonstrated less communication and more hyporesponsiveness. These findings highlight the importance of communication and sensory characteristics (particularly hyporesponsiveness) of children at-risk for ASD, as these characteristics may influence the nature of parent responsive behaviors, which have theoretical importance for early parent-mediated interventions.

194 **146.194** Psychophysical Correlates of Excitatory/Inhibitory Imbalance during Visual Motion Perception in Adults with ASD and Schizophrenia

B. D. Adkinson[1,2], *J. H. Foss-Feig*[3], *W. J. Park*[4], *E. J. Levy*[5], *N. Santamauro*[6], *C. Schleifer*[7], *K. B. Schauder*[8], *K. Deckert*[5], *V. Srihari*[6], *J. Krystal*[9], *D. Tadin*[4], *J. McPartland*[3] *and A. Anticevic*[6], *(1)Department of Psychiatry, Yale School of Medicine, New Haven, CT, (2)Marietta College, Marietta, OH, (3)Child Study Center, Yale School of Medicine, New Haven, CT, (4)Brain and Cognitive Sciences, University of Rochester, Rochester, NY, (5)Yale Child Study Center, New Haven, CT, (6)Yale University School of Medicine, New Haven, CT, (7)Yale University, New Haven, CT, (8)Clinical and Social Sciences in Psychology, University of Rochester, Rochester, NY, (9)Yale University - Psychiatry, New Haven, CT*

Background: Recent evidence implicates neural excitatory (E) and inhibitory (I) imbalance as a mechanistic underpinning of autism spectrum disorder (ASD). E/I imbalance is also implicated in other disorders, such as schizophrenia (SZ), that are associated with social and cognitive deficits. While phenotypic similarities across diagnoses suggest common mechanistic origins, no studies have tested the existence of shared markers of E/I imbalance across ASD and SZ. Surround suppression and gain control are two well-established neural processes affecting perception of visual motion that rely on precise E/I balance. Previous studies examining visual motion processing in ASD and SZ have identified surround suppression and gain control abnormalities. However, none of these studies directly compared these processes across both populations.
Objectives: Evaluate E/I balance in the context of surround suppression and gain control affecting visual motion perception in young adults with ASD relative to SZ and healthy controls.
Methods: Participants were 10 young adults with ASD, 9 with SZ, and 14 healthy controls, matched for demographic variables. Recruitment is ongoing with expected final sample sizes of 20 per group. Participants completed three visual processing tasks that involved motion discrimination of gratings that varied by size at high (Task 1) and low (Task 2) contrast, as well as gratings with fixed, small size but varied contrast level (Task 3). Task order was counterbalanced across participants. Duration thresholds were computed for eight different sizes and contrasts. Suppression index (Tasks 1 and 2) and response gain control (Task 3) were computed by contrasting thresholds at the highest level of contrast/largest size to those at the lowest contrast level/smallest size for each task. Group differences were assessed using one-way ANOVAs.
Results: Results revealed few differences between groups in duration thresholds across contrast levels or sizes. Contrary to predictions, response gain control did not differ among ASD, SZ, or controls ($F=.070$, $p=.93$). Likewise, at high contrast, the suppression index did not differ by group ($F=.556$, $p=.58$). However, at low contrast, there were

group differences in suppression index (F=4.378, *p*=.023), wherein, relative to controls, SZ, but not ASD, was characterized by an unexpected increase in spatial suppression.
Conclusions: Contrary to predictions, differences in surround suppression for high contrast stimuli and gain control with increasing contrast during motion discrimination were not observed in ASD or SZ relative to controls. Moreover, an unexpected increase in suppression was observed at low contrast for SZ participants. These data suggest that, at least in the context of low-level visual motion processing, young adults with ASD and SZ may have intact E/I balance. Transdiagnostic correlations with measures of sensory, social, and cognitive functioning are ongoing to quantify if deficits in surround suppression and gain control are associated with symptoms that cross traditional diagnostic categories.

195 **146.195** Reduced Restricted and Repetitive Behaviors after Pivotal Response Treatment

***S. M. Abdullahi**, D. G. Sukhodolsky, C. A. Paisley, M. L. Braconnier and P. E. Ventola, Yale Child Study Center, Yale School of Medicine, New Haven, CT*

Background:
Children with ASD show a high frequency of Restricted and Repetitive Behaviors (RRBs), and these behaviors interfere with daily functioning (Harrop et al., 2014). However, RRBs have remained largely resistant to behavioral interventions and pharmacological treatments within the context of controlled trials (Harrop, 2015; Tanner, Hand, O'Toole, & Lane, 2015). Pivotal Response Treatment (PRT) is a naturalistic behavioral treatment that focuses on increasing a child's motivation and improving social function.
Objectives:
We investigated change in the severity of RRBs in children with ASD who participated in a 16-week trial of PRT.
Methods:
Participants included 15 children with ASD between the ages of 4 and 7 (Mean IQ = 98.7, SD = 19.7) who took part in a 16-week PRT trial. Treatment included 6 hours per week of individual work with the child as well as training the parents in implementing PRT at home. Inclusion criteria for the study were diagnosis of ASD and IQ > 70 as measured by the Differential Abilities Scales-2nd Edition. To assess RRBs, parents completed the Repetitive Behavioral Scales- Revised (RBS-R) and Aberrant Behaviors Checklist (ABC) before and after the 16 weeks of PRT.
Results: Overall, RRBs decreased significantly following 16 weeks of PRT (RBS-R Total Score: pre-PRT M= 28.36, SD= 19.70; post-PRT M= 16.27, SD= 12.60, $p<0.01$). Individual RBS-R subdomains for stereotyped behavior ($p < 0.01$), self-injury ($p < 0.02$), ritualistic behavior ($p < 0.05$), sameness ($p < 0.01$) and restricted behaviors ($p < 0.02$) decreased significantly as did the stereotypy subdomain of the ABC (pre-PRT M= 3.57, SD= 3.23; post-PRT M= 1.43, SD = 2.71, $p < 0.001$).
Conclusions:
Based on these preliminary results, RRBs significantly decreased following a 16-week trial of PRT. This improvement may be a result of greater communication competency and improved social engagement, potentially in combination with stronger emotion regulation. Further study can determine if these results hold in a broader sample and investigate the mechanisms of improvement.

196 **146.196** Relationship of Atypical Prosodic Features to Acoustic Startle Measures in Children with Autism Spectrum Disorders and Those with Typical Development

***H. Takahashi**[1], A. Kondo[2], T. Konishi[2], K. Nishikawa[2], T. Nakahachi[1], S. Komatsu[1], R. Mazuka[2] and Y. Kamio[1], (1)National Center of Neurology and Psychiatry, Japan, National Institute of Mental Health, Tokyo 187-8553, Japan, (2)RIKEN, BSI Lab. for Language Development, Wako-city, Saitama, Japan*

Background: People with autism spectrum disorders (ASD) has long been known to have atypical prosodic features in their speech. Yet their prosodic difference from typically developing (TD) people as well as its physiological background, has not been well-understood. Recently, using an intonational phonological framework, we found that ASD participants can produce lexically and syntactically intact prosody, on the other hand, ASD children produced many more various atypical prosodic and non-prosodic features in spontaneous speech than TD children, which appeared to be associated with the core symptoms of ASD in social, communicative interaction difficulty. As the ability to produce prosody is acquired during infancy, investigation of the physiological aspect of prosodic atypicality in ASD might increase understanding of the biological mechanisms underlying the development of ASD characterisitics.
Objectives: The objectives of this study is to investigate the relationship between intonational phonological framework of prosody and physiological indexes of acoustic startle response (ASR), which is a promising endophenotype of developmental and psychiatric disorders.
Methods: Participants were 11 children diagnosed with high functioning ASD, and 12 TD children. Spontaneous speech of participants was recorded while each child talked with an experimenter about common topics for 5-10 minutes. Three trained phoneticians listened to the speech, and marked the sections that were judged "atypical." The atypical sections were then annotated using the X-JToBI scheme, and, were classified into subtypes of prosody [utterance too long, too much emphasis (stress, pitch), sudden speech rate changes, pitch range too narrow, inappropriate boundary pitch movement (pitch contour, type), and, others]. As for acoustic startle measurements, mean ASR magnitudes to acoustic stimuli presented at 65 dB to 105 dB in increments of 10 dB were analyzed. Average peak startle latency (PSL) and startle modulations (habituation and prepulse inhibitiion) was also examined.
Results: Compared to TD control, children with ASD had more atypical prosodic section for prosody subtype of "utterance too long" and "too much emphasis". And, the total number of atypical prosodic sections was also significantly larger in ASD compared to TD. As for ASR measures, ASD children had greater ASR magnitude to small stimuli intensity of 75 and 85 dB, and, more prolonged PSL compared to TD children.
The total number of atypical prosodic sections and the number of atypical prosodic section for prosody subtype of "too much emphasis" and "others" significantly correlated to startle measures of PSL as well as ASR magnitude to large stimuli intensity of 95 and 105 dB.
Significant correlations to PSL were also found in the number of atypical prosodic section for prosody subtype of "utterance too long" and "sudden speech rate changes."
Conclusions: Our results suggest that various atypical prosody subtype of ASD in spontaneous speech is associated in part with the mechanism of ASR latency delay. Considering the fact that PSL in TD is usually 60-80 msec, atypical neural mechanism to acoustic stimuli around this latency window might contribute to the development of prosody production as well as the core symptoms of ASD in social, communicative interaction difficulty.

197 **146.197** Restricted Interests and Repetitive Behaviors Behavior As a Distinguishing Feature of Autism Spectrum Disorder (ASD) in Nonverbal Children

***A. R. Marvin**[1], J. K. Law[2], Y. Zhang[3], P. H. Lipkin[4], P. A. Law[5], E. M. Arthur[4], D. J. Marvin[6], A. A. Westreich[6] and J. N. Constantino[3], (1)Painter Bldg 1st Fl, Kennedy Krieger Institute, Baltimore, MD, (2)Interactive Autism Network, Baltimore, MD, (3)Washington University School of Medicine, Saint Louis, MO, (4)Kennedy Krieger Institute, Baltimore, MD, (5)Congo Protestant Unversity, Baltimore, MD, (6)Medical Informatics, Kennedy Krieger Institute, Baltimore, MD*

Background:
Differentiating ASD from other developmental disorders can be particularly difficult among nonverbal patients (NV).
Objectives:
To explore diagnostic accuracy and autism symptom profiles of nonverbal children with ASD (ASD-NV) in a large autism registry.
Methods:
Fifty-five ASD-NV children ages 6-17 years were recruited from a large, voluntary ASD registry. Participants had a confirmatory score >=12 on the Social Communication Questionnaire (SCQ)-Lifetime. Nonverbal status was determined by a "no" response to the SCQ-Lifetime question: "Is she/he now able to talk using short phrases or sentences?" Participation was limited to one of four US geographic regions so participants could receive an in-person ASD assessment and cognitive testing. Parents completed online questionnaires -- Social Responsiveness Scale (SRS); Adaptive Behavior Assessment System-Second Edition (ABAS-II); Repetitive Behavior Scale, Revised (RBS-R) -- and produced evidence their child had received a community ASD diagnosis. Parents asked a teacher to complete an SRS on their child. Data were compared via ANOVA and post-hoc tests with ratings of 108 *verbal* ASD (ASD-V) children enrolled in a university-based ASD research program at one of the sites. ASD-V children were split into higher-functioning (ASD-V-HighSoc; n = 75) and lower-functioning (ASD-V-LowSoc; n = 33) based on Vineland-II Adaptive Behavior Scale Socialization Domain score of >=70 and <70, respectively.
Results:
All 55 ASD-NV children were judged by clinicians to meet criteria for ASD (CI_{95}: 0.935-1.00), and all met ASD cut-offs on both the ADI-R and the ADOS. All exhibited low adaptive functioning at the floor of the ABAS-II, and cognitive functioning was either untestable or at the floor of the selected test(s).
RBS-R: The RBS-R was scored according to the Lam/Aman five-factor solution and scores compared across the three groups controlling for age and sex. There were no statistically significant differences across the three groups for "Ritualistic/Sameness Behavior" and "Restricted Interests." There were no statistically significant differences across ASD-NV and ASD-V-LowSoc for "Self-Injurious Behavior" and "Compulsive Behavior"; however, both lower-functioning groups more prone to such behaviors than the ASD-V-HighSoc group [$F(4,156)=7.086$, $p<.000$ and $F(4,156)=4.392$, $p<.002$, respectively]. "Stereotypic Behavior" presented a unique pattern whereby there were statistically significant differences between each group [$F(4,156)=21.205$, $p<.000$], with increased presentation of stereotypies corresponding with lower functioning [ASD-NV=11.8(4.88) >ASD-V-LowSoc=7.3(5.12)>ASD-V-HighSoc=5.2(3.99)].
Composite indices of Restricted Interests and Repetitive Behavior (RRB): There were no statistically significant differences across groups for ADI-R Repetitive Behavior. SRS-Teacher Report RRB T-Scores (higher is more severe) were inversely related to level of functioning [$F(3, 132)=24.810$, $p<.000$; ASD-NV=90.1.8(12.25) >ASD-V-LowSoc=81.6(17.08)>ASD-V-HighSoc=71.4(12.79)]. SRS-Parent Report RRB T-Scores were comparable for ASD-NV and ASD-V-LowSoc, and both higher than ASD-V-HighSoc [$F(3, 157)=11.242$, $p<.000$; ASD-NV=84.2 (10.6) <>ASD-V-LowSoc=87.1 (10.47)>ASD-V-HighSoc=76.8 (11.29)].

See Table 1.

Conclusions:

ASD-NV children with community diagnoses of ASD met formal diagnostic criteria for ASD and share Restricted Interests/Repetitive Behavior characteristics with ASD-V children, with severity of such characteristics – both composite and at the factor-level – either comparable or greater than those of ASD-V children. Further research may be valuable in determining whether such Restricted Interests/Repetitive Behavior characteristics may be useful in distinguishing ASD-NV children from NV children with other development disorders.

Table 1 Group Comparisons of Key Measures

	ASD-NV Lower Socialization	**ASD-V** Lower Socialization	**ASD-V** Higher Socialization	**Anova** All Groups	**Post Hoc** Lower Socialization Groups
	Mean(SD)	Mean(SD)	Mean(SD)	Significance	Significance
Repetitive Behavior Scale-Revised *(RBS-R)*	n = 55	n = 33	n = 74		
Stereotypic Behavior	11.8 (4.88)	7.3 (5.12)	5.2 (3.99)	***	***
Ritualistic/Sameness Behavior	8.7 (6.77)	8.7 (5.66)	7.4 (5.84)	ns	ns
Restricted Interests	4.1 (2.56)	4.03 (2.52)	3.0 (2.24)	ns	ns
Self-injurious Behavior	4.2 (4.37)	3.4 (3.06)	1.4 (1.99)	***	ns
Compulsive Behavior	4.1 (3.85)	3.6 (2.87)	2.3 (2.56)	**	ns
Autism Diagnostic Interview, Revised (*ADI -R*)	n = 55	n = 33	n = 75		
Social Interaction and Communication	40.3 (3.12)	40.3 (9.20)	33.2 (8.91)	***	ns
Repetitive Behavior	6.4 (1.83)	7.2 (2.49)	6.5 (2.65)	ns	ns
Total	46.8 (3.55)	47.6 (10.51)	39.6 (10.00)	***	ns
Social Responsiveness Scale, Second Edition (SRS-2) - Parent	n = 54	n = 33	n = 75		
Social Communication and Interaction (SCI) T Score	86.4 (7.85)	85.6 (9.10)	75.0 (9.24)	***	ns
Restricted Interests and Repetitive Behavior (RRB) T Score	84.2 (10.6)	87.1 (10.47)	76.8 (11.29)	***	ns
Total T Score	87.0 (8.04)	86.9 (8.91)	76.0 (9.37)	***	ns
Social Responsiveness Scale, Second Edition (SRS-2) - Teacher	n = 47	n = 28	n = 62		
Social Communication and Interaction (SCI) T Score	82.9 (9.85)	74.4 (12.79)	67.7 (10.02)	***	**
Restricted Interests and Repetitive Behavior (RRB) T Score	90.1 (12.25)	81.6 (17.08)	71.4 (12.79)	***	***
Total T Score	85.1 (10.27)	86.3 (15.92)	77.9 (12.78)	**	ns

** P<0.05, ** P<0.01, *** P<0.001. Analyses controll for verbal status (NV= nonverbal; V=verbal), socialization (lower= Vineland 2 Socialization <70 or floored/low ABAS-2; higher=Vineland 2 Socialization >=70), age, and gender.*

198 **146.198** Restricted and Repetitive Behavior As Predictors of Diagnosis and Clinician Confidence in Toddlers at Risk of ASD

D. Hedley[1], *M. Uljarevic*[2] *and R. E. Nevill*[3], *(1)School of Psychology and Public Health, La Trobe University, Melbourne, Australia, (2)Olga Tennison Autism Research Centre, La Trobe University, Bundoora, Australia, (3)The Ohio State University, Columbus, OH*

Background: A wide range of restricted and repetitive patterns of behaviors (RRBs) has been consistently reported among the earliest infant predictors of a later Autism Spectrum Disorder (ASD) diagnosis (Ozonoff et al., 2008; Wolff et al., 2014). However, it has also been suggested that RRBs may develop later, and may not be a good predictor of differential diagnosis in young children (Young, 2007). Furthermore, the relationship between RRBs and clinical judgements regarding diagnosis of ASD in young children (i.e., < 3 years) has not been explored. Here we examined the role of RRBs in the confidence expressed by clinicians when making judgements of a child's diagnosis, and also in the final diagnostic status of the child following assessment. We were interested in whether or not observed and parent reported RRBs predicted clinicians' confidence in their diagnostic judgements, and also diagnostic status, independently of child characteristics (e.g., age, gender, SES, adaptive functioning), and in particular social communication.

Objectives: Our aim was to examine the relationship between RRBs, diagnosis of ASD, and clinicians' confidence in their judgments regarding diagnosis. Specifically, we examined both the ADOS-2 RRB score and the parent reported ASRS Unusual Behaviors and Behavioral Rigidity subscales on a) clinicians' confidence in their judgments of diagnosis, and b) final diagnostic status, controlling for demographic variables such as age, gender, socioeconomic status, and child characteristics such as developmental level and adaptive functioning.

Methods: Participants were 125 children aged under 14-39 months (M = 28.62, SD =5.41) who presented for screening at a Midwestern hospital child development center due to developmental concerns. Screening clinicians were asked whether or not they thought the child would receive a diagnosis of ASD. A Likert scale was used to generate a confidence score. Diagnostic status and assessment results were retrieved from medical record review.

Results: Correlational analysis were first used to explore the association between diagnosis (ASD, non-ASD), clinician confidence, and relevant variables. Diagnosis was significantly correlated with ADOS-2 RRBs, $r(89) = .70$, $p < .001$, but not ASRS Unusual Behaviors, $r(66) = .08$, $p > .05$, or Behavioral Rigidity, $r(66) = .14$, $p > .05$. Clinicians' confidence was significantly associated with ADOS-2 RRBs, $r(89) = .32$, $p = .002$, ASRS Unusual Behaviors, $r(66) = .34$, $p = .005$, and Behavioral Rigidity, $r(66) = .29$, $p = .017$. Regression analysis identified both ADOS-2 SA, $t = 2.55$, $p = .013$, $\beta = .335$, and RRBs, $t = 2.14$, $p = .036$, $\beta = .249$, as significant predictors of diagnosis, however only ADOS-2 RRBs independently predicted clinicians' confidence, $t = 3.35$, $p = .002$, $\beta = .492$.

Conclusions: Neither parent reported unusual behaviour nor behavioural rigidity was found to be associated with diagnosis of ASD and was not an independent predictor of clinicians' confidence in their diagnostic judgements. Of interest, however, the ADOS-2 RRB scale was identified as a predictor of both diagnosis and, moreover, was the only independent predictor of clinicians' confidence.

199 **146.199** Risk Factors for Self-Injurious Behavior Among Infants at-Risk for Autism Spectrum Disorder

A. Dimian[1], *J. J. Wolff*[2], *J. T. Elison*[1], *R. T. Schultz*[3], *L. Zwaigenbaum*[4], *J. Piven*[5] *and .. The IBIS Network*[5], *(1)University of Minnesota, Minneapolis, MN, (2)University of Minnesota, University of Minnesota, Minneapolis, MN, (3)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (4)University of Alberta, Edmonton, AB, Canada, (5)University of North Carolina at Chapel Hill, Chapel Hill, NC*

Background: Lifetime prevalence of self-injurious behavior (SIB) is approximately 50% among individuals with autism spectrum disorder (ASD). Once entrenched, SIB can be difficult and costly to treat. Commonly identified risk factors for this behavior include a diagnosis of ASD, lower intellectual functioning, communication impairment, and presence of motor stereotypy (Baghdadli et al., 2003; Oliver & Richards, 2015). To date, there is little empirical research utilizing a prospective research design to identify risk factors for SIB during the first years of life.

Objectives: Our aims were two-fold: 1) investigate the relationship of early SIB to a diagnosis of ASD; and 2) identify early risk factors for SIB.

Methods: Participants were from a longitudinal study of infants at familial risk for ASD. The present sample included 237 high-risk infants who completed the following

assessments at ages 12 and 24 months: MSEL, Vineland-II, and Repetitive Behavior Scales-Revised (RBS-R). The RBS-R was used to characterize SIB and motor stereotypy. The study sample was 62.9% male. Mean ages at 12 and 24 month assessment dates were 12.54 (*SD* = 0.62) and 24.82 (*SD* =1.47), respectively. Logistic regression was used to evaluate potential 12 month predictors of SIB at age 2.

Results: SIB was reported for 32% of participants at age 24 months and was significantly higher among children also meeting diagnostic criteria for ASD (χ^2 = 4.30, p =.04). The risk of engaging in SIB at 24 months was 1.85 times higher among children who were later diagnosed with ASD compared to children with no diagnosis. The first logistic regression model included sex, total composite scores from the MSEL and Vineland-II, and SIB and stereotypy from the RBS-R at 12 months. The overall model significantly predicted 24 month SIB (χ^2 = 31.2, p < .001, R^2_{pseudo} = 0.22). Of individual predictors, Mullen composite score and presence of SIB at 12 months were significantly associated with SIB at age 24 months. A second model excluding Vineland composite and RBS-R stereotypy score was fit. The overall model was significant (χ^2 = 34.8, p < .001, R^2_{pseudo} = 0.19). For participants who exhibited SIB at 12 months, the odds of SIB at 24 months increased by 93%. Odds of SIB increased by 3% for each point decrease in MSEL composite score.

Conclusions: The purpose of this study was to evaluate behavioral characteristics predicting early SIB among children at high familial risk for ASD. SIB was more prevalent among those children receiving a diagnosis of ASD but was not exclusive to this subset of high-risk infants. Logistic regression results indicated that presence of SIB and lower intellectual functioning at age 12 months significantly predicted later SIB. In contrast with previous studies, motor stereotypy was not associated with SIB in our sample. This may indicate a developmental relationship between stereotypy and SIB which, early in life, qualitatively differs from that observed in older individuals. Identifying risk factors for the early development of SIB has the potential to inform prevention and early intervention programming.

200 **146.200** Sensory Dis-Integration: Theoretical Foundations for and Practical Barriers to Interdisciplinary Collaboration Among Neuroscientists and Clinical Practitioners Focused on Sensory Function in Autism Spectrum Disorder

C. J. Cascio[1], *T. Woynaroski*[2], *G. T. Baranek*[3] *and M. T. Wallace*[4], *(1)Vanderbilt University School of Medicine, Nashville, TN, (2)Vanderbilt University, Thompsons Stn, TN, (3)UNC Chapel Hill, Chapel Hill, NC, (4)Psychology, Psychiatry and Hearing & Speech Sciences, Vanderbilt University, Nashville, TN*

Background:

Heightened interest in sensory function in persons with autism spectrum disorder (ASD) presents an unprecedented opportunity for impactful, interdisciplinary work between neuroscientists and clinical practitioners for whom sensory processing is a focus. In spite of this promise, and a number of overlapping perspectives on sensory function in persons with ASD, neuroscientists and clinical practitioners are faced with significant practical barriers to transcending disciplinary silos. Barriers to interdisciplinary collaboration include divergent goals, values, and approaches that shape each discipline, as well as different lexical conventions. In this overview to the panel, some of the most salient differences between fields will be described, alongside shared perspectives that may serve as a common foundation upon which interdisciplinary work can build. These shared perspectives include 1) the assumption that differences in behavioral reactivity reflect differences in neural response to sensory stimuli, 2) the assumption that "higher-order" deficits in ASD, such as social-communication deficits, arise at least in part from differences in basic sensory processing, and 3) the assumption that sensory function may be malleable with treatment or environmental manipulation. These foundational concepts will be presented as testable hypotheses that form a potential framework for the conceptualization of sensory function in individuals with ASD (see Figure 1), which researchers from a range of disciplines may work collaboratively to test. The divergent goals, values, and approaches of each discipline will be described in order to facilitate improved cross-disciplinary dialogue. Although challenging, engaging in interdisciplinary work will capitalize on the complementary strengths of each field to unveil the links between neural and behavioral manifestations of sensory differences in persons with ASD. Ultimately, the experimental tractability and early developmental onset of sensory function will be powerful advantages in determining the role of sensory processing in the more developmentally complex socio-communicative and repetitive behaviors that characterize ASD. A better understanding of this putative role for foundational sensory function is critical to facilitate early identification and improved intervention for persons with ASD.

Objectives: NA Conceptual/Educational Overview

Methods: NA Conceptual/Educational Overview

Results: NA Conceptual/Educational Overview

Conclusions: NA Conceptual/Educational Overview

201 **146.201** Sensory Processing Disorders: Phenotypic Characterization Pre and Post Intensive Occupational Therapy Based Model (STAR Model)

L. J. Miller[1] *and S. A. Schoen*[2], *(1)Sensory Processing Disorder Foundation, Greenwood Village, CO, (2)Sensory Processing Disorder Foundation, Greenwood, CO*

Background:

Sensory processing challenges negatively effect an individual's functioning in daily life. However, debate continues to exist in the literature as to the effectiveness of many sensory-based interventions. The literature is rampant with descriptions of many protocolized approaches or equipment specific sensory strategies (such as brushing, sitting on a ball or wearing a weighted vest) that are misrepresented as individualized occupational therapy, which relies on a broader clinical reasoning approach. Problems exist in previous studies because the intervention is poorly defined, lacks a manualized approach, and reports no method for maintaining fidelity to the intervention.

Objectives:

The present study aims to determine whether there are sensory and behavioral changes, which can be reliably measured after the administration of a manualized OT intervention, the STAR Approach, which combines regulation and relationship-based OT with principles of sensory integration and mental health consultation (Miller, 2014: chapter 4).

Methods:

This study used a retrospective pretest and posttest design. All referrals to STAR Center between 2007 and 2013 were included if they met criteria for a Sensory Processing Disorder. Children with ASD, known brain injury or genetic conditions, and movement disorders were excluded. The final dataset included 179 children ranging from 2 to 13 years of age (mean = 6.1 years, SD = 2.3), 139 males. All children engaged in the STAR approach, which is a short term, intensive program with 50-minute sessions, scheduled 3-5 times a week for a total of 20-40 sessions. Each family participates in all direct treatment sessions with their child as well as 5-6 parent-only, education sessions. The model includes pre and post testing for all participants using standardized scales, parent report measures and individualized goals. Post testing is conducted within 2 weeks of completing the program.

Results:

In this study, we noted significant improvement over the course of the intervention on all sensory and motor measures as well as standardized behavioral measures. Specifically, using the MFUN and GOAL scales, we noted significant improvement on visual motor control, fine motor control, and gross motor control/coordination (effect sizes (ES) > 0.52). Using the SPD3, a standardized parent report measure of sensory related behaviors, we found a reduction in sensory craving, sensory-over and under-responsivity. Using the ABAS-II and BASC, two commonly used standardized parent report measures of function and behavior, we again saw significant changes in many composite scores including general adaptive function, social function, internalizing behaviors and externalizing behaviors with moderate to large effect sizes (r>0.41).

Conclusions:

This study provides preliminary support for the effectiveness of a novel treatment, the STAR Approach that combines short-term intensive occupational therapy using principles from DIR/Floortime ™, and sensory integration, with extensive parent education and training. Children improved on standardized measures of adaptive behavior, emotional functioning, sensory processing and motor skills, thus suggesting that these measures are sensitive to change. Prospective studies may benefit from using these outcome measures.

202 **146.202** Sensory Processing Relationships to Autism Spectrum Disorder Risk in Toddlers Diagnosed with ASD

S. D. Tomchek[1,2], *L. Little*[2], *W. Dunn*[2] *and E. Dean*[2], *(1)University of Louisville - Weisskopf Center, Louisville, KY, (2)University of Kansas Medical Center, Kansas City, KS*

Background: Early identification of ASD in young children creates opportunity for early intervention to improve outcomes. Sensory processing differences are common in toddlers with an ASD (Ben-Sasson et al., 2007) and been reported to predate diagnosis (Adrien et al., 1993; Baranek, 1999; Dahlgren & Gillberg, 1989; Lord, 1995). This, coupled with the addition of the new DSM-5 item related to hyper- or hypo-reactivity to sensory input or unusual interests in sensory aspects of the environment (APA, 2014) heightens the need to better understand sensory processing in toddlers with ASD and the relationship to early screening measures. Therefore, the purpose of this study was to examine the extent to which sensory processing patterns are related to autism spectrum disorder (ASD) risk status as measured by the MCHAT and STAT in very young children with a diagnosis.

Objectives: Understand the relationships between sensory processing patterns in toddlers and ASD risk as measured by ASD screenings

Methods: We analyzed developmental and sensory processing variables from the diagnostic evaluation process. Participants included children with a diagnosis of ASD (n=60), mean age 27.82 months (SD=4.98; range=17-35 mos). The sample currently includes 43 boys and 17 girls; sample size will increase to n=75 by time of presentation. Sensory pattern variables were compared to ASD screenings. We used the Toddler Sensory Profile-2 (Dunn, 2014), the Modified Checklist for Autism in Toddlers series (M-CHAT) (Robins et al., 2001; 2013), and the Screening Tool for Autism in Toddlers & Young Children (STAT) (Stone et al., 2000).

Results: Preliminary results suggest that sensitivity and registration scores were positively associated with MCHAT total risk score (p<.01 and p<.05, respectively). Although sensory processing scores were not significantly associated with STAT total risk score, analysis of STAT subscale risk scores showed that sensitivity and registration neared significance with directing attention (p=.077 and p=.081, respectively).

Conclusions: Research suggests that the ways in which toddlers process sensory information contributes to participation in daily routines and to their overall development.

Caregivers of children with ASD notice sensory processing differences early in development, particularly when children show aversion to sensory experiences (i.e., sensitivity) or seem to be unaware of sensory stimuli (i.e., registration). In this very young sample of children with ASD, sensitivity and registration were associated with early risk scores on ASD screening measures. It may be that particular behaviors associated with these patterns illuminate aspects of early development in ASD, providing potential avenues for both early identification and intervention approaches in this population.

203 **146.203** Sensory Response Patterns Are Associated with Attentional Deficits in Preschoolers with ASD

M. Sabatos-DeVito[1], *M. Murias*[2], *B. P. Rardin*[1], *S. T. Major*[1], *J. Newman*[1], *K. S. Davlantis*[1] *and G. Dawson*[1], *(1)Duke Center for Autism and Brain Development, Duke University School of Medicine, Durham, NC, (2)Duke University, Durham, NC*

Background: Autism Spectrum Disorder (ASD) and Attention-Deficit/Hyperactivity Disorder (ADHD) are common childhood neurodevelopmental disorders that often co-occur, and include both sensory processing and attention difficulties. Many individuals with ASD demonstrate aberrant sensory response patterns, including *hyporesponsiveness*, *hyperresponsiveness*, and *sensory seeking* (Baranek et al., 2006). Children with ADHD also demonstrate sensory deficits, particularly *hyperresponsivness*. Children at-risk for and diagnosed with ASD demonstrate attentional disengagement differences, and children with ADHD exhibit poor sustained attention. These findings suggest a link between sensory and attentional processes early in development; however, research regarding the nature of and relations between attention and sensory difficulties in ASD are limited.
Objectives: Aim one of this study explores the extent to which sensory response patterns are related to ADHD symptoms in preschoolers with ASD. Aim two investigates the degree to which sensory responsiveness and ADHD symptoms predict orienting and sustained attention during a naturalistic eye-tracking paradigm.
Methods: Participants included preschoolers with ASD (N=25, Mean Age=4.47 years, Range=2.27-5.98 years; Mean Nonverbal IQ=64.3 +/- 24.6). ASD diagnosis was based on the ADOS-2 and ADI-R. The Sensory Experiences Questionnaire (Baranek et al., 2006) yielded scores for hyporesponsiveness, hyperresponsiveness, and sensory seeking, and the Behavior Assessment System for Children (Reynolds & Kamphaus, 2004) provided inattention/hyperactivity scores. Measures of orienting (time to first look) and sustained attention (proportion of time looking) were derived from a naturalistic eye-tracking paradigm in which participants viewed an actress and four dynamic, nonsocial stimuli (Chawarska et al., 2012). Final results will include additional participants' data.
Results: All three sensory response patterns were significantly, positively correlated with attention problems, with hyporesponsiveness showing the strongest relation (r=0.55, p<0.01), followed by hyperresponsiveness and sensory seeking (r=0.49, p<0.05). Hyperresponsiveness was significantly, positively related to hyperactivity (r=0.44, p<0.05). Total sensory scores (collapsed across all patterns) were significantly, positively associated with both attention problems (r=0.71, p<0.01) and hyperactivity (r=0.46, p<0.05). Hyporesponsiveness and attention problems showed trends toward significance (t=1.99, p=0.06; t=1.77, p=0.09) as positive predictors of orienting to dynamic stimuli, accounting for 16.5% and 13.5% of the variance in time to first look, respectively. Sensory response patterns and attention deficits were not predictors of proportion of time looking at dynamic, nonsocial stimuli.
Conclusions: Sensory response patterns were associated with attentional deficits in preschoolers with ASD. All patterns related to difficulties maintaining attention and hyperresponsiveness related to hyperactivity. Additionally, hyporesponsiveness and attention problems showed trends toward predicting attentional orienting speed to dynamic, nonsocial stimuli. These findings shed light on early sensory symptoms' relations to the presence of attentional deficits in preschoolers with ASD, identify relations between sensory and attentional behaviors across measures, and can inform behavioral interventions targeting sensory responsiveness and attentional patterns in ASD.

204 **146.204** Sensory and Motor Difficulties Predict Severity of Autism Symptoms

P. Hannant[1], *S. A. Cassidy*[1], *F. Mann*[2] *and T. Tavassoli*[3], *(1)Coventry University, Coventry, United Kingdom, (2)University of Birmingham, Birmingham, United Kingdom, (3)Psychiatry, Seaver Autism Center at Mount Sinai, New York, NY*

Background: Recent research has linked motor coordination difficulties with atypical sensory processing, and demonstrated abnormalities in either sensory processing and motor coordination separately in Autism Spectrum Conditions (ASC). However, few studies have explored both sensory and motor difficulties together, and their impact on the severity of autism symptoms.
Objectives: 1) To explore whether children with ASC have significant motor and sensory difficulties compared to typically developing (TD) children; 2) To explore whether sensory and motor difficulties predict severity of ASC symptoms.
Methods: 36 children took part: 18 (13 male, 5 female) children with ASC (mean age = 9.93 years, SD = 2.71) and 18 (7 male, 11 female) TD children (mean age = 9.16 years, SD = 1.89), matched on age and non-verbal IQ. All children completed a battery of tasks to assess performance IQ (WASI), receptive language ability (BPVS-III), motor coordination (Movement ABC), visual motor integration (BEERY-VMI), sensory processing (Sensory Profile) and autistic traits (Social Communication Questionnaire; SCQ). Autism diagnosis was confirmed and severity measured using both the Autism Diagnostic Observation Schedule General (ADOS-II), and the Autism Diagnostic Interview Revised (ADI-R).
Results: Children with ASC scored significantly higher on parent reported autistic traits (SCQ) ($p < 0.001$, $d = 0.831$) than TD children, and significantly lower than TD children on receptive language ability (BPVS-III) ($p < 0.001$, $d = 0.565$), Movement ABC total ($p < 0.001$, $d = 0.616$), Sensory Profile total ($p < 0.001$, $d = 0.797$), and Modulation of Movement (a sensorimotor sub-component of the Sensory Profile) ($p < 0.001$, $d = 0.565$). After Bonferroni correction, there was no significant group difference in visual-motor integration (BEERY VMI) ($p = 0.009$, $d = 0.529$). Stepwise multiple regression analyses were conducted with autism severity as outcome measures (ADOS-II, ADI-R and SCQ), and the Sensory Profile, Movement ABC, and BPVS scores as predictors. In the ASC group the BPVS and Sensory Profile were retained as significant predictors of ADI-R Communication ($R^2 = .55$, $p < 0.05$); the BPVS was retained as a significant predictor of ADI-R total ($R^2 = .36$, $p < 0.01$); the Movement ABC was retained as a significant predictor of ADOS-II Communication ($R^2 = .46$, $p < 0.01$) and ADOS-II total ($R^2 = .42$, $p < 0.01$); and the BPVS and Sensory Profile total were retained as significant predictors of the SCQ ($R^2 = .79$, $p < 0.001$). Modulation of Movement significantly predicted autism symptom severity across all measures (ADOS, ADI-R and SCQ) (all $p < 0.05$).
Conclusions: Results show that children with ASC have significant difficulties in sensory processing, motor coordination, sensorimotor integration and receptive language compared to controls. Furthermore, after accounting for receptive language difficulties in the ASC group, the Sensory Profile significantly predicted parent reported autism symptom severity (ADI-R and SCQ), whereas the Movement ABC significantly predicted an in-person measure of autism severity (ADOS-II). Additionally, sensorimotor integration difficulties significantly predicted autism symptom severity across all diagnostic measures. These results suggest that sensory and motor difficulties together impact severity of autism symptoms.

205 **146.205** Sensory-Motor and Language Behaviors in Infants with High and Low ASD Risk in the First Year of Life

J. Heathcock[1], *A. Bean Ellawadi*[2], *B. Hand*[2] *and A. E. Lane*[3], *(1)Division of Physical Therapy, The Ohio State University, Columbus, OH, (2)The Ohio State University, Columbus, OH, (3)University of Newcastle, Callaghan, Australia*

Background: Early motor, sensory, and language signs of ASD are a priority for the field as they could provide: 1) earlier diagnosis criteria and 2) the development of targeted interventions. Currently, early signs of ASD including reliable language, social, cognitive, and motor differences have been identified from 12 to 24 months of age. More recent work has begun to identify differences between typical development and infants at high risk for ASD in the first year of life. These high-risk infants are identified in infancy as having an older sibling who has ASD. There are reports of upper extremity and language developmental variation in the first year of life in infants at-risk for ASD. For example poor midline behaviors and poor coordination of upper extremity movements with early babbling have been identified.
Objectives: We conducted a multi-disciplinary, behavioral study of infants with and without risk factors for autism to characterize gross motor, upper extremity movement and sensory response trajectories in the first year of life and their relationship to early signs of autism including language and gesture.
Methods: Thirty-nine infants participated in a longitudinal study at 2, 4, 6 and 12 months of age. Twenty-five infants were at high risk for ASD with a sibling or first cousin with ASD, and the remaining 14 infants were classified as typically developing with no ASD risk factors. Five infants went on to receive an ASD diagnosis at age 3–4 yr. Infants were part of larger study to develop earlier diagnostic tools for ASD.
Results: Infants' gross motor skills, spontaneous and upper extremity movements, sensory response (visual, auditory, tactile) and language behaviors were evaluated from standardized video recordings during a naturalistic play session at 2, 4, 6 and 12 months of age. Repeated measures statistical approaches (parametric or non-parametric) were used to analyze main effects of risk group and changes in trajectory. Differences in trajectory were observed in gross motor skills ($p < .05$), midline performance with the hands ($p < .05$), and response to sensory stimulation ($p < .1$). All groups of infants produced vocalizations and arm movements (rhythmic arm movements and gestures) at 6 & 12 months. At 12 months a higher proportion of children with ASD did not produce coordinated overlapping gestures with the upper extremities and vocalizations.
Conclusions: Identification of specific behaviors that are discriminative of ASD in the first year of life is of high impact because interventions that begin early in life can reduce the severity of cognitive and behavioral impairments ultimately lessening the expression of disability.

206 **146.206** Studying Restricted and Repetitive Behaviors : An Individual Items Versus a Clustered Approach of Analysis

V. Langlois[1], *A. Beauchamp Chatel*[2], *V. Larose*[3], *V. Courchesne*[4], *S. Mineau*[1], *L. Mottron, M.D.*[5] *and C. Jacques*[6], *(1)Centre d'excellence en Troubles envahissants du développement de, Montréal, QC, Canada, (2)Psychiatry, University of Montreal, Montreal, QC, Canada, (3)Université du Québec en Outaouais, Gatineau, QC, Canada, (4)University of Montreal, Montréal, QC, Canada, (5)Centre d'Excellence en Troubles Envahissants du Développement, Montréal, QC, Canada, (6)Universite du Quebec en Outaouais, Gatineau, QC, Canada*

Background: Restricted and repetitive behaviors (RRBs) are one of the two core domains required for an autism diagnosis (APA, 2013). Different classifications of RRBs have been used in young autistic children. Some observational studies have used a small number of clusters (Turner, 1999; Barber et al. 2012; MacDonald et al. 2007; Stonach & Wetherby; 2012), while others have used a more detailed approach (Goldman et al. 2008; Loh et al. 2007; Mottron, et al. 2007; Ozonoff et al. 2007). Using many items gives a more precise picture of RRBs, but could mean a loss of statistical power when multiple tests are conducted. Therefore, comparing different methods of clustering RRBs will help understand how these methods influence the results.
Objectives: This study aims to compare the RRBs profiles of autism spectrum disorder (ASD) and typically developing (TD) preschooler groups using the Montreal Stimulation Play Situation (MSPS) items analysed individually or in 3 clusters inspired by the ADOS-2 classification.
Methods: 53 autistic children (43.4 months ± 15.2; MSEL standard score 65.5 ± 20.0) and 46 TD children (48.1 months ± 11.5, p<0.05; MSEL standard score 110.8 ± 17.3, *p*<0.001) were exposed to the MSPS, which includes free and semi-free play sessions with objects of interest to ASD children. The frequency and duration of the 49 RRBs were coded twice by coders blind to the diagnosis using Noldus Observer. The mean duration and frequency of the 49 items were compared between the ASD and TD groups using non-parametric analysis. The 49 RRBs items of the MSPS scale were then pooled according to the clusters of the ADOS-2 algorithm (except those related to vocalization): 1) unusual sensory interests in play material/person; 2) hand, finger and other complex mannerisms; 3) unusually repetitive interests/stereotyped behaviors. Differences between the groups in the mean duration and frequency of these three clusters were determined using a Student's *t*-test.
Results: When analysed separately, three of the 49 items were significantly higher on both mean duration and frequency in the ASD group (p<0.01): *hand flapping*, *arm movements*, *close look to an object*. *Hand flapping* and *arm movements* are included in the *mannerisms* cluster, while *close look to an object* is included in the *unusual sensory interests* cluster. When pooled using 3 clusters from the ADOS-2 classification, only *mannerisms* was significantly higher on both frequency and duration for the ASD group.
Conclusions: When the RRBs were analysed separately, differences between the ASD and TD groups were found in one of the *unusual sensory interests*. However, this information was lost in the pooled analysis, where only the *mannerisms* cluster showed significant differences. This suggests that by using a small number of RRB clusters, the differences between TD and ASD children may be blurred by RRBs which are less specific to ASD children. Future studies should aim to determine the optimal number and the contents of clusters.

207 **146.207** The Content and Function of Interests in the Broad Autism Phenotype

K. E. Morrison[1], *L. Chambers*[2], *D. J. Faso*[3] *and N. J. Sasson*[2], *(1)The University of Texas at Dallas, Dallas, TX, (2)University of Texas at Dallas, Richardson, TX, (3)University of Texas at Dallas, Allen, TX*

Background: Many recent studies have demonstrated that the social features of ASD can be found in qualitatively similar but milder forms in members of the general population with the Broad Autism Phenotype (BAP). Less clear is whether individuals with the BAP are also characterized by non-social features of ASD, such as "circumscribed interests" (CI), defined by an intense preoccupation within a narrow range of topics.
Objectives: This study compared the content and function of interests between adults with and without the BAP. We predicted that individuals classified as having the BAP would report greater interest in hobbies related to common CIs found in ASD (e.g., video games) compared to those without the BAP, and that the hobbies they endorsed would be more limited in range (i.e., more circumscribed) but pursued with greater intensity (i.e., time per hobby).
Methods: Seventy-four undergraduates (59% female; Mean Age: 22.81) completed the Broad Autism Phenotype Questionnaire (BAPQ), an interest survey, and a computerized task in which images related to various interests were rated on valence (i.e., pleasure) and arousal (i.e., excitement). Both the survey and the ratings task consisted of content related to common CI previously reported for individuals with ASD, as well as control content (i.e., interests not disproportionately prevalent in ASD).
Results: Twenty-eight participants were classified as "BAP-positive" by exceeding the gender-specific self-report cutoff score on the BAPQ (Sasson et al., 2013). On the ratings task, a repeated-measures ANOVA with BAP-status and gender as the between-group variables, and image-type (ASD vs non-ASD interests) as the within-group variable, produced a significant group x object type interaction for both valence ($F(1,69)=18.41$, $p<.001$) and arousal ($F(1,69)=7.56$, $p=.007$). Post-hoc tests showed that these interactions were driven by BAP-positive individuals having lower valence ratings of images related to non-ASD interests ($t(71)=2.45$, $p=.015$), and higher arousal ratings of images related to ASD interests ($t(71)=2.17$, $p=.033$). On the survey, BAP-positive individuals endorsed fewer hobbies than BAP-negative individuals ($p=.049$), but the groups did not differ in the intensity in which hobbies were pursued. Compared to BAP-negative individuals, BAP-positive individuals reported significantly lower interest in exercising, playing sports, watching sports, running/biking, hunting/fishing, and studying religion, but significantly higher interest in programming, reading fiction, using phone apps/games, and a trend towards greater interest in computer games. Although many gender differences emerged on both the ratings task and the interest survey, they largely did not interact with BAP status.
Conclusions: Across multiple measures, adults classified as having the BAP differed in their interests from those classified as not having the BAP. Those with the BAP rated images related to interests common in ASD as more exciting, and those related to interests less common in ASD as less pleasurable. They also self-reported fewer interests overall, with lower interest in many outdoor activities and sports (both playing and watching) but greater interest in some solitary (e.g., reading) and technology-related areas (e.g., computers). These findings suggest that many of the differences in the content and function of interests previously reported in ASD may extend to the BAP.

208 **146.208** The Difference in Sensory Processing Between Children with and without ASD

T. Brahim, *N. Gaddour, S. Missaoui and L. Gaha, University of Monastir, Monastir, Tunisia*

Background: Autism spectrum disorder (ASD) is a very heterogeneous condition. Sensory processing abnormalities are common and can be detected very early. Several methods exist to assess these abnormalities; the most accessible ones rely on description of behavioral responses to different stimuli**.**
Objectives: to describe the differences in sensory processing between children with and without ASD.
Methods:
A case-control study was conducted from July 2014 to August 2015, at the Child and Adolescent Psychiatry Unit at the University Hospital of Monastir. We included all outpatients diagnosed with ASD seen during their routine follow-up. A control group was chosen randomly in 4 different kindergarten of the region of Monastir. Each group included 100 children, with a sex ratio M/F of 4.2 and a mean age of 3.2 years. ASD was diagnosed according to DSM-IV criteria by certified Child and Adolescent Psychiatrists and the Childhood Autism Rating Scale (CARS). We excluded children with neurological or genetic comorbidities. In the control group, we excluded children with abnormal m-CHAT or abnormal psycho-emotional development.
The Sensory Profile for Toddlers 2, translated to Arabic, was used to describe sensory abnormalities and was filled during clinical sessions with parents
Results:
All the children with ASD had abnormalities in at least one sensory domain (p<0.001). The most significant differences in T-scores between the two groups were noted in general score, oral and tactile sections (p<0.001 for the three section) then in auditory sections (p=0.013), and movement (p=0.026); all more problematic in ASD group. No difference was found for vision (p=0.724).
More than 62% of children with ASD had more sensitivity/sensor patterns (+1 to +2 SD) versus 7% in the typically developing group. More than 80% of the children with ASD had less seeking/seeker patterns (between -1 and -2SD) against only 35% of the typical developed children. Approximately 62% of children with ASD were more bystander versus 5% in the control group. There was no difference in the quadrant of avoiding/avoider.
We noted a correlation between the severity of ASD rated on the CARS and the presence of abnormalities on the sensory profile (p<0.001).
Conclusions: With the exception of visual processing, sensory domains were clearly different and impaired in ASD group. Underlying neuronal processing abnormalities need to be clarified.

209 **146.209** The End-State Comfort Effect in Children with Autism Spectrum Disorder and Typically Developing Children: The Importance of Functionally Relevant Motor Tasks

G. C. Bellinger[1], *R. A. Rodgers*[1], *S. J. Gannon*[1], *B. G. Travers*[2] *and A. H. Mason*[1], *(1)University of Wisconsin - Madison, Madison, WI, (2)Occupational Therapy Program in Kinesiology, University of Wisconsin Madison, Madison, WI*

Background: The end-state comfort effect occurs when one adopts an initially uncomfortable posture during a movement sequence in order to attain a comfortable posture at the completion of object manipulation, thus demonstrating motor planning (Rosenbaum et al., 1990). For example, one may grasp a key with an awkward underhand grip, so that a comfortable hand position is achieved after the key is rotated in the lock. Previous studies suggest that children and adolescents with Autism Spectrum Disorder (ASD) do not exhibit the end-state comfort effect (Hughes, 1996; Simermeyer & Ketcham, 2015), but it is unclear whether these motor impairments generalize from lab tasks to more functional types of motor behaviors.
Objectives: To determine if the end-state comfort effect is demonstrated in children with ASD compared to children with typical development (TD) in both the traditional paradigm and a more functional task.
Methods: Twenty-one participants with ASD and 16 age-matched TD participants (ages 6-17 years, $p=.76$) completed a traditional dowel task and a more functionally relevant task which required them to use a mallet to hammer a peg. In the dowel task, participants were instructed to grasp a horizontally positioned dowel and touch one end to a target positioned to the left or right. The ends of the dowel and the targets were different colors so that participants understood the directions (e.g., touch the blue end of the dowel to the red target). Each condition was repeated twice. In the mallet task, participants were instructed to use the mallet to tap a peg to the left of the stand holding the mallet. Initially, the head of the mallet was positioned to the participant's right or left side. Each condition was repeated four times and the tasks were counter-balanced. In both tasks, two researchers live coded whether the participant used an overhand or underhand grasp to complete the task. A two-way repeated-measures ANCOVA with group as the between-subjects factor, task as the within-subjects factor, and age as a covariate was used to test the percentage of trials completed in accordance with end-

state comfort.
Results: The two groups did not differ in the percentage of trials completed in accordance with the end-state comfort effect for either task. There was a significant effect of task, with the mallet task (*M*=88.5) having a higher percentage of comfortable end-state positions compared to the dowel task (*M*=65.1) (*p*=.001). This result suggests that both children with ASD and with typical development demonstrate a greater degree of motor planning when the task has functional relevance. There was a trend toward a higher percentage of comfortable end-state positions in the dowel task with increasing age (*r*=.30, *p*=.07).
Conclusions: Participants with ASD did not differ from their TD peers in the percentage of movement sequences performed in accordance with the end-state comfort effect. This is in contrast to previous work but suggests the ability to plan motor sequences. The results of this study emphasize the importance of using functional tasks when evaluating motor planning in children with and without autism.

210 **146.210** The Factor Structure of Restricted and Repetitive Behaviors in Young Children with and without Autism Spectrum Disorder

D. Dow *and A. M. Wetherby, Florida State University Autism Institute, Tallahassee, FL*

Background: Given the heterogeneity of restricted and repetitive behaviors (RRBs) and their relevance to DSM-5 diagnostic criteria for autism spectrum disorder (ASD), empirical evidence informing which RRB factors are prevalent in young children is critical in improving early detection. While it is clear that RRBs are present at a young age (Elison et al., 2014; Guthrie et al., 2013), RRB symptoms do not discriminate young children with ASD as effectively as social communication (SC) symptoms in early screening instruments (Berument et al., 1999; Rowberry et al., 2015), and clinicians do not endorse the presence of RRBs as frequently as SC symptoms (Stone et al., 1999). Children with developmental delays (DD) and typical development (TD) also frequently demonstrate RRBs (Evans et al., 1997; Bodfish et al., 2000), leading to further challenges in determining whether certain behaviors are symptomatic of ASD at an early age.
Objectives: (1) To determine the factor structure of RRBs in two through five year olds using the Repetitive Behavior Scale–Revised (RBS-R), and (2) to examine whether the factor structure of RRBs is consistent across children with ASD, DD, and TD.
Methods: There were 363 participants selected from a larger sample of children recruited for the FIRST WORDS® Project at Florida State University, a longitudinal, prospective study investigating early detection of ASD and other communication disorders. Children were included if an RBS-R had been completed between ages 2 and 5 (*mean*=34.81 months, *SD*=7.19). The RBS-R is an empirically derived clinical rating scale for measuring the presence and severity of a range of RRBs that are characteristic of ASD.
Outcome measures of developmental level (Mullen Scales of Early Learning), adaptive behavior (Vineland Adaptive Behavior Scales, Second Edition) and autism symptoms (Autism Diagnostic Observation Schedule) were obtained to determine a best estimate diagnosis. The sample included 190 children with ASD, 99 with DD, and 74 with TD. Confirmatory Factor Analysis (CFA) was used to evaluate previously supported three-, five-, and six-factor models using the RBS-R in toddlers (Mirenda et al., 2010). Because models were nested within each other, a difference test was computed to determine whether the most parsimonious model was preferable. Further analyses utilizing Measurement Invariance techniques will also be reported in order to examine diagnostic group differences in RRB factor structure.
Results: Results suggested that the three-factor model, consisting of stereotyped/restricted, compulsive/ritualistic/sameness, and self-injurious behaviors provided preferable fit (χ^2/df=1.36, CFI=.98; TLI=.98; RMSEA=.03). Similarly, the five- and six-factor models provided good fit, but were not as parsimonious (five-factor: χ^2/df=1.30, CFI=.98; TLI=.98; RMSEA=.03; six-factor: χ^2/df=1.31, CFI=.98; TLI=.98; RMSEA=.03).
Conclusions: The RBS-R allows for thorough assessment of a range of RRBs in toddlers and young children. Stereotyped and restricted behaviors emerge as a single factor, a second consists of compulsive, ritualistic, and sameness behaviors, and self-injurious behaviors fall independently on a third factor. Evidence-based support regarding the structure of RRBs in children across diagnostic groups is critically important in understanding early symptomology and improving early detection of ASD.

211 **146.211** The Flexibility Scale: A Parent-Report Inventory of Flexibility Skills in Children with Autism Spectrum Disorders without ID

J. F. Strang[1]*, L. Kenworthy*[2]*, L. G. Anthony*[3]*, B. E. Yerys*[4]*, K. Hardy*[5] *and G. Wallace*[6]*, (1)Children's National Medical Center, Silver Spring, MD, (2)Children's Research Institute, Children's National Medical Center, Rockville, MD, (3)Children's National Medical Center, Rockville, MD, (4)The Center for Autism Research, Philadelphia, PA, (5)Neuropsychology, Children's National Medical Center, Rockville, MD, (6)The George Washington University, Washington, DC*

Background: Restricted, repetitive behaviors and interests (RRBI) comprise one of two core symptom domains in autism spectrum disorders (ASD). Existing RRBI measures are limited in their utility to measure RRBI symptoms dimensionally. The Autism Diagnostic Interview is a widely used diagnostic evaluation of RRBI symptoms and has been inappropriately used as a quantitative measure. The Behavior Rating Inventory of Executive Function provides quatitative measurement of cognitive and behavioral flexibility, and has consistently indentified flexibility deficits in ASD, but its eight items do not measure possible subcomponents of cognitive/behavioral flexibility. A novel measure, the Flexibility Scale (FS) targets broad flexibility characteristics in ASD using a larger set of items with the goal of increasing power and specificity when describing the inflexibility phenotype in ASD without ID.
Objectives: Evaluate the factor structure of the FS in children with ASD.
Methods: The original 50-item FS was developed through an iterative process based on known RRBI/flexibility characteristics in ASD without ID. Parents of 227 children with ASD (age 7-14) completed the FS. Polychoric exploratory factor analysis (EFA) and assessments of internal consistency were conducted.
Results: Minimum Average Partial and Parrallel Analysis tests indicated best fit with a 5-factor model accounting for 45% of the variance. Items with factor correlations falling below .4 were eliminated. Ten international ASD/executive function experts evaluated significantly cross-loaded items for factor placement or removal, and generated descriptions of the factors based on item set and known ASD flexibility characteristics. The resulting 29-item questionnaire has 5 factors: Routine/Rituals, Transitions/Change, Special Interests, Social Flexibility, and Generativity.
Conclusions: These results suggest that RRBI/flexibility characteristics in ASD without ID are multi-dimensional. If confirmed, this factor structure has important implications for the phenotypes of RRBI in ASD without ID, including intervention development and measurement.

212 **146.212** The Impact of Movement Complexity on Movement Planning and Execution in Individuals with an Autism Spectrum Disorder

R. Zheng[1]*, S. R. Passmore*[2,3] *and* ***C. M. Glazebrook***[3,4]*, (1)University of Alberta, Edmonton, AB, Canada, (2)Faculty of Kinesiology & Recreation Management, University of Manitoba, Winnipeg, MB, Canada, (3)Health, Leisure, & Human Performance Research Institute, Winnipeg, MB, Canada, (4)Kinesiology & Recreation Management, University of Manitoba, Winnipeg, MB, Canada*

Background:
Basic fine motor skills provide a foundation for developing more complex communication skills and performing activities of daily living. Difficulties with some aspects of reaching movements are now reported consistently in the literature; however the details are not always consistent (Fournier et al., 2010). Reaction time (RT) results, a measure of movement planning, consistently indicate that individuals with ASD spend more time preparing to move (Glazebrook et al., 2006; Rinehart et al., 2006). That said, whether people with ASD also spend longer executing their movements, and if these movements are performed as consistently and accurately as age-matched peers, is unclear (Glazebrook et al., 2006, 2009; Rinehart et al., 2006; Papadopoulos et al., 2010). On closer examination of the tasks used for the above work we predicted that the inconsistent results for movement execution may be due to differences in movement complexity.
Objectives:
The present study sought to determine: 1) If differences in movement complexity account for the inconsistent reports of movement time and variability. 2) If longer RTs were associated with the cognitive aspects of movement planning, or the motor preparation needed to initiate a voluntary movement.
Methods:
We manipulated movement complexity by comparing sliding (1D and 2D) and aiming (3D) movements. We recruited 11 young adults with ASD and 13 typically developing (TD) age-matched peers to perform three types of reaching movements to targets in the sagittal plane: 1) sliding along a track on a piece of Plexiglas (1D, constrained); 2) sliding along a piece of Plexiglas (2D, constrained); and 3) aiming (3D, unconstrained). Movements were recorded using a 3D motion-analysis system (Optotrak 3D Investigator, NDI) and muscle activity was recorded using surface electromyography (CED 1902 dual system amplifier). RT was parsed into premotor and motor time to assess the relative contributions of cognitive and motor processes respectively. Movement time and the variability of the movement path were derived from the 3D motion analysis data. All dependent variables were submitted to a 2 Group (ASD, TD) by 3 Movement Type (1D, 2D, 3D) mixed analysis of variance.
Results:
No group differences for RT was found (Fs<0.6). A significant Group by Movement Type interaction for MT was consistent with predictions that there were no differences between groups for sliding movements, but the ASD group took longer to execute unconstrained movements. The TD group also exhibited significantly shorter premotor RTs for less constrained movements, whereas premotor RT did not change as a function of movement type for the ASD group. Finally, the ASD group's movements were more variable throughout the entire movement.
Conclusions:
We propose the lack of group difference for RT occurred because the task allowed participants to plan ahead since movement direction was consistent. Based on the group interaction for premotor RT, MT, and other kinematic variables, we suggest that unconstrained reaching movements are more difficult for people with ASD. The present findings will be discussed in the context of brain connectivity models and related preferences for sensorimotor integration.

213 **146.213** The Influence of Atypical Sensory Processing and Anxiety on ASD Symptomatology

K. R. Black[1], *R. A. Stevenson*[1], *B. L. Ncube*[2], *M. Segers*[2], *S. Z. Sun*[1], *J. M. Bebko*[2], *A. Philipp-Muller*[1], *M. Johnston*[3], *Z. Y. Wang*[1], *M. D. Barense*[1] *and S. Ferber*[1], *(1)Department of Psychology, University of Toronto, Toronto, ON, Canada, (2)York University, Toronto, ON, Canada, (3)University of Western Ontario, London, ON, Canada*

Background: Restricted interests and repetitive behaviors (RIRBs) are a defining feature of autism spectrum disorder (ASD). These symptoms can be divided into three distinct constructs: insistence on sameness (I/S), repetitive motor behaviors (RMB) and sensory processing abnormalities. High rates of co-morbid anxiety in ASD have been linked to both I/S and RMB, yet conflicting findings suggest that atypical sensory processing may also play a role in the relationship, particularly with I/S.
Objectives: This novel investigation had 2 goals:

1. Determine if the contribution of atypical sensory processing in ASD to I/S and anxiety varies depending on sensory phenotype (hyper- or hypo-sensitive, sensory avoiding or seeking) and specific type of anxiety.
2. Compare these relationships between individuals with ASD and typically-developing (TD) children.

Methods: Parents of 87 children (ASD, n=49, M_{age}=12.0 years, SD=3.1; TD, n=38, M_{age}=11.6 years, SD=3.1, data collection ongoing) completed questionnaires reporting on sensory processing (the Sensory Profile-2), I/S (the Repetitive Behavior Questionnaire-2), and anxiety (the Spence Children's Anxiety Scale). A two-step analysis was undertaken:

1. A correlational analysis was used to investigate the relationships between variables in both the ASD and TD group, then correlations were compared across groups to highlight between-group differences.
2. A hierarchical regression was run to examine the unique contributions of atypical sensory processing and anxiety to I/S in the ASD group.

Results:
Correlational analysis
The correlational analysis revealed significant differences between ASD and TD groups for anxiety subscales and I/S, and anxiety subscales and sensory sensitivity (Figure 1). Specifically, significantly different correlations were observed between I/S and separation anxiety (p=.03, z=2.15), I/S and panic (p=.01, z=2.47), I/S and general anxiety disorder (p=.05, z=1.91), I/S and total anxiety symptoms (p=.02, z=2.33), as well as between separation anxiety and sensory sensitivity (p=.05, z=1.93). Neither social anxiety, physical anxiety, nor obsessive compulsive disorder were significantly different for correlations with I/S or sensory sensitivity when compared between groups.
Hierarchical regression
In the hierarchical regression, we explored which variables significantly predicted the occurrence of I/S symptomatology (Table 1). I/S was significantly predicted by the sensory phenotype of *hypersensitivity* (β=.34, t=2.86, p=.007) and the subscale of *separation anxiety*(β=.252, t=2.41, p=.021). Notably, I/S decreased with age (r=-.39, p=.003).
Conclusions: Our correlative findings indicate that I/S is atypically related to three specific types of anxiety (separation, panic, and general anxiety) in individuals with ASD. The results from the hierarchical regression suggest that the expression of I/S in children with ASD varies based on a child's level of hypersensitivity to sensory stimulation, and distress due to separation anxiety. Furthermore, younger children may demonstrate more frequent I/S behaviors. Finally, despite the numerous differences between TD and ASD groups' relationships between sensory processing, RIRB, and anxiety, there was also a significant amount of overlap between groups, underscoring the importance of non-clinical control groups.

Figure 1

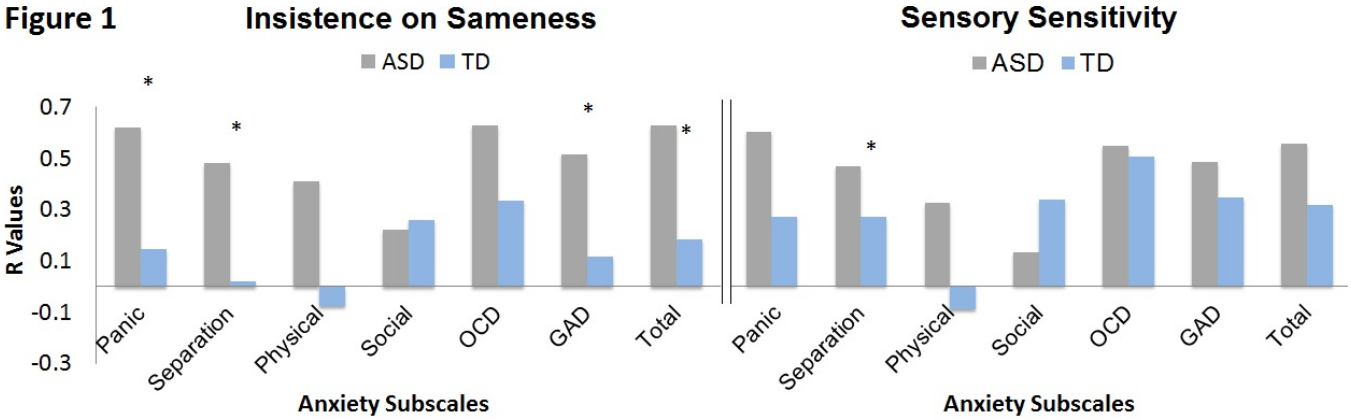


Table 1| Hierarchical multiple regression predicting I/S

Predictor	Partial correlation (*pr*)	*p*-Value
Step 1: *R* = 0.72, *F-change*(4,41) = 11.11, *p-change* < 0.001		
Gender	0.26	0.09
Age	-0.47	**0.002**
IQ	0.03	0.84
Step 2: *R* = 0.82, *F-change*(1,40) = 17.54, *p-change* < 0.001		
Gender	0.21	0.18
Age	-0.38	**0.01**
IQ	0.07	0.68
Sensory Sensitivity	0.55	**<0.001**
Step 3: *R* = 0.84, *F-change*(1,39) = 5.78, *p-change* = 0.021		
Gender	0.28	0.78
Age	-0.35	**0.02**
IQ	0.17	0.28
Sensory Sensitivity	0.42	**0.007**
Separation Anxiety	0.36	**0.02**

Significant results of added predictors are shown in **bold**.

146.214 The P-Gsq: A New Self-Report Sensory Questionnaire for Children

D. R. Simmons[1], *A. E. Robertson*[2] *and L. Brown*[1], *(1)School of Psychology, University of Glasgow, Glasgow, Scotland, (2)Psychology, University of Dundee, Dundee, Scotland*

Background: The Glasgow Sensory Questionnaire (GSQ; Robertson & Simmons, 2013) is a 42-item self-report questionnaire which measures the frequency and severity of sensory difficulties (both hyper- and hypo-responsiveness), giving a score ranging from 0 (no sensory difficulties) to 168 (Extremely severe and frequent difficulties in all sensory modalities). Research with this questionnaire has shown that there are strong correlations of sensory score with self-reported autistic traits (Robertson & Simmons, 2013; Horder et al, 2014) and (in a Japanese translation) significant differences in sensory scores between diagnosed ASD and control populations (Takayama et al, 2014). However, so far the GSQ has only been critically tested with adults. We have therefore developed a version of the questionnaire adapted for children: the Pictured-Glasgow Sensory Questionnaire (P-GSQ).
Objectives: To develop and validate a version of the GSQ adapted for children (8-15 years).
Methods: The questionnaire adaptation was achieved by (a) modifying the language slightly to make it understandable to a typical 8-year-old and (b) incorporating eye-catching illustrations to support the question text. After performing pilot experiments to verify that the text and pictures were adequately understood, the questionnaire was completed by 234 children (mean age 10.15 years, age range 8-15 years) during the course of a public workshop at a local "hands-on" science museum. The caregiver with the child was asked to complete the Children's version of the AQ (Auyeung et al, 2009) at the same time, so that the link between P-GSQ and autistic trait level could be evaluated.
Results: Overall results show only a modest, if significant, correlation between P-GSQ and AQ score (Pearson's $r(234) = 0.147$, $p < 0.05$, $R^2 = 0.022$). Subsequent analysis of sub-scales of the P-GSQ indicated that this correlation was largely driven by auditory and gustatory hyper-sensitivity and by the proprioceptive modality. Splitting the ages up into two groups showed that the correlation was only significant in the 8-11 age range and not in the 12-15-year-olds. Splitting the group by gender found that the correlation was only significant in females and not males. Cronbach's Alpha revealed a good degree of internal consistency (alpha = 0.835).
Conclusions: These results are curious given the well-documented and replicated significant correlations between GSQ sensory scores and autistic trait levels found in adults (16+). Pilot data collected with 12-15-year-olds and the adult GSQ in a similar way to these data also revealed no significant correlations. The general response seems to be a modest amount of sensory difficulty (somewhere between "often" and "sometimes") for most of the young people we tested. One explanation is that all young people have mild difficulties with sensory stimulation: the difference is how they *react* to it, and this "sensory reactivity" is what is picked up in the more-frequently used caregiver questionnaires. Alternatively, young people may lack the insight necessary to self-report on their own sensory difficulties and/or the difficulties that they experience may be qualitatively different from those that adults experience.

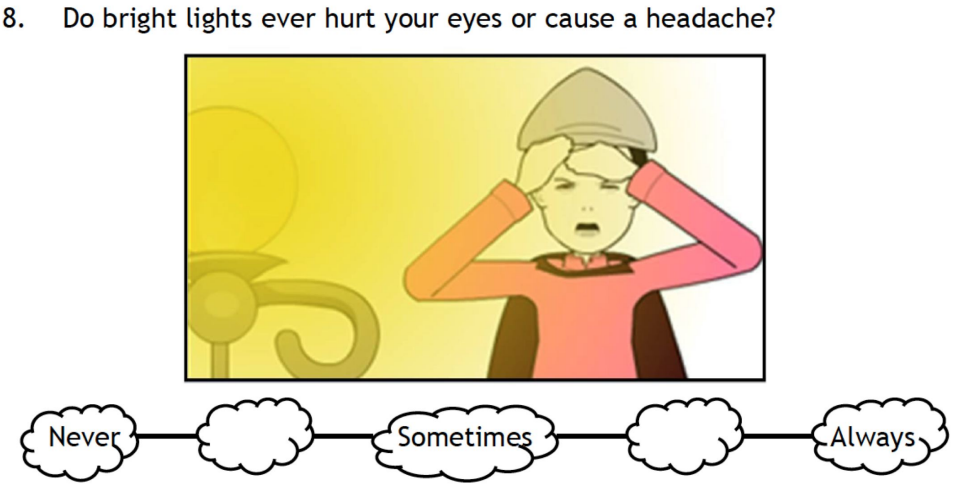


Figure: A sample question and associated illustration from the P-GSQ

215 **146.215** The Use of a Kinect-Based Technology to Enhance Sensory-Motor Skills in Children with Autism

M. Mademtzi[1], *K. Guldberg*[2] *and K. Wittemeyer*[3], *(1)University of Birmingham, Bimringham, United Kingdom, (2)University of Birmingham, Birmingham, United Kingdom of Great Britain and Northern Ireland, (3)University of Birmingham, Birmingham, United Kingdom*

Background: Current estimates indicate that 80% of children diagnosed with autism present sensory processing problems. These problems refer to all sensory systems, including tactile, auditory, visual, gustatory, olfactory and also vestibular and proprioceptive. The last two systems along with input from the visual system, play a crucial role in many areas of development, mostly in sensory-motor development (Baranek, 2002). The most known interventions in this area include sensory integration therapy (Ayres, 1972; 1979), traditional occupational therapy and physical exercise. These interventions require trained personnel (e.g. occupational therapists) and specialized equipment. As a result, they cannot be delivered by classroom teachers. Another medium recently started used for dealing with the same matters is technology. Platforms like Nintendo Wii and Microsoft Kinect allow full body input and they enable physical and sensory stimuli.
Objectives: The objective of this study was to investigate whether a new, free and easily implemented kinect-based technology called *Pictogram Room* can contribute to the development of children's with autism sensory-motor skills as observed in three school settings (i.e. physical education, classroom and playground).
Methods: *Pictogram Room* uses augmented reality to help children with autism to develop a range of skills, creating a virtual space with highly customizable educational activities. Through the recognition of movement, it is possible to reproduce the image of the player himself/herself augmenting with a series of graphic and musical elements that guide the learning process. A matched control group design was followed with 5 children (all males, M_{age}=5.4 years) in the intervention and 5 children (4 males and 1 female, M_{age}=5.2 years) in the control group. The children completed a set of 20 sessions in total working on *Pictogram Room* (2 familiarization sessions and 18 sessions delivered twice a week for a period of 9 weeks) in a mainstream school with autism units in the UK. Pre and post intervention the children's teachers completed the Balance, Body Awareness and Planning (BBAP) checklist, developed by the researcher, to monitor potential changes in the targeted skills.
Results: Following intervention there was a significant difference between the two groups' sensory-motor skills in physical education (intervention group: M=104.4, SD=5.9; control group: M=93.2, SD=6.98; $t(4)=7.6$, $p=0.0016$; Cohen's $d=1.7$). In the classroom environment the difference between the two groups was close to being significant but with large effect size (intervention group: M=74.8, SD=6.94; control group: M=69, SD=6.75; $t(4)=2.4$, $p=0.0694$; Cohen's $d=0.8$). Finally, in playground, the difference in sensory-motor skills development between the two groups was not significant (intervention group: M=60.8, SD=5.63; control group: M=58.2, SD=4.55; $t(4)=1.35$, $p=0.2457$; Cohen's $d=0.5$).

Conclusions: This study suggests that teachers can use *Pictogram Room* as an effective way to support students' with autism sensory-motor skills. However, more research is needed, with larger samples, as well as using different methods with which greater generalization of skills can be achieved. It does not cut off the need for professional support like occupational therapy but it is a tool that teachers can easily use in the classroom and incorporate it with curriculum goals.

216 **146.216** The Validation of a New Measure for Assessing the Frequency and Impact of Sensory Sensitivities in Autism, the Sensory Processing Behaviour Questionnaire, and Its Association with Anxiety Symptoms

*L. E. Neil[1], **E. Pellicano**[1] and D. Green[2], (1)Centre for Research in Autism and Education (CRAE), UCL Institute of Education, University College London, London, United Kingdom, (2)Oxford Brookes University, London, United Kingdom of Great Britain and Northern Ireland*

Background:
Sensory sensitivities are included in the DSM-5 criteria for autism yet there are few well-validated measures to assess them. A newly developed scale, the Sensory Processing Behaviour Questionnaire (SPBQ: Green, 2013) has been uniquely designed to measure the frequency (e.g., 'How often have you noticed your child show an unusual response to bright lights in the last month?') and impact ('How much of a problem is it?') of 25 sensory behaviours in multiple domains. Evidence suggests that sensory sensitivities are closely associated with anxiety in autism. The DSM-5 specifies several different types of anxiety disorder yet the differential relationship sensory sensitivities may show with anxiety symptoms in different domains remains hitherto unexamined.
Objectives: The aims of this study were twofold: (1) to investigate the psychometric properties of the SPBQ, including internal consistency, factor structure and convergent validity, and (2) to determine the association between autistic children's scores on the SPBQ and subtypes of anxiety.
Methods:
Parents of 67 children with autism and 71 typically developing children, aged between 6 and 17 years were administered the Sensory Processing Behaviour Questionnaire (SPBQ), the Short Sensory Profile (SSP) and the Spence Children's Anxiety Scale (SCAS), which assesses anxiety symptoms in six domains in keeping with the DSM-IV. Groups were matched on age (p = .25) and IQ (p = .20).
Results:
As expected, children on the autism spectrum scored significantly higher on the SPBQ than typically developing children of similar age and ability, indicative of greater levels of sensory sensitivities, t(136) = 12.0, p <.001. Internal consistency, factor structure and convergent validity were assessed in the autistic sample only. The 50-item SPBQ showed excellent internal consistency (α = .97) as did the separate frequency (α = .93) and impact (α = .94) scales. Principal components analysis, with varimax rotation, suggested an 8-factor solution. Six of these factors broadly related to daily routines, posture and balance, sensation seeking, noise sensitivity, visual sensitivity and food sensitivities. The two remaining factors were less straightforward to interpret, but one featured difficulties dealing with cluttered environments and the other motor behaviours such as rocking and mouthing objects. The SPBQ scores showed good convergent validity with the most commonly used assessment of sensory symptoms in autism, the SSP (total: r = .79; frequency: r = .78; impact: r = .74). Consistent with previous work, the SPBQ showed a medium-to-strong correlation with children's anxiety scores on the SCAS (r = .58, p <.001). The SPBQ was most strongly associated with the generalised anxiety subscale (r = .60), and most weakly associated with the social anxiety subscale (r = .17).
Conclusions:
The SPBQ is a psychometrically valid tool to assess sensory sensitivities in children on the autism spectrum. Its assessment of the impact, as well as the frequency, of sensory sensitivities makes it particularly useful in a clinical context.

217 **146.217** Tip-Toe Behavior (TTB) Presentation Pattern and Achilles's Tendon Shortening: Are They Related in ASD Children?

***G. Valagussa**, V. Balatti, L. Trentin and E. Grossi, Autism Unit, Villa Santa Maria Institute Neuropsychiatric Rehabilitation Center, Tavernerio, Italy*

Background:
About twenty percent of individuals with ASD walk on their tiptoes. Persistent toe-walking in children with ASD may contribute to secondary motor deformities by producing a shortening of the Achilles's tendon (made up by the soleus muscle SM and gastrocnemius muscle GM). It is not clearly understood why some ASD subjects develop this tendon shortening while others do not. A possible contributing factor could be the amount of time children spend in TTB during the day, i.e. if TTB is present only in running (class 3) or in walking and running (class 2) or in standing, walking and running (class1), three mutually exclusive patterns we described in a previous study.
Objectives:
The aim of this cross-sectional study is to evaluate the relationship between the three TTB presentation patterns described above and the Achilles's tendon shortening.
Methods:
The study includes 69 consecutive children (57 males, 12 females, mean age = 14 years – 3.6 SD) diagnosed with ASD according to the DSM V criteria and under observation at our institute. The severity of ASD was established through ADOS (2nd version). A therapist assessed the presence of Tiptoe behavior (TTB) during standing, walking and running using direct observation and an interview of the main caregiver living with the children. Another therapist assessed both the soleus and gastrocnemius muscles length using a manual goniometer.
Results:
Overall 23/69 children presented TTB. Ten children exhibited it in standing, walking and running (class 1), 8 only during walking and running (class 2) and 5 children only during running (class 3).
There were no significant differences in the mean overall ADOS score of the TTB children according to TTB classes: 20.13 (5.48 SD) no TTB class; 23.90 (5.36 SD) class1, vs 21.13 (4.29 SD) class 2 and vs 23.60 (5.13 SD) class3.
The mean length of the **left GM** of non TTB children was 9.20° (5.18°SD) vs a value of -0.2°(10.16°SD) TTB class 1(p<0.01), vs 6° (2.73°SD) TTB class 2 (p NS) , vs 10.2° (9.92°SD) TTB class 3 (p NS). The mean length of the **right GM** of non TTB children was 9.02° (5.39°SD) vs a value of 1.7°(10.91°SD) TTB class 1(p<0.01), vs 8.75° (4.58°SD) TTB class 2 (p NS), vs 11.6° (4.39°SD) TTB class 3(p NS). The mean length of the **left SM** of non TTB children was 21.07° (7.67°SD) vs a value of 10° (9.65°SD) TTB class 1 (p< 0.05), vs 18.63° (9.90°SD) TTB class 2(p NS), vs 22.80° (6.30°SD) TTB class 3(p NS). The mean length of the **right SM** of non TTB children was 19.33° (6.87°SD) vs a value of 9.7°(8.84°SD) TTB class 1(p <0.05), vs 19.25° (8.26°SD) TTB class 2(p NS), vs 21.8° (6.61°SD) TTB class 3 (p NS).
Conclusions:
The data confirm the existence of a positive relationship between the presence and severity of TTB and the Achilles's tendon shortening, with a significant difference between the NonTTB group and Class 1 TTB group.

	NON TTB children (46 subjects)	TTB class 1 (10 subjects)	TTB class 2 (8 subjects)	TTB class 3 (5 subjects)
Left gastrocnemius	9.20° (5.18°SD)	-0.2°(10.16°SD)	6° (2.73°SD)	10.2° (9.92°SD)
Right gastrocnemius	9.02° (5.39°SD)	1.7°(10.91°SD)	8.75° (4.58°SD)	11.6° (4.39°SD)
Left soleus	21.07° (7.67°SD)	10°(9.65°SD)	18.63° (9.90°SD)	22.80° (6.30°SD)
Right soleus	19.33° (6.87°SD)	9.7°(8.84°SD)	19.25° (8.26°SD)	21.8° (6.61°SD)

218 **146.218** Typology of Temporal Patterns: Identifying Subgroups of Individuals with ASD

***M. S. Goodwin**[1] and H. McGee[2], (1)312 E Robinson Hall, 360 Huntington Ave., Northeastern University, Boston, MA, (2)University of Rhode Island, Kingston, RI*

Background: Technological advances in data acquisition and analytics have increased the feasibility and usefulness of employing idiographic methods in autism research. While there are many advantages to employing an idiographic approach, a major criticism has been lack of generalizability from single subject research to the larger population of interest. This is an especially important issue in Autism Spectrum Disorder (ASD) given the high heterogeneity observed in the population, and fact that important individual differences in data can be obscured by group-level averages.
Objectives: Develop a novel analytic method that combines time series analysis and dynamic cluster analysis (Typology of Temporal Patterns; TTP) to identify subgroups of individuals who share similar longitudinal trajectories, helping address the issue of generalizability in idiographic research in autism research.
Methods: Apply TTP to the assessment of cardiovascular arousal to environmental stressors in individuals with ASD. Data analyses were performed on heart rate (HR) data collected telemetrically from 43 severely affected (*M* IQ = 31) individuals with confirmed diagnoses of ASD (*M* = 14.55 yrs, *SD* = 4.24) during rest and several psychological and physical challenges established in previous studies by Goodwin and colleagues (Goodwin et al., 2004; 2006; Groden et al., 2005). Interrupted time series analysis was performed for each participant to examine individual-level HR patterns across rest and challenge conditions. High variability observed across interrupted time series results demonstrated the presence of subgroups of individuals with similar HR patterns. Accordingly, dynamic cluster analysis was conducted on HR time series data from the 43 participants.
Results: While HR response patterns were generally elevated for all participants (80bpm <), the first cluster analysis revealed a three-cluster solution (Low, Middle, and High) largely dominated by differences in HR level (i.e., mean). Importantly, if only the total sample level average was considered, results suggest that all participants are in the Middle group (denoted by the black line in Figure 1, top panel). A second cluster analysis, focused on shape and scatter of HR patterns, revealed two subgroups (Autonomic

Stabiles and Autonomic Labiles) that differed in their patterns of HR reactivity to stressors and HR recovery during rest conditions. Thus, TTP yielded a combined six-cluster solution defined by level and shape (Figure 1, bottom panel). Following these clustering results, a series of ANOVAs produced statistically significant differences between identified subgroups, even after controlling for age, sex, IQ, verbal ability, medication status, and motor movements.
Conclusions: Our findings provide support for the utility of TTP to evaluate idiographic data at both individual and subgroup levels, and suggest that cardiovascular reactivity is a useful biological marker for identifying meaningful individual differences in the heterogeneous population of ASD. Furthermore, this is the first report of clearly defined ASD subgroups relating to cardiac stability/lability. This variable may represent an important dimension for assessing ANS as an indicator of hypo- or hyper-reactivity to environmental conditions (i.e., not just level and variability, but shape) – a new feature in the DSM-5 symptom description of ASD.

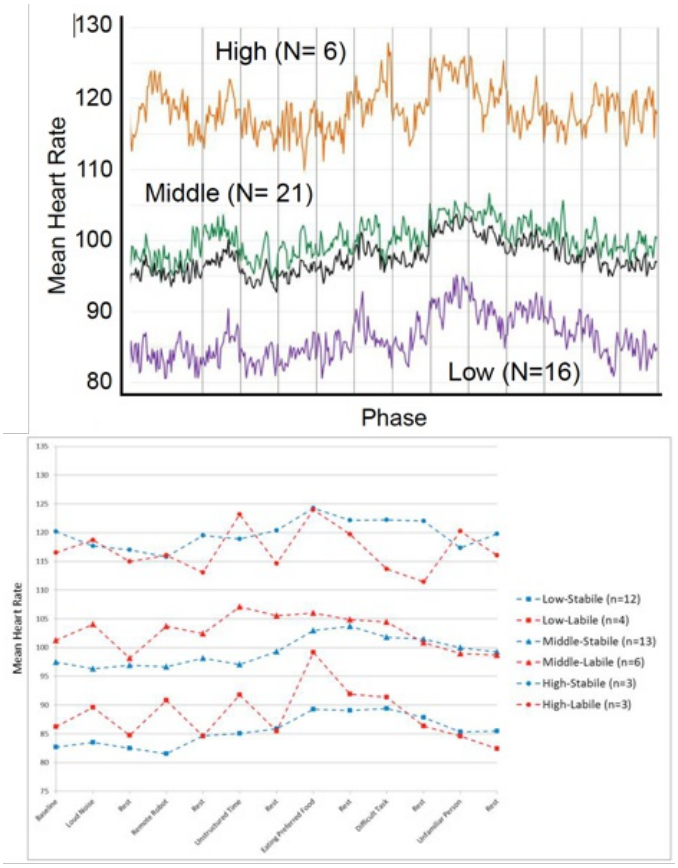


Figure 1. Top Panel: Three-cluster solution based on HR level (black line represents grand mean for total sample, and obscures Low and High Cluster). Bottom Panel: Six-cluster solution based on HR level, shape, and scatter.

219 **146.219** Unusual Sensory Behaviors in Infants at Risk for Autism

A. N. Bhat[1], *H. Van Etten*[2], *M. Kaur*[1], *S. Srinivasan*[1] *and K. R. Dobkins*[3], *(1)University of Delaware, Newark, DE, (2)UCSD Department of psychology, San Diego, CA, (3)Department of Psychology, University of California, San Diego, La Jolla, CA*

Background:
Autism Spectrum Disorder (ASD) is characterized by the presence of social communication deficits as well as restricted and repetitive behaviors (American Psychiatric Association, 2013). Comorbidities in ASD include unusual sensory behaviors (USBs) and this feature has now been incorporated into the DSM 5. To date, little is known about whether USBs can be observed early on in ASD.
Objectives:
In the current study, we employed the Infant/Toddler Sensory Profile (ITSP) parent questionnaire (Dunn, 2002) to track USBs in infants at a High-Risk for developing ASD because they have an older sibling with ASD. Although one previous study has used the ITSP in 12-month-olds (Mulligan & White, 2012), the current study is the first to look at multiple time points in order to gain a more comprehensive view.
Methods:
At two testing sites (University of Connecticut-Storrs and the University of California, San Diego), parents were asked to fill out the ITSP at several time points from 3 to 36 months. The final data sample included 32 High-Risk infants, and for comparison, 39 Low-Risk infants (i.e., infants from families with no history of ASD). The ITSP was used to determine USBs (i.e., outside the "typical" range) within each of the five sensory processing domains (low registration, sensation seeking, sensory sensitivity, sensation avoidance, and low threshold) and five sensation types (auditory, visual, vestibular, tactile, and oral). In our sample, for each domain, we asked whether – at any time point – a child's ITSP score was indicative of USBs, in which case, they were given a score of "1", or else, the child received a score of "0".
Results:
In terms of sensory processing domains, greater proportion of USBs were observed in High-Risk than Low-Risk infants, specifically in the domains of *low registration* (High-Risk=78.1%, Low-Risk=46.2%, x^2 = 41.2, p <.001), *sensation avoidance* (High-Risk=62.5%, Low-Risk=41%, x^2 = 20, p <.001), *and low threshold* (High-Risk= 62.5%, Low-Risk= 41%, x^2 = 20, p <.001). In contrast, *sensation seeking* and *sensory sensitivity* domains showed no group differences. In terms of the various sensation types, greater proportion of USBs were observed in the *auditory* (High-Risk= 68.8%, Low-Risk= 53.8%, x^2 = 9.1, p<.01), *visual* (High-Risk= 71.9%, Low-Risk= 51.3%, x^2 = 17.6, p <.001), *tactile* (High-Risk= 90.6%, Low-Risk= 64.1%, x^2 = 31.6, p<.001), and *vestibular* (High-Risk= 93.8%, Low-Risk= 43.6%, x^2= 101.5, p<.001) sensations. There were no significant differences in oral processing.
Conclusions:
Infants at a High-Risk for ASD showed elevated unusual sensory behaviors compared to Low-Risk infants within multiple sensory processing domains and sensation types. These results have implications for early interventions that target sensory processing abilities in ASD. To be clear, clinicians must screen for USBs in High-Risk infants and address them through appropriate sensori-motor and behavioral interventions.

220 **146.220** What Interests Young Autistic Children? Assessing Object Exploration and Repetitive Behaviors in a Stimulating Play Situation

C. Jacques[1], *V. Courchesne*[2], *A. A. S. Meilleur*[3], *S. Mineau*[4], *S. Ferguson*[5], *D. Cousineau*[6], *L. Mottron, M.D.*[7] *and M. Dawson*[4], *(1)Universite du Quebec en Outaouais, Gatineau, QC, Canada, (2)University of Montreal, Montréal, QC, Canada, (3)Centre d'excellence en Troubles envahissants du développement, Montreal, QC, Canada, (4)Centre d'excellence en Troubles envahissants du développement de, Montréal, QC, Canada, (5)Centre d'excellence en Troubles envahissants du développement, Montréal, QC, Canada, (6)Hôpital Ste-Justine, Montréal, QC, Canada, (7)Centre d'Excellence en Troubles Envahissants du Développement, Montréal, QC, Canada*

Background: Restricted and repetitive behaviors (RRBs) now play a more prominent role in autism diagnosis (APA, 2013), but remain understudied in young children. RRBs in autism range from repetitive movements to intense interests and are targeted in early interventions as barriers to progress (e.g., Rogers & DawsonG. 2010). However, studies in typical children suggest a positive relationship between intense interests and intelligence or expertise (DeLoache et al., 2007; Johnson et al. 2004; Krapp, 2002). Further, there are suggestions that autistics may learn well given access to materials related to their interests (DawsonM et al. 2008; Dunst et al. 2012). Thus one question about young autistic children is whether their repetitive behaviors limit or interfere with their object exploration. Another is whether they are interested only in simple sensory

objects, or are also attracted to more complex materials such as those related to literacy.
Objectives: To document object exploration and repetitive behaviors in young autistic and typical children, during periods of free and semi-free play in the Montreal Stimulating Play Situation (MSPS).
Methods: 53 autistic and 46 typical children were exposed to the MSPS. Autistic children were on average somewhat older (*M*=48.1 months, *SD*=11.5) than typical children (*M*=41.7 months, *SD*=16.0, *p*<0.05) but their mean MSEL composite standard scores (*M*=65.5, *SD*=20.0 vs *M*=110.3, *SD*=17.3, *p*<0.001) and language T-scores (expressive: *M*=25.9, *SD*=11.8 vs *M*=55.6, *SD*=12.7, *p*<0.001; and receptive: *M*=28.8, *SD*=12.8 vs *M*=53.3, *SD*=11.2, *p*<0.001) were dramatically lower. Using Noldus Observer, two naive raters coded 49 previously selected and defined repetitive behaviors in all children. They also coded the use of the 40 objects in the MSPS. 30% of the videos were double coded (K=0.47).
Results: Autistic children displayed a significantly greater overall number (*p*=0.02) and duration (*p*<0.001) of repetitive behaviors than typical children. Three specific repetitive behaviors were found in a greater proportion of autistic children, with higher frequency and greater duration: hand-flapping; arm movements; and the combination of close gaze, waving fingers, and lateral glances; all *p*s<0.05. In contrast, there were no significant differences between groups in duration (*p*=0.71) and frequency (*p*=0.24) of overall object exploration in the MSPS. For specific objects, exploration of mirror balls and books were observed in a greater proportion of autistic children, with higher frequency and longer duration (all *p*s< 0.05); whereas a greater proportion of typical children explored the roller caterpillar and remote-controlled car, with more frequent and longer explorations (all *p*s<0.05). With respect to literacy-related objects, proportion of autistic vs typical children who explored each was as follows: books 17% vs 6%; magnetic letters and numbers 59% vs 53%; picture dictionary 17% vs 17%; and regular dictionary 15% vs 6%.
Conclusions: Our results are preliminary but suggest that increased repetitive behaviors do not interfere with object exploration in young autistic children. In addition, these children showed equal or greater interest in literacy-related objects, in striking contrast to their low MSEL composite and language scores. These findings raise questions about popular assessments and interventions for young autistic children.

Oral Session - 6A
148 - Perinatal Risk Factors
1:45 PM - 2:35 PM - Hall B

1:45 **148.001** Neonatal Inflammation and Autism Risk in a Swedish Birth Cohort

R. M. Gardner[1], *B. Lee*[2,3,4], *H. Karlsson*[1] *and C. Dalman*[1], *(1)Karolinska Institutet, Stockholm, Sweden, (2)Drexel University, Philadelphia, PA, (3)Drexel University School of Public Health, Philadelphia, PA, (4)A.J. Drexel Autism Institute, Philadelphia, PA*

Background: Mounting evidence from both animal and human studies indicates that early life immune function can influence neurodevelopmental outcomes relevant to autism. However, there are few biomarker-based studies of larger birth cohorts.
Objectives: We aimed to measure acute phase proteins in neonatal dried blood spots, as markers of neonatal inflammation, and determine associations with later risk of autism spectrum disorders (ASD).
Methods: We performed a case-control study of 851 ASD cases and 1,132 controls born 1996-2000 in Sweden, with case ascertainment as of December 2011. Blood spots were collected from a central biobank. Nine acute phase proteins were measured using a magnetic bead-based multiplex panel: α-2 microglobulin, C-reactive protein, haptoglobulin, serum amyloid P, procalcitonin, ferritin, tissue plasminogen activator, fibrinogen, and serum amyloid A. We examined logistic regression models of the inflammatory markers adjusted for total protein content, sex of child, maternal age, and birth year. Inflammatory markers were individually examined, as well as combined into an acute phase protein risk score based on ridge regression coefficients.
Results: All neonatal acute phase proteins were moderately to highly correlated, ranging from Spearman correlations of 0.31 (fibrinogen and C-reactive protein) to 0.80 (ferritin and α-2 microglobulin). Higher levels of 6 of the 9 acute phase proteins were individually associated at p < 0.05 with increased risk of ASD in a monotonic fashion. For example, the highest tertile of serum amyloid P had a 1.49 (95% CI: 1.17, 1.90) times higher odds of ASD, compared to the lowest tertile. Factors including maternal hospitalization with infection in the third trimester, low Apgar score, and higher gestational age appeared to be associated with higher levels of the acute phase proteins. A 1 standard deviation increase in the acute phase protein risk score was associated with a 21% increase in odds of ASD, OR: 1.21, 95% CI 1.10-1.33.
Conclusions: Because acute phase proteins are not thought to cross the placenta, the results suggest that the perinatal innate immune system may influence later risk of ASD. We discuss the results in the context of environmental obstetric influences of early life immune function.

1:57 **148.002** Prenatal Maternal Thyroid Antibody, Immune Context and Risk of Autism in a Finnish Prenatal Birth Cohort

K. Cheslack-Postava[1], *H. M. Surcel*[2], *S. Hinkka-Yli-Salomäki*[3], *Y. Bao*[1], *A. Sourander*[3] *and A. S. Brown*[1], *(1)Columbia College of Physicians and Surgeons, New York, NY, (2)National Institute for Health and Welfare, Oulu, Finland, (3)University of Turku, Turku, Finland*

Background: Prenatal maternal autoimmunity has been associated with an increased risk of autism in the offspring, for example through studies showing a higher incidence of autoimmune disease diagnoses in mothers of children with autism versus those of controls. This has not been tested using clinical biomarkers of autoimmune disorders. Additionally, the role of prenatal maternal autoimmunity in relation to autism risk has not been examined in the context of additional biomarkers of immune dysfunction or other potentially related factors.
Objectives: To assess: a) the association between maternal thyroid peroxidase (TPO) autoantibodies in prenatal serum samples and the subsequent diagnosis of childhood autism in the offspring; and b) additional immune related factors that may influence this association.
Methods: The Finnish Prenatal Study of Autism (FIPS-A) is a case-control study nested in a national birth cohort. Cases with childhood autism (ICD-10 F84.0) born from 1987-2005 were identified using national registries and matched with controls by birth date, sex, location of birth, and residence in Finland. Prenatal maternal serum samples from 967 pairs of cases and matched controls were analyzed for thyroid peroxidase antibodies (TPO-Ab), a marker of autoimmune thyroid disease, using a chemiluminescent microparticle immunoassay. Data were analyzed using conditional logistic regression. Stratified analyses were conducted by offspring sex, the presence or absence of intellectual disability in the case, and birth year. Heterogeneity of the association across strata was determined using tests of interaction. We will further test this association in the context of additional immune related factors such as biomarkers of inflammation and exposures/conditions potentially related to inflammation/immune dysfunction.
Results: TPO antibody positivity was associated with a significantly increased odds of autism (OR (95% CI) =1.78 (1.16-2.75)) after adjusting for potential confounders. Log transformed TPO antibody defined as a continuous variable was also positively associated with the odds of autism (OR (95% CI) =1.09 (1.01-1.17)). The association between TPO antibody positivity and autism was stronger for cases without intellectual disability (OR (95% CI) = 2.35 (1.33-4.14)) than for cases with intellectual disability (OR (95% CI) = 1.13 (0.57-2.27)), although the difference between groups was not statistically significant. A lack of association between thyroid hormone levels and autism suggested that altered hormone levels secondary to autoimmunity did not mediate the relationship. We will also present results of analyses assessing the joint role of TPO antibody and additional immune related factors.
Conclusions: These findings provide biomarker-based evidence for the association of prenatal maternal autoimmune thyroid disease with autism. The results suggest that the association may be related to underlying maternal autoimmunity or immune factors rather than thyroid dysfunction. We will also present results on the relationship of maternal inflammation to TPO autoantibodies and whether the association is mediated by inflammation.

2:09 **148.003** Hypertensive Disorders with Placental Insufficiency Associated with Increased Autism and Intellectual Disability Risk

P. Krakowiak[1], *D. J. Tancredi*[2], *G. Xing*[3] *and C. Walker*[4], *(1)2825 50th Street, UC Davis, Sacramento, CA, (2)Pediatrics, UC Davis School of Medicine, Sacramento, CA, (3)Center for Healthcare Policy and Research, University of California, Davis, Davis, CA, (4)MIND Institute, University of California, Davis, Sacramento, CA*

Background: Pregnancies complicated by hypertensive disorders have been linked to poor neurodevelopmental outcomes, such as autism and intellectual disability (ID). Hypertensive disorders can lead to inflammation, vascular damage, and restricted nutrient transfer at the placental level; these physiologic changes may result in aberrant neurodevelopment. Although we have previously investigated preeclampsia and placental insufficiency (PI) in relation to neurodevelopmental outcomes, we were unable to examine the finer categories of hypertensive disorders, including chronic hypertension only and hypertension with superimposed preeclampsia.
Objectives: To determine whether the risk for autism or ID relative to the general population (GP) differed across specific categories of hypertensive disorders and whether the presence of PI changed these associations.
Methods: We used a large population-based cohort of California births from 1991 to 2008 with linked information on autism and ID diagnoses from the California Department of Developmental Services (DDS). Hypertensive disorders were identified by ICD-9-CM codes and grouped into chronic hypertension (HTN), preeclampsia (PE), and HTN with superimposed PE (HTN+PE), and evidence of PI included intrauterine growth restriction, oligohydramnios and/or small-for-gestational-age birthweight. We conducted log-binomial regression models with mutually exclusive categories of hypertensive disorders plus or minus PI as predictors of interest and neurodevelopmental disorders autism and ID as outcomes relative to GP. All models were adjusted for birth year, maternal age, race, delivery payer, and parity to estimate risk ratios (RR) and 95% confidence intervals (CI).
Results: Women with any type of hypertensive disorder had approximately a 20% increased risk for having a child with autism relative to GP. Although PI alone was only modestly associated with autism, the risk for autism increased in relation to these hypertensive disorders in the presence PI: 19% to 32% for HTN and 23% to 35% for PE. HTN+PE was associated with a 39% increased risk for ASD; however, HTN+PE in the presence of PI was not associated with ASD. Associations between hypertensive

disorders and ID were more pronounced. Women with HTN+PE had a nearly 2-fold increased risk for having a child with ID; whereas women with PE or HTN only each had a 1.4-fold increased risk for ID. In contrast to autism, PI alone was associated with a nearly 3-fold increased risk for ID. Similar to autism, the presence PI with any hypertensive disorder elevated the risk for ID: 40% to 214% for HTN+PE; 40% to 214 for HTN, and 31% to 186% for PE.
Conclusions: Risks for autism and especially for ID were increased in fetuses whose mothers had any form of hypertensive disorder during pregnancy, particularly when PI was present. Suboptimal placentation limits oxygen and nutrient transfer creating oxidative stress, growth restriction and progressive hypoxemia. Although the exact causal mechanisms linking hypertensive disorders and adverse neurodevelopmental outcomes are unknown, improved prepregnancy health may help to reduce the likelihood of developing these conditions.

	Autism vs. GP				ID vs. GP			
	crude RR	95% CI	adj RR*	95% CI	crude RR	95% CI	adj RR*	95% CI
Hypertensive disorders								
No HTN/PE [referent]	1.000	--	1.000	--	1.000	--	1.000	--
HTN	**1.517**	**1.403, 1.641**	**1.197**	**1.106, 1.294**	**1.510**	**1.399, 1.631**	**1.435**	**1.329, 1.549**
PE	**1.369**	**1.315, 1.426**	**1.243**	**1.193, 1.295**	**1.344**	**1.291, 1.399**	**1.393**	**1.338, 1.451**
HTN+PE	**1.597**	**1.388, 1.836**	**1.231**	**1.070, 1.415**	**2.073**	**1.840, 2.336**	**1.896**	**1.683, 2.137**
Hypertensive disorders ± Placental insufficiency (PI)								
No HTN/PE or PI [referent]	1.000	--	1.000	--	1.000	--	1.000	--
PI only	**1.078**	**1.044, 1.112**	**1.075**	**1.041, 1.110**	**2.840**	**2.777, 2.904**	**2.839**	**2.775, 2.904**
HTN only	**1.500**	**1.374, 1.636**	**1.188**	**1.089, 1.296**	**1.447**	**1.317, 1.589**	**1.397**	**1.271, 1.534**
HTN + PI	**1.704**	**1.420, 2.045**	**1.320**	**1.100, 1.584**	**3.485**	**3.048, 3.985**	**3.140**	**2.746, 3.590**
PE only	**1.344**	**1.283, 1.409**	**1.225**	**1.169, 1.284**	**1.248**	**1.185, 1.313**	**1.314**	**1.248, 1.383**
PE + PI	**1.500**	**1.383, 1.627**	**1.348**	**1.243, 1.462**	**2.748**	**2.579, 2.928**	**2.861**	**2.685, 3.049**
HTN+PE only	**1.794**	**1.529, 2.106**	**1.392**	**1.186, 1.634**	**1.844**	**1.560, 2.180**	**1.717**	**1.453, 2.030**
HTN+PE + PI	1.216	0.911, 1.622	0.929	0.696, 1.239	**3.623**	**3.042, 4.316**	**3.289**	**2.761, 3.917**

*Adjusted for maternal age, race, delivery payer, parity, and birth year

2:21 **148.004** Diabetes and Hypertension in Pregnancy in Association with Autism Spectrum Disorder in the Child

C. Cordero[1], *G. C. Windham*[2], *M. D. Fallin*[3], *L. A. Croen*[4], *W. Thompson*[5], *L. A. Schieve*[5] *and J. L. Daniels*[6], *(1)The University of North Carolina-Chapel Hill, Carrboro, NC, (2)California Department of Public Health, Richmond, CA, (3)Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD, (4)Division of Research, Kaiser Permanente, Oakland, CA, (5)National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention, Atlanta, GA, (6)University of North Carolina, Chapel Hill, NC*

Background: Previous studies have shown complications of pregnancy, labor, and the neonatal period to be associated with autism spectrum disorder (ASD). However, because specific conditions are relatively rare, multiple conditions of pregnancy have often been examined in aggregate and with inconsistent results. More common complications in pregnancy should be investigated independently.
Objectives: To examine the association between 1) maternal diabetes and 2) maternal hypertension active during pregnancy and the development of ASD in the child.
Methods: Our analysis uses the Study to Explore Early Development (SEED), a multi-site, case-control study. Children born from 2003-2006 were enrolled in SEED at 2 to 5 years of age. Developmental assessment in the clinic was used to classify children into three groups based on presence of ASD (n=702), non-ASD developmental delay (DD; n= 893), or non-ASD controls drawn from the general population (POP; n=982). Mothers who had an active diagnosis of diabetes or a hypertensive disorder during pregnancy were identified from prenatal medical records, maternal interviews, and questionnaires. We examined the associations between diabetes, hypertension, and case status (ASD and DD groups to POP) using adjusted multivariable logistic regression models. We examined the impact of diabetes and hypertension independently, as well as adjusted for the co-occurrence of each condition. Odds ratios were further adjusted (aOR) for maternal age, race/ethnicity, education, smoking during pregnancy, and pre-pregnancy body mass index. Models of hypertension were additionally adjusted for parity and plurality.
Results: From a sample of 2,577, we identified 244 mothers (9.5%) with diabetes and 433 mothers (16.8%) with hypertension in pregnancy. The crude OR=1.32 (95% confidence interval (CI) 0.94, 1.86) for diabetes was attenuated after adjusting for covariates, aOR=0.99 (95% CI 0.68, 1.45). No differences in association were seen between mothers with gestational diabetes (n=199) and preexisting diabetes (n=45). For hypertension, the crude OR=1.71 (95%CI 1.32, 2.23) was attenuated slightly with covariate adjustment, but remained elevated, aOR=1.37 (95% CI 1.02, 1.84). A stronger association was observed for mothers with a preexisting diagnosis of hypertension (n=134) that persisted into pregnancy and ASD relative to mothers without a diagnosis of hypertension (adjusted OR=1.61 [95% CI 1.00, 2.58]. Associations were slightly stronger when comparing DD vs. POP, diabetes aOR=1.22 (95% CI 0.87, 1.71) and hypertension aOR=1.49 (95% CI 1.13, 1.96).
Conclusions: Our results did not show an association between diabetes during pregnancy and ASD in the child. An association was found with hypertension during pregnancy. A stronger association was observed with preexisting hypertension, which may highlight the importance of the early prenatal period in the development of ASD. In general, most associations between mother's conditions and child outcomes were slightly stronger when examining children with a non-ASD developmental delay. Further analysis will be conducted to examine these differences and explore additional factors related to the etiology of ASD.

Oral Session - 6B
149 - Environmental Exposures
2:40 PM - 3:30 PM - Hall B

2:40 **149.001** Air Pollution, Developmental Delays and Autism Spectrum Disorder in the Early Markers of Autism (EMA) Study

B. Park[1], *L. A. Croen*[2], *M. Kharrazi*[3], *M. Pearl*[3], *G. C. Windham*[3], *O. Zerbo*[2] *and* ***H. E. Volk***[4], *(1)Drexel University, Philadelphia, PA, (2)Division of Research, Kaiser Permanente, Oakland, CA, (3)California Department of Public Health, Richmond, CA, (4)Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore,*

MD

Background: Many epidemiologic studies have suggested that air pollutants may play a role in impaired neurodevelopment and more specifically in the etiology of ASD However, it is unclear whether the air pollution effects are ASD-specific or extend to individuals with developmental delays (DD). Studies examining exposures during the gestational period are also needed to better understand the role of air pollution in autism risk.
Objectives: To examine the relationship between prenatal and first year of life air pollution exposure and ASD or DD risk in the Early Markers for Autism (EMA) study.
Methods: This study includes 420 children with ASD, 169 with DD, and 428 general population (GP) controls from a population-based case-control study of pregnant women in San Diego, Orange, and Imperial counties created through the linkage of California birth records, Department of Developmental Services (DDS) records, and the California Prenatal and Newborn Screening Program records. All diagnoses were derived from DDS records and verified by expert medical record review. The maternal residence on the birth certificate and addresses reported during prenatal screening visits were used to estimate exposure for each trimester of pregnancy and first year of life. Regional air pollutant measures (NO_2, PM_{10}, $PM_{2.5}$, Ozone) were based on the Environmental Protection Agency's Air Quality System data and near roadway air pollution (NRAP) estimates from the CALINE-4 traffic dispersion model. Logistic regression models were used to determine the association between estimated air pollutant levels and ASD or DD risk, compared to GP controls. We further examined if this relationship differed among children with ASD and comorbid intellectual disability (ID) (n=184), as compared to GP controls. Models were adjusted for maternal education, method of prenatal payment, and county of birth.
Results: Comparison of the highest and lowest quartiles of the air pollution distribution showed non-statistically significant increased ASD risk for prenatal and first year of life exposure to $PM_{2.5}$, PM_{10}, and NO_2. Analyses with continuous measures of air pollutants during pregnancy or the first year of life showed no significant associations with ASD risk after adjusting for confounders, in particular county of residence at birth. Examination of the subset of children with ASD+ID indicated an increased risk per 2 standard deviation (2 SD) increase in ozone exposure in the first year of life [aOR=1.52 (1.04-2.23) per 6.7 ppb] relative to GP controls. Increasing PM_{10} exposure during the first trimester was significantly associated with DD risk [aOR=2.09 (1.10-4.04 per 16.8 ug/m^3 (per 2SD increase))], after adjusting for all confounders.
Conclusions: Air pollutant exposure may have broad neurodevelopmental effects, which manifest differently across ASD, DD, and ID phenotypes. In contrast to previous studies we did not observe a statistically significant association of air pollutants with ASD risk overall. Differences in case ascertainment, ASD severity, and pollutant exposure range may have affected our results and should be considered in further examinations of geographically-defined exposures for ASD.

2:52 **149.002** PBDE Exposures during Pregnancy and Risk of Autism Spectrum Disorders at 3 Years: Results from the Prospective MARBLES Study

I. Hertz-Picciotto[1], *C. Philippat*[2], *D. J. Tancredi*[3], *D. Bennett*[4], *Y. Lin*[5] *and B. Puschner*[5], *(1)Dept of Public Health Sciences, School of Medicine, UC Davis MIND Institute, Davis, CA, (2)UC Davis MIND Institute, Sacramento, CA, (3)Pediatrics, UC Davis School of Medicine, Sacramento, CA, (4)Public Health Sciences, University of California, Davis, Davis, CA, (5)University of California, Davis, Davis, CA*

Background: Polybrominated diphenyl ethers (PBDE) are flame retardants that were used in consumer products such as electronic devices, construction materials, foam furniture, car seats, and home textiles to reduce their flammability. Both federal and state bans on PBDE mixtures (penta and octa-BDE formulations) were enacted in the early to mid 2000s in response to both evidence that levels in humans were rising and results from toxicologic studies showing adverse neurodevelopmental outcomes in experimental animals. Nevertheless, exposure to PBDE is still widespread in the general population as a result of long half-lives of these compounds and bioaccumulation up the food chain. PBDE can interact with pathways involved in normal brain development, such as thyroid hormone homeostasis and cell signaling.
Objectives: To study the associations between exposure to four prevalent PBDEs during pregnancy and the risk of having a child with Autism Spectrum Disorders (ASD) or other developmental concerns (ODC), which include speech and language delay, hyperactivity, and broader autism phenotype.
Methods: Mothers participating in the ongoing MARBLES (*Markers of Autism Risk in Babies – Learning Early Signs*) Study have previously delivered a child who received an ASD diagnosis, and are either pregnant or planning a pregnancy. Interviews, self-administered questionnaires, and blood specimens are collected at multiple time points from enrollment through the child's 3rd birthday. The child is assessed on various instruments by expert clinicians during study visits at the participant's home (6 and 12 months) and the UC Davis MIND Institute (24 and 36 months). At 36 months these include the Mullen Scales of Early Learning, Vineland Adaptive Behavior Scales, SRS, ADOS, and ADI-R, which are used to assign final diagnoses: ASD (n = 26), ODC (n = 29) or typically developed (TD, n = 77), based on a consensus clinical best estimate from two independent clinicians and, for ASD only, results of the ADOS and ADI-R. We measured four PBDEs using gas chromatography/ mass spectrometry/mass spectrometry, along with lipids in repeated blood samples collected during pregnancy (1 to 3 samples per woman). Adjusted ORs from multiple logistic regression models are reported for a 2 fold increase in PBDE concentrations (ng/g lipids), along with 90% confidence intervals.
Results: PBDEs were detected in 82% to 99% of maternal pregnancy plasma samples. After adjustment for maternal age, body mass index, maternal education and year of birth, PBDE153 trended to be associated with increased risk of ASD (OR = 1.35, 90%CI: 1.00; 1.81). This association was strengthened when we restricted analysis to boys (OR = 1.53, 90%CI: 1.07; 2.18). The number of girls with ASD was too few for separate analysis (n=3). No other PBDE was associated with the risk of ASD (p-values > 0.26) or ODC (p-values > 0.35), compared to TD.
Conclusions: These results from the MARBLES Study indicate PBDE153 is associated with increased risk of ASD, especially among boys. This is, to our knowledge, the first report of an association between clinically confirmed ASD diagnoses, and PBDEs measured prospectively during critical periods during gestation.

3:04 **149.003** Neonatal Thyroid Hormone Levels in Association with Autism Spectrum Disorder

K. Lyall[1], *M. Anderson*[2], *M. Kharrazi*[3] *and G. C. Windham*[3], *(1)A.J. Drexel Autism Institute, Philadelphia, PA, (2)Impact Assessment, Inc., La Jolla, CA, (3)California Department of Public Health, Richmond, CA*

Background:
Thyroid hormones (TH) are critical in early neurodevelopment, but whether neonatal TH levels influence risk of autism spectrum disorder (ASD) is not well-researched.
Objectives:
The goal of this study was to examine whether neonatal levels of thyroxine (T4) and thyroid-stimulating hormone (TSH) are related to risk of ASD, using existing data from California state-wide programs.
Methods:
Program data from California neonatal screening in 1996 and 2002 were linked with live birth certificates and Department of Developmental Services records in order to examine TH levels in association with ASD (defined as ever receiving services for ASD by 2014). T4 and TSH levels were measured in newborn bloodspots as part of routine screening. Mean levels of T4 (measured in 1996) and raw and log-transformed TSH (measured in 2002) were compared between ASD cases and the general population of births from the same years. Binomial regression, using categories of T4 and TSH percentiles separately by year, was used to obtain crude and adjusted risk ratios (RR), adjusting for maternal age, race, education, parity, and child gestational age and gender as well as hours until specimen draw. In addition, a number of stratified analyses were conducted to examine potential effect modification.
Results:
447,059 singleton births from 1996 and 446,424 from 2002 were used in these analyses, including 4,818 ASD cases. ASD cases had significantly lower mean levels of T4 than those of comparison births. Individuals in the lowest 5th percentile of T4 levels (<9.3ug/dl) had modestly increased risk of ASD, an association that was no longer significant in primary adjusted analyses (RR 1.13, 95% 0.93-1.37). This association appeared stronger in certain subgroup analyses, including those with advanced maternal age (≥35 years; RR 1.43, 95% CI 0.96, 2.12), those with Cesarean deliveries (RR= 1.35, 95% CI 0.94, 1.94), and in particular, those with blood drawn ≥24 hours after birth (RR=1.46, 95% CI 1.11, 1.91), after which TH levels become more stable. No significant associations were found with TSH levels and ASD in primary crude or adjusted analyses, though a significant reduction in risk was seen for those in the highest percentile (≥95thpercentile, corresponding to ≥1.05 log-transformed concentration) of TSH for those with Cesarean deliveries (RR=0.56, 95% CI 0.32, 0.96). No other subgroups demonstrated significant associations with TSH levels and ASD.
Conclusions:
Results from this large, population-based study did not suggest strong associations between neonatal TH and ASD, but individuals with the lowest T4 levels may have modest increases in risk of ASD.

3:16 **149.004** Maternal Plasma Folate, Vitamin B12 Levels and Multivitamin Supplement during Pregnancy and Risk of Autism Spectrum Disorders in the Boston Birth Cohort

R. Raghavan[1], *A. Riley*[2], *D. M. Caruso*[3], *X. Hong*[4], *G. Wang*[2], *B. Ajao*[5], *J. Zhang*[6], *Y. Ji*[2], *M. Li*[7], *H. He*[2], *Z. Chen*[2], *M. C. Wang*[2], *C. Pearson*[8], *L. K. Hironaka*[8], *L. Sices*[8], *M. D. Fallin*[9] *and X. Wang*[10], *(1)Center on Early Life Origins of Disease, Population, Family and Reproductive Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (2)Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (3)Center on the Early Life Origins of Disease, Department of Population, Family, Reproductive Health, JHBSPH, Baltimore, MD, (4)Johns Hopkins University School of Public Health, Baltimore, MD, (5)Population, Family and Reproductive Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (6)Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (7)Johns Hopkins School of Public Health, Baltimore, MD, (8)The Boston University Medical Center, Boston, MA, (9)Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD, (10)Center on Early Life Origins of Disease, Department of Population, Family, Reproductive Health, JHBSPH, Baltimore, MD*

Background: The role of preconception/prenatal nutrition in the development of Autism Spectrum Disorder (ASD) is under-studied. Folate deficiency is a well-recognized risk factor for neural tubal defects. For this reason, universal cereal grain fortification of folic acid, synthetic form of folate, has been implemented in the U.S. since 1998 and

pregnant women are advised to take multivitamin supplements. While some studies have suggested that mothers' periconceptional multivitamin use, dietary folic acid intake and/or folic acid supplementation are associated with a decreased risk of ASD in their children, others have suggested the opposite effect. Most previous studies were based on maternal self-report of vitamin intake. Only a few have simultaneously examined the relationships using self-report and biomarker data and inconsistencies have been reported. Uncertainty remains whether excess folate and other B-vitamin exposure during critical gestational periods can adversely affect neurodevelopment.
Objectives: To understand the relationship between maternal multivitamin supplementation during pregnancy and maternal plasma biomarkers of folate and vitamin B12 measured 24-72 hours after delivery and risk of later ASD in children.
Methods: Data are from the Boston Birth Cohort, an ongoing longitudinal prospective birth cohort study that recruited low-income urban, primarily minority mother-offspring pairs (n=1,391) at the Boston Medical Center and followed them from birth through childhood between 1998-2013. Using electronic medical records, children ever diagnosed with autism, Asperger syndrome and/or pervasive developmental disorder not otherwise specified were categorized as having ASD (n=107); those without ASD, ADHD, intellectual and developmental disabilities constituted 'typical' group (n=1284). Cox proportional hazard regression was used to account for differential follow-up time and pertinent covariates were adjusted.
Results: Maternal multivitamin supplement of 3-5 times/week was associated with significantly lower risk of ASD in offspring across all trimesters (adjusted hazard ratio (HR): 0.33, 0.38 and 0.43 for 1st, 2nd and 3rd trimesters respectively) (Table 1). However, when maternal plasma folate and vitamin B12 levels were analyzed as exposure variables, high levels of maternal vitamin B12 (>600 pmol/L) were associated with significantly increased risk of ASD (HR: 3.01; 95% CI: 1.64 – 5.52; p value: 0.001). High maternal folate levels (>59 nmol/L) were also associated with increased risk of ASD (HR: 2.27; 95% CI: 1.26 – 4.09; p value: 0.007). The risk was greatest for those children whose mothers had both high plasma folate (>59 nmol/L) and vitamin B12 (>600 pmol/L) (HR: 17.59; p value: <0.001) (Table 2).
Conclusions: In this urban low-income minority birth cohort, we observed an elevated risk of ASD associated with high maternal plasma folate levels (>59 nmol/L), which far exceeds the excess cutoff suggested by the WHO (>45.3 nmol/L). Excess maternal vitamin B12 (>600 pmol/L) was also shown to be associated with greater ASD risk in offspring. The risk of ASD was highest if mothers had both excess in folate and B12 levels. Our findings warrant additional investigation and highlight the need to identify optimum prenatal folate and vitamin B12 levels that maximize health benefits, at the same time minimize the risk of excess and its associated adverse consequences such as ASD.

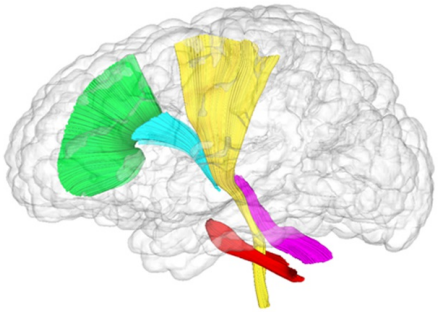
Oral Session - 7A
150 - White Matter Development in ASD
1:45 PM - 2:35 PM - Room 307

1:45 **150.001** White Matter Development in Infancy Predicts Repetitive Behavior and Sensory Features

J. J. Wolff[1], *M. R. Swanson*[2], *J. T. Elison*[1], *H. C. Hazlett*[3], *J. R. Pruett*[4], *R. T. Schultz*[5], *M. D. Shen*[2], *C. Vachet*[6], *L. Zwaigenbaum*[7], *J. Piven*[2] *and .. The IBIS Network*[2], *(1)University of Minnesota, Minneapolis, MN, (2)University of North Carolina at Chapel Hill, Chapel Hill, NC, (3)Carolina Institute for Developmental Disabilities, University of North Carolina at Chapel Hill, Chapel Hill, NC, (4)Washington University School of Medicine, Saint Louis, MO, (5)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (6)University of Utah, Salt Lake City, UT, (7)University of Alberta, Edmonton, AB, Canada*

Background: Restricted and repetitive behaviors are early emerging (Wolff et al., 2014) and possibly prognostic features (Lord et al., 2006) of autism spectrum disorder (ASD). Recent changes to diagnostic criteria include for the first time unusual responses to sensory stimuli as part of the restricted and repetitive behavior domain despite a lean body of literature supporting this conceptual grouping. To date, little is known about the neurobiology underlying the development of these features of ASD early in life, with the vast majority of published work focused on older children, adults, or adult non-human animal models (see Langen et al, 2011, for a review).
Objectives: To investigate the development of specific white matter pathways in relation to emerging repetitive behaviors and sensory features in infants who developed ASD.
Methods: Diffusion tensor imaging data were collected longitudinally from high-risk infant siblings at ages 6, 12, and 24 months during natural sleep as part of an ongoing study. The present sample includes 44 infant siblings meeting clinical best-estimate criteria for ASD at age 2 years. Cognitive and behavioral data, including the Repetitive Behavior Scales, Revised (Bodfish et al., 2001) and the Sensory Experiences Questionnaire, v2.1 (Baranek et al., 2009) were collected at age 2. Five white matter fiber pathways of interest (see **Figure 1**) were selected on the basis of previous empirical or conceptual work (e.g. Kern 2002; Langen et al 2014; Pierce et al. 2001; Wolff et al. 2015). Pathways were deterministically segmented in common atlas space (see Verde et al. 2014) and microstructure characterized by fractional anisotropy (FA), a measure reflecting magnitude of diffusion based on tensor shape. The relationships between FA development and repetitive behavior/sensory features were examined using generalized estimating equations controlling for sex and age.
Results: Repetitive behaviors and sensory features were strongly correlated ($r = .74$, $p < .001$) and this relationship held when controlling for social symptom severity and IQ. Development of the genu from 6 to 24 months of age significantly predicted repetitive behaviors and sensory features. The mid- and superior- cerebellar peduncles also significantly predicted both repetitive behavior and sensory features. Development of striatal pathways (ATR, CST) was not significantly associated with these behaviors (see full results in **Table 1**). To determine the specificity of our findings, we next examined whether development of targeted pathways predicted social symptom severity as indexed by the ADOS. This analysis yielded no significant results ($p \geq 0.20$).
Conclusions: Our findings suggest that 1) restricted and repetitive behaviors and sensory features co-occur in toddlers with ASD; and 2) share a common relationship with underlying neural circuitry. We specifically identified that these core features of autism are predicted by the structural development of callosal and cerebellar white matter pathways over the first two years of life, suggesting a possible shared mechanism unique to infancy. These brain-behavior relationships were strikingly specific given the absence of any association between targeted pathways and social symptom severity.

Figure 1. Targeted white matter fiber pathways.



green = genu of corpus callosum
yellow = cortico-spinal
blue = anterior thalamic radiation
pink = superior cerebellar peduncle
red = mid-cerebellar peduncle

Table 1. Longitudinal model results for fractional anisotropy (FA) of targeted white matter pathways across 6, 12, and 24 months and repetitive behavior (RBS-R) and sensory features (SEQ) at age 2.

	Total RBS-R		Total SEQ	
Pathway	χ^2	p	χ^2	p
ATR FA	2.9	0.09	0.7	0.40
CST FA	0.6	0.44	0.0	0.91
Genu FA	9.0	0.003	4.5	0.033
MCP FA	8.5	0.004	8.2	0.004
SCP FA	11.2	0.001	5.5	0.019

RBS-R = Repetitive Behavior Scales, Revised; SEQ = Sensory Experiences Questionnaire v2.1
ATR = anterior thalamic radiation; CST = cortico-spinal tract; SCP = superior cerebellar peduncle; MCP = midcerebellar peduncle

1:57 **150.002** Structural Abnormalities in Corpus Callosum Fibers during Early Autism Development

N. Fingher[1], *I. Dinstein*[2], *M. Ben-Shachar*[3], *S. Haar*[1], *A. M. Dale*[4], *L. T. Eyler*[5], *K. Pierce*[6] *and E. Courchesne*[6], *(1)Cognitive and Brain Sciences, Ben Gurion University, Beer Sheva, Israel, (2)Psychology, Ben Gurion University, Beer Sheva, Israel, (3)Linguistics, Bar Ilan University, Ramat Gan, Israel, (4)Radiology, University of California San Diego, La Jolla, CA, (5)Psychiatry, University of California San Diego, San Diego, CA, (6)Neuroscience, UCSD Autism Center of Excellence, La Jolla, CA*

Background: It has been hypothesized that abnormalities in the development of the corpus callosum (CC) may be a common characteristic of many individuals with autism. This hypothesis, however, has rarely been tested during early stages of autism development, in infants and toddlers. Furthermore, previous diffusion tensor imaging (DTI) studies have subdivided the CC roughly into two or three segments without determining the cortical projections of the fibers in each segment. A more detailed examination of

CC development, which takes into account the projection of CC fibers into specific cortical areas, is critical for determining which inter-hemispheric connections develop abnormally in autism and for revealing the nature and timing of abnormalities in each fiber group.
Objectives: To determine the nature and developmental timing of potential abnormalities in specific inter-hemispheric CC tracts of 1-4 year old toddlers with autism.
Methods: We examined DTI scans from 68 toddlers with autism and 29 toddlers with typical development. All toddlers were 1-4 years old during the MRI scan and underwent thorough behavioral assessments including ADOS, ADI, Mullen, and Vineland tests. The DTI protocol was a single-shot, echo-planar diffusion-weighted sequence that was applied along 51 diffusion directions in fifty 2.5mm thick axial slices (±10, depending on head size) with in-plane resolution of 1.875 x 1.875 mm and b-value of 1000 sec/mm^2. Toddlers who were under the age of 2.5 years old returned for a second visit to establish a final diagnosis and assess potential changes in symptom severity. DTI analyses were performed using the Automated Fiber Quantification toolbox, which utilizes a deterministic tractography algorithm to identify seven CC fiber tracts according to their cortical projections in the native space of each subject. The different diffusion properties were then compared across groups in each of the tracts.
Results: Younger (<2.5 years old), but not older (> 2.5 years old) toddlers with autism exhibited abnormally high fractional anisotropy and low mean, radial, and axial diffusivity values in the CC tracts connecting occipital, temporal, mid-frontal, and anterior-frontal areas (t-test, $p<0.05$ in all cases, FDR corrected). Furthermore, *early* diffusion measures in the temporal CC tract of the young toddlers were correlated with outcome measures of autism severity at *later* ages.
Conclusions: We suggest that abnormally low diffusivity values, which indicate that water diffusion is more restricted in the CC of young toddlers with autism, may be due to an overabundance of small caliber axons as predicted by the early overgrowth and excess neuron theories of autism. These findings reveal critical details regarding the nature, timing, and location of CC abnormalities in early autism development and add to accumulating evidence which suggests that poor inter-hemispheric connectivity in the first years of life is a hallmark of the disorder.

2:09 **150.003** Longitudinal Development of White Matter in Autism Spectrum Disorder

D. C. Dean[1], *B. G. Travers*[2], *N. Adluru*[1], *D. Tromp*[1], *D. Destiche*[1], *A. Freeman*[1], *B. A. Zielinski*[3], *M. D. Prigge*[4], *J. S. Anderson*[5], *E. D. Bigler*[6], *N. Lange*[7], *A. L. Alexander*[1] *and J. E. Lainhart*[1], *(1)Waisman Center, University of Wisconsin-Madison, Madison, WI, (2)Occupational Therapy Program in Kinesiology, University of Wisconsin Madison, Madison, WI, (3)Pediatrics and Neurology, University of Utah, Salt Lake City, UT, (4)Pediatrics, University of Utah, Salt Lake City, UT, (5)University of Utah, Salt Lake City, UT, (6)Psychology/Neuroscience Center, Brigham Young University, Provo, UT, (7)McLean Hospital, Cambridge, MA*

Background: Increasing evidence has suggested autism spectrum disorder (ASD) to be a disorder of impaired brain connectivity, and in particular, microstructural alterations of underlying white matter (see Travers et al. 2012 for review). In particular, diffusion tensor imaging (DTI) has been influential to the study of white matter alterations in ASD, while recent evidence has implicated aberrant development of specific white matter regions in association with ASD. These region of interest studies impart great insight into the neurobiological changes of white matter in ASD, however, it is unclear the magnitude and extent of such alterations across the whole brain. To assess this, we can examine and longitudinally model developmental change at the voxel-level. Understanding these specific white matter network “signatures” at the group and individual levels may help us better determine meaningful subgroups within the autism spectrum.
Objectives: We examined and characterized the developmental changes of DTI parameters across the brain in a large, longitudinal sample of ASD and and typically developing (TD) individuals. We specifically compared the developmental trajectories of FA, MD, RD, and AD between TD and ASD individuals.
Methods: *MRI Acquisition*: Participants for this study consisted of 100 males with ASD and 57 age-matched males with typical development (TD) between 3 and 39 years of age. A total of 434 (287 ASD, 147 TD) longitudinal DTI datasets were acquired. Images were corrected for distortion and head motion and maps of fractional anisotropy (FA), mean diffusivity (MD), and radial diffusivity (RD) were calculated. Images were subsequently aligned to a population-specific template using DTI-TK. *Analysis:* Developmental changes of diffusion parameters (i.e. FA, MD, RD) of the brain were modeled using a semi-parametric approach with penalized smoothing splines. This modeling was performed at the voxel-scale, creating statistical maps of developmental changes across the brain. Results were subsequently corrected for multiple comparisons using the false discovery rate.
Results: Across white matter, the group with ASD had significantly different developmental trajectories ($p<0.05$, FDR corrected) than the group with typical development (Fig 1). In particular, trajectory differences of FA were observed in genu of the corpus callosum, bilateral posterior limb of the internal capsule, cortical spinal tract, superior longitudinal fasciculus and inferior fronto-occipital fasciculus (Fig. 1A). While overlapping MD trajectory differences were found in the internal capsules, widespread and distinct MD trajectory differences were also observed (Fig 1B).
Conclusions: Longitudinal studies have traditionally focused on examining developmental differences within predefined brain regions. However, this has the potential of masking subtle changes within a particular brain region. By utilizing a voxel-wise mixed-effect modeling approach, our findings reveal the developmental trajectory of white matter to differ between ASD and TD across much of the brain. While these findings agree with the literature of white matter microstructure alterations in ASD, they also raise questions about the behavioral processes involved with these alterations as well as the specific neurobiological mechanisms underlying these changes.

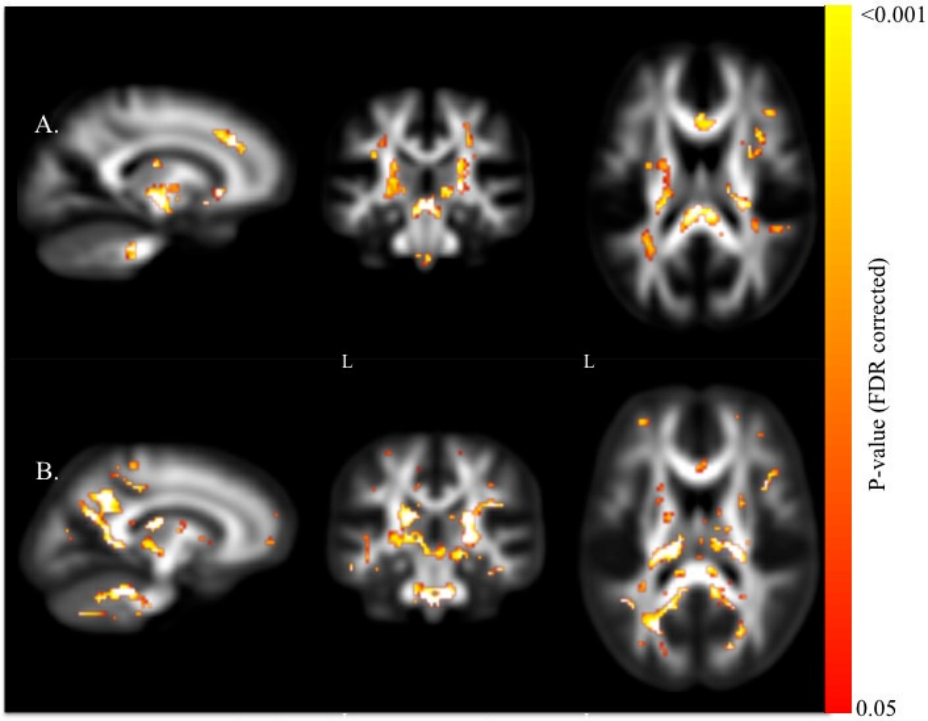


Figure: Representative views of significant ($p<0.05$, FDR corrected) age x group interactions, demonstrating altered areas of altered developmental trajectory between ASD and TD individuals. **A**. Trajectory differences of FA were observed across the internal capsules, genu and splenium of the corpus callosum. **B**. Trajectory differences of MD were also observed to be different in the internal capsules between ASD and TD groups, while also having widespread differences in the thalamic radiations, cerebellum, and optic radiations.

2:21 **150.004** White Matter Microstructure in Youth with a History of Autism Spectrum Disorder Who Have Achieved an Optimal Outcome

B. Castelluccio[1], *M. Stevens*[2,3], *I. M. Eigsti*[1], *R. T. Schultz*[4], *L. Naigles*[1], *E. A. Kelley*[5] *and D. A. Fein*[6], *(1)University of Connecticut, Storrs, CT, (2)Olin Neuropsychiatry Research Center, Hartford, CT, (3)Psychiatry, Yale University School of Medicine, New Haven, CT, (4)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (5)Queen's University, Kingston, ON, Canada, (6)Psychology, University of Connecticut, Storrs, CT*

Background: A minority of persons with an autism spectrum disorder (ASD) lose the symptoms, a phenomenon referred to as an "optimal outcome" (OO). Ongoing research is revealing clinical differences between OO and ASD youth, but the neural basis of the phenomenon is currently unknown. One functional MRI investigation of language comprehension in a sample that overlaps with the current study found evidence of compensatory functional activation and residual ASD-like activation patterns, but no evidence of normalization toward the activation patterns of typically developing (TD) comparison participants. This suggests an equifinality model, in which multiple neurodevelopmental pathways yield similar behavioral outcomes. There has not yet been an attempt to uncover neurostructural differences that facilitate or characterize OO. Given the prominence of white matter atypicalities in ASD and the emergence of a disconnection model of ASD (e.g. Belmonte et al., 2004, *J. Neuroscience*), the current study investigated white matter microstructure in OO.

Objectives: This study evaluated white matter tract microstructure in OO youth to determine whether it differed from those with ASD and TD.

Methods: Three age- and IQ-matched groups comprised 14 typically developing, 22 high functioning ASD (HFA), and 11 youths with a well-established early childhood history of an ASD who no longer met diagnostic criteria (OO). Participants underwent magnetic resonance diffusion tensor imaging (DTI). Data were subjected to strict screening for head motion, leading to exclusion if more than 10% of motion estimates for any image was greater than one voxel length. One OO and two HFA participants were excluded on this basis. A tract-based spatial statistics analysis was implemented using Functional MRI of the Brain Software Library (FSL) tools. Whole-brain three-group ANOVAs were conducted to compare fractional anisotropy (FA), radial diffusivity (RD), and axial diffusivity (AD). Post-hoc pairwise comparisons were evaluated on tracts with positive findings.

Results: FA differences did not survive correction for multiple comparisons. Uncorrected findings showed differences in multiple cortical association tracts. The TD group had the highest FA, followed by the HFA group. The OO group had the lowest FA of the three groups in multiple tracts. These FA differences were driven by RD differences, which appropriately showed the opposite pattern. The OO group had the greatest RD, followed by HFA and TD. There were no group differences in AD.

Conclusions: The presence of white matter microstructural differences in OO raises the possibility that these characteristics contribute to achievement of OO. Lower FA and greater RD in OO youth may represent plasticity mechanisms that facilitated movement off the spectrum. Provided they can be replicated, these findings can guide future research seeking to understand the relationship of white matter structure to OO. The findings converge with prior functional MRI work to support a model in which movement off the spectrum involves compensation rather than normalization.

Table 1. Group differences in white matter microstructure.

Tracts with Group Differences in FA by ANOVA	Post-hoc Comparisons
R hippocampal cingulum	TD, HFA > OO
L inferior longitudinal fasciculus	TD > HFA > OO
R inferior longitudinal fasciculus	TD, HFA > OO
L superior longitudinal fasciculus	TD, HFA > OO
R superior longitudinal fasciculus	TD > HFA > OO
L cingulum	TD > HFA > OO
R cingulum	TD, HFA > OO
L forceps major	TD > HFA > OO

Tracts with Group Differences in RD by ANOVA	Post-hoc Comparisons
L corticospinal tract	OO > HFA, TD
R corticospinal tract	OO > HFA, TD
L anterior thalamic radiations	OO > HFA, TD
R anterior thalamic radiations	OO > HFA, TD
L inferior longitudinal fasciculus	OO > HFA > TD
R inferior longitudinal fasciculus	OO > HFA, TD
L inferior fronto-occipital fasciculus	OO > HFA > TD
R inferior fronto-occipital fasciculus	OO > HFA, TD
L superior longitudinal fasciculus	OO > HFA, TD
R superior longitudinal fasciculus	OO > HFA, TD
R uncinate fasciculus	OO > HFA, TD
R forceps minor	OO > HFA, TD
Corpus callosum body	OO > HFA, TD

Note: Results did not survive correction for multiple comparisons. Results shown are $p<.05$ (uncorrected). FA= fractional anisotropy; RD= radial diffusivity; L=left; R=right. TD= typically developing; HFA = high functioning autism; OO= optimal outcome.

151 - Brain Connectivity and neural networks in ASD

2:40 PM - 3:30 PM - Room 307

2:40 **151.001** Dysfunctional Brain Communities in Autism

A. Venkataraman[1], *D. Yang*[2], *K. Pelphrey*[2] *and J. S. Duncan*[1,3], *(1)Diagnostic Radiology, Yale University, New Haven, CT, (2)Yale Child Study Center, Yale School of Medicine, New Haven, CT, (3)Biomedical & Electrical Engineering, Yale University, New Haven, CT*

Background: Univariate analyses of fMRI activation patterns have allowed us to localize group-wise functional differences. However, there is increasing evidence that autism reflects distributed impairments across multiple brain systems. These findings underscore the importance of network-based methodologies for fMRI data. In accordance, community detection is the process of identifying highly interconnected subgraphs within a larger network. These regions often share common properties and are crucial to understanding complex neurodevelopmental processes, such as those induced by autism.

Objectives: We develop a novel probabilistic framework to extract both hyper- and hypo-synchronous functional communities from task fMRI data. Our approach differs from prior literature in three ways. First, we propose a unified Bayesian model that describes the relationship between population templates and individual subject observations. Second, we perform community detection in the space of group-level functional *differences*, which allows us to identify both heighted and reduced synchrony. Finally, we use a clustering framework to simultaneously detect multiple abnormal communities of varying type.

Methods: Our model assumes that the altered whole-brain functional synchrony associated with autism can be explained by K non-overlapping communities. Each community is associated with a binary label that indicates either a hyper- or hypo-synchronous subgraph. We use multinomial variables to represent the latent functional synchrony within each population. Empirically, we find that three states (low, medium and high) best capture the dynamic range and variability in our fMRI dataset. The fMRI metrics are modeled as noisy Gaussian observations of the underlying latent structure. We apply our model to an fMRI study of social perception in autism. The dataset consists of 72 high-functioning autistic children and 43 age-matched ($p > 0.124$) and IQ-matched ($p > 0.122$) neurotypical controls. The experimental paradigm features coherent and scrambled point-light animations. The coherent biological motion depicts a point-light figure performing movements relevant to early childhood experiences, and the scrambled animations combine random trajectories from the coherent displays.

Results: Our model identifies a hyper-synchronous community that concentrates in the left superior temporal sulcus, the visual cortex and the somatosensory cortex. Concurrently, we detect a hypo-synchronous community that localizes to the bilateral ventral prefrontal cortex, insula, posterior cingulate, caudate and amygdala. The corresponding network diagram reveals increased synchrony between temporal and occipital nodes and reduced synchrony between the frontal and parietal nodes. Consistent with neurocognitive findings, these results suggest hyper-functionality in a visual perception network; individuals with autism tend to outperform their neurotypical peers in such tasks. In contrast, the hypo-synchronous circuits include regions that are well known for their role in social cognition and the high-level interpretation of social stimuli. A comparison with the Neurosynth meta-analytic database (www.neurosynth.org) also exposes a clear functional distinction between the two communities.

Conclusions: Our novel Bayesian framework for fMRI community detection in autism retrieves key networks associated with autism. Unlike prior methods, we explicitly model multivariate *differences* in the global functional organization of the brain. Subsequent decoding via Neurosynth confirms the clinical validity of our results within the neuroimaging literature.

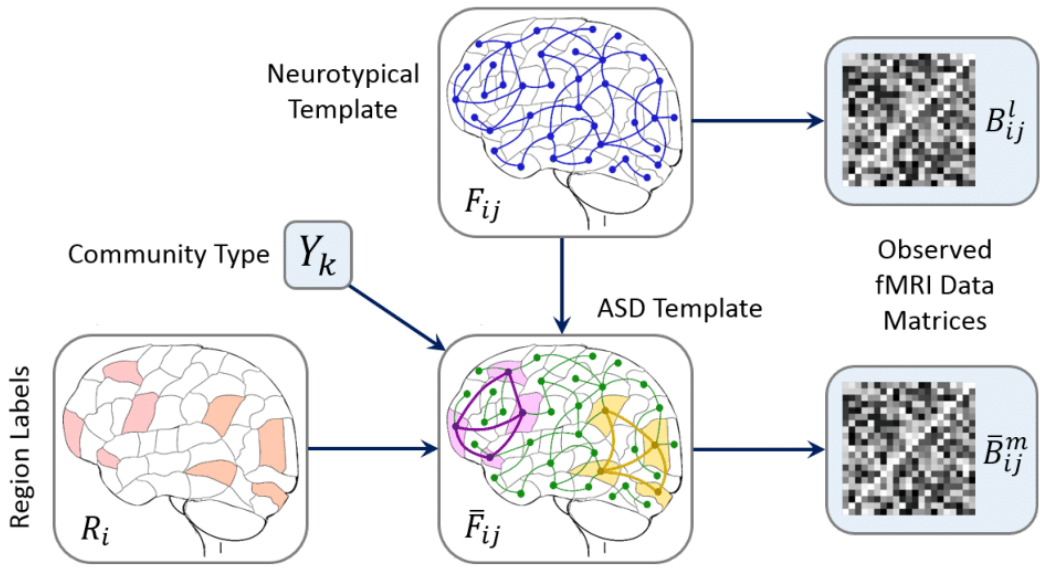


Figure 1: Hierarchical model of community structure for $K = 2$. The label R_i indicates whether region i is healthy (white) or whether it belongs to one of the two abnormal communities (red). The binary variable Y_k denotes either a hyper-synchronous or hypo-synchronous subgraph k. The neurotypical template $\{F_{ij}\}$ provides a baseline functional architecture for the brain, whereas the clinical template $\{\bar{F}_{ij}\}$ describes the latent organization of ASD. The green connections $\langle i, j \rangle$ are unchanged from baseline; the purple and yellow lines signify heightened and reduced synchrony, respectively. Each template generates a set of subject observations $\{B^l_{ij}\}$ and $\{\bar{B}^m_{ij}\}$ for the group.

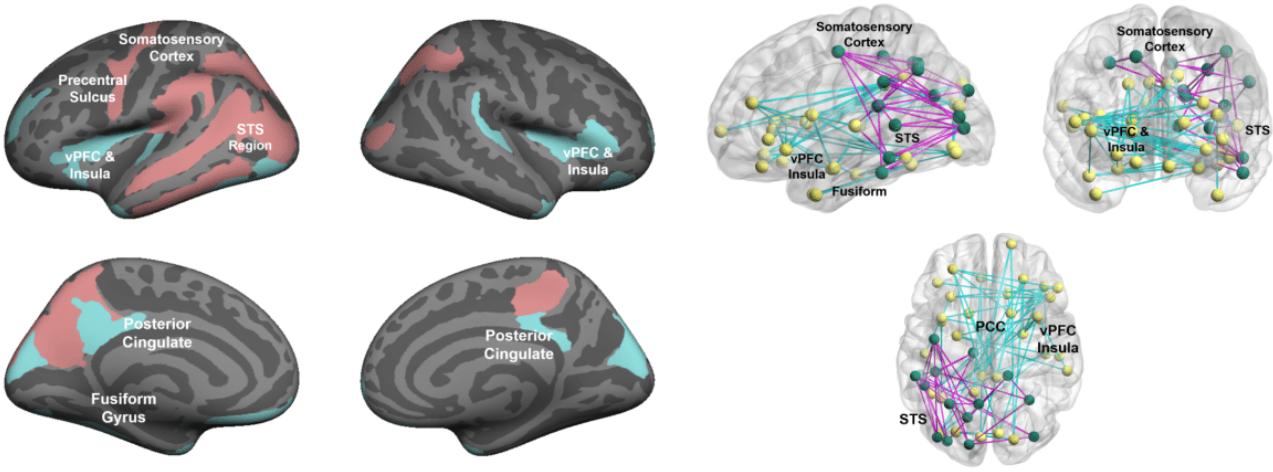


Figure 2: Abnormal functional communities inferred by our Bayesian model for $K = 2$. **Left:** Region membership in each community. Red indicates hyper-synchrony, and blue areas delineate hypo-synchronous activity. **Right:** Estimated network of abnormal functional synchrony. Nodes correspond to regions within each community. Blue lines signify reduced functional synchrony in ASD across the paradigm; magenta lines denote increased functional synchrony in ASD.

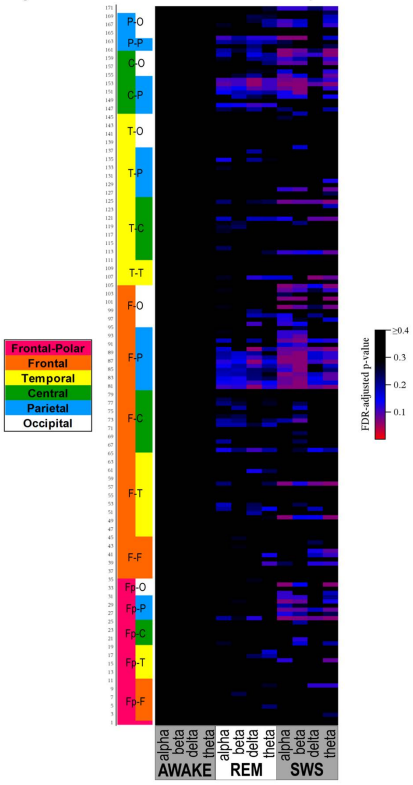
2:52 **151.002** Differences in EEG Coherence Between ASD and Typical Development Are State-Dependent

A. W. Buckley[1], *C. Farmer*[1], *R. Scott*[2], *A. Tyler*[2], *J. M. Mahoney*[2], *S. Burroughs*[2], *G. Holmes*[2], *S. E. Swedo*[1] *and A. Thurm*[1], *(1)Pediatrics and Developmental Neuroscience Branch, National Institute of Mental Health, Bethesda, MD, (2)University of Vermont College of Medicine, Burlington, VT*

Background: The role of sleep in the proper maturation of the developing brain is an area of current intense interest, with the contribution of state-specific processes to synaptic refinement just beginning to be understood. There is increasing evidence of altered brain connectivity in autism, however, the vast majority of ASD coherence studies are not performed during sleep, and taken as a whole, show very mixed results.
Objectives: The aim of the present study was to compare connectivity in children aged 2 to 6 years with ASD (n=87) to that of typically developing controls (TYP; n=29).
Methods: Digital EEGs were recorded during the fully awake, drowsy, and sleep states using the 10–20 System of Electrode placement (Figure 2). Ten minute segments of awake, slow wave sleep, and rapid eye movement sleep were selected for analysis. Analysis was performed masked to participant diagnosis using Neuroguide software. Coherence values were subjected to Fisher-transformation for statistical analysis. Differences in mean coherence and phase lag between groups were assessed using the general linear model, controlling for age.
Results: Significantly increased coherence was observed in ASD relative to TYP, concentrated in the frontal-parietal pairs (Figure 1). Significantly decreased phase lag, particularly in long-distance pairs, was also observed in ASD relative to TYP (Figure 2). Strikingly, these differences were found exclusively during sleep, most commonly during slow wave sleep. No differences in coherence or phase lag were observed during the awake state.

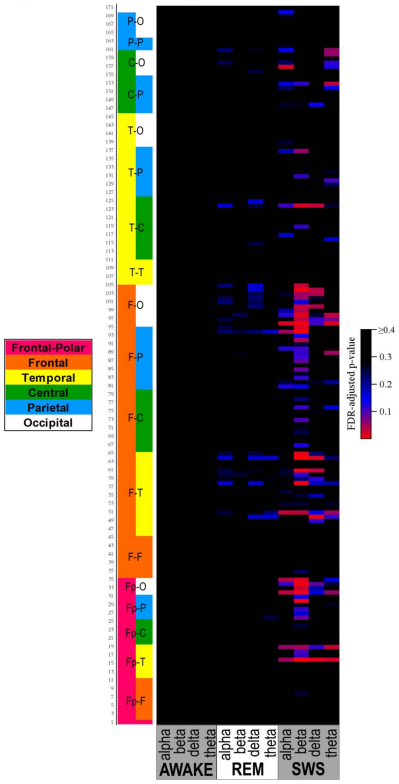
Conclusions: Evaluation of brain connectivity during sleep is extremely important, as the sleep EEG reflects the maturation of the brain and allows for examination of dynamic neural networks in the absence of external stimuli. Future attempts to classify developmental disorders by using differences in connectivity must take into account brain state.

Figure 1. Increased EEG coherence in ASD compared to TYP is concentrated in SWS



Note: Row axis refers to the lead pair; abbreviations are explained in the left legend. Pairs are numbered but specific pair names are omitted due to space constraints. All differences reflect increased coherence in ASD. REM=rapid eye movement, SWS=slow wave sleep.

Figure 2. Decreased phase lag in ASD compared to TYP is concentrated in SWS



Note: Row axis refers to the lead pair; abbreviations are explained in the left legend. Pairs are numbered but specific pair names are omitted due to space constraints. All differences reflect decreased phase lag in ASD. REM=rapid eye movement, SWS=slow wave sleep.

3:04 **151.003** Functional Connectivity Scanning in Minimally-Verbal Children with ASD

M. South[1], *T. P. Gabrielsen*[1], *B. Hansen*[2], *R. Kellems*[2], *E. Anderberg*[1], *K. G. Stephenson*[1], *L. Peacock*[1], *A. Ward*[1], *C. J. Kipp*[1], *M. D. Prigge*[3], *R. A. Lundwall*[1], *B. A. Zielinski*[4], *P. T. Fletcher*[5] *and J. S. Anderson*[5], *(1)Brigham Young University, Provo, UT, (2)Department of Counseling Psychology and Special Education, Brigham Young University, Provo, UT, (3)Pediatrics, University of Utah, Salt Lake City, UT, (4)Pediatrics and Neurology, University of Utah, Salt Lake City, UT, (5)University of Utah, Salt Lake City, UT*

Background: Functional connectivity analysis is a powerful tool for examining neural phenotypes in ASD. However, there are multiple challenges to successful scanning of less verbal individuals and there is very little published research regarding functional scanning in this population. Recent advances in fMRI protocols and data analysis techniques, combined with specially-developed behavioral protocols, have allowed us to obtain adequate functional connectivity data for about ¾ of children and adolescents we have scanned.
Objectives: To obtain valid functional connectivity data from minimally verbal children diagnosed with ASD.
Methods: After initial phone screening regarding suitability for scanning, we recruited 12 children ages 8-16 who qualified based on current functional language level for either Module 1 or 2 on the ADOS-2. There were three key elements to successful imaging and interpretation. 1) A rich behavioral management program that included a) iPad-based video modeling practiced at home and in the imaging facility; b) as much time as needed in a mock partial scanner using a 3D printed head coil; c) as much time as needed over several sessions in the actual MRI scan room; d) true noise-cancelling headphones to reduce background sensitivities; e) parent and research assistant in the scan room to provide reassurance at all times; f) a short (8 minute) movie created especially for maintaining interest and calm for vulnerable samples. 2) implementation of multiband sequences that allow for rapid collection of high resolution functional data, counteracting unwanted physiological artifacts and allowing for discarding of epochs contaminated by movement and other artifacts. This allowed us to scan for as long as possible (a maximum of 2 x 8 minute sessions) while keeping and interpolating data from shorter periods of successful data acquisition. 3) Analytic techniques including standard ICA methods and a novel Bayesian fcMRI analysis method for estimating individual functional networks using a hierarchical Markov random field tool.
Results: Preliminary results indicated successful data acquisition from more than 75% of participants. Data indicates markedly elevated internetwork synchrony relative to controls, similar to that seen in a previously-reported low-functioning Down Syndrome cohort. Increased short-range connectivity seems to be specifically abnormal for the low-functioning cohort versus previous higher-functioning autism samples and is negatively correlated with IQ. We hypothesize that ongoing analyses will show that connectivity between fusiform face area and language areas (Broca Area, Wernicke Area, lateral premotor cortex) with default mode network hubs will respectively predict social and language prognosis, respectively.
Conclusions: Methods for successful scanning of lower-functioning, minimally-verbal individuals have the potential to substantially increase our understanding of the whole spectrum of autism, including both structural and functional scanning and the capacity to identify cross-sectional and longitudinal functional connectivity MRI biomarkers for language function, restrictive and repetitive behaviors, and social impairment. We will continue to share ongoing improvements to behavioral protocols and imaging/analysis methods in pursuit of this important goal.

3:16 **151.004** Cerebellar Connectivity and Glutamatergic Metabolite Concentration in ASD As Assessed By fcMRI/MRS

J. P. Hegarty II[1], *D. Weber*[2] *and D. Q. Beversdorf*[3], *(1)Psychiatry and Behavioral Sciences, Stanford University, Stanford, CA, (2)University of Missouri, Columbia, MO, (3)University of Missouri, Columbia, Columbia, MO*

Background: Cerebellar pathology is observed in ASD. Atypical cortico-cerebellar functional connectivity has also recently been reported in ASD. Furthermore, several lines of evidence have suggested atypical excitatory-to-inhibitory (E/I) balance in ASD, with an imbalance between glutamate and GABA, observed in brain regions including the cerebellum.
Objectives: We examined the relationship between E/I balance using magnetic resonance spectroscopy (MRS) and functional integrity of cerebrocerebellar connections in ASD for language-associated cerebellar regions and their cortical projections.
Methods: Twelve adults with ASD and 12 gender, age, and IQ -matched controls participated. Social communication was assessed with the Social Responsiveness Scale (SRS), maladaptive behaviors with the Aberrant Behavior Checklist (ABC), and language competence with the Test of Language Competence (TLC). MRI was performed at 3T and BOLD sequences were collected at rest. Functional connectivity (FC) analyses were performed with conservative motion correction. Single voxel spectroscopy spin-echo sequences were used to detect glutamate, and J-coupling edited sequences were used to detect GABA. Voxels were localized in each participant in the right postereolateral cerebellar hemisphere junction of crus I&II (RCere) and the left dorsolateral prefrontal cortex (LDLPFC). Metabolite levels were quantified with LCModel.
Results: ASD participants were impaired on the SRS, ABC, and TLC. Within the ASD group, LDLPFC-RCere connectivity was associated with listening comprehension (r=0.588, p=0.027). Furthermore, RCere-LFLPFC FC was significantly associated with RCere E/I, regardless of diagnosis.
Conclusions: Significant variability exists in the literature regarding FC and MRS of glutamate and GABA in ASD. Our data suggests connectivity and pharmacopathology may be interrelated in ASD. Furthermore, this may relate to behavior, as FC to the portion of the cerebellum most involved with language was related to language comprehension performance. Future studies will need to explore whether these might serve as markers for or predictors of response to pharmacological agents targeting E/I balance in ASD.

Oral Session - 8A
152 - Early Detection and Access to Care
1:45 PM - 2:35 PM - Room 308

1:45 **152.001** Increasing Access to Autism Diagnostic Care: A Quality Improvement Model

***H. L. Johnson**, P. Manning-Courtney and B. Cunningham, Cincinnati Children's Hospital Medical Center, Cincinnati, OH*

Background: Timely access to autism spectrum disorder (ASD) diagnostic services is a well known problem. Demand for diagnostic services is expected to increase as reported prevalence rates continue to increase and awareness efforts continue.
Objectives: Demonstrate access to ASD diagnostic evaluations can be improved using Quality Improvement methodology and employment of access principles.
Methods: Cincinnati Children's Hospital Medical Center (CCHMC) is a member of the Autism Speaks-Autism Treatment Network. CCHMC participated in yearlong consultation from access consultants, Mark Murray and Associates, to improve access to ASD diagnostic services. After mapping the diagnostic process, and identifying constraints, access principles were employed to identify opportunities for interventions and systems change. CCHMC specifically employed strategies to increase clinician supply without adding additional clinical providers (FTE), and manage and reduce patients on waitlists. Access principles employed included supply demand management, backlog reduction and reducing system complexity. Specifically, CCHMC reduced visit lengths for some providers, implemented standardized clinic blocks and utilized incentives to temporarily increase clinician supply to address backlog reduction. CCHMC also developed a new, more efficient clinical model for the diagnosis of children under age 3 years at risk for ASD, which decreased redundancy in clinical assessments that were occurring at different times.
Results: Time to first ASD diagnostic visit was improved at CCHMC from 122 days to 52 days in patients referred under the age of 6 years and from 404 days to 78 days for patients referred over 6 years of age. These gains have been sustained through ongoing collection and analysis of demand and supply data. Time from first diagnostic appointment to final diagnosis was reduced from 119 days to 21 days using a same day diagnostic model for children under age 3 referred for risk of ASD.
Conclusions: Despite increasing demand for ASD diagnostic services, improvement in access to ASD diagnostic services can be obtained through implementation of Quality Improvement Methodology and access principles.

1:57 **152.002** Mobilizing Community Systems to Tackle Challenges of Early Detection of ASD in Underserved Populations

***R. R. Grinker**[1], A. Delehanty[2], A. M. Wetherby[3], A. Evans[4], J. Brown[5], J. L. Stapel-Wax[6], C. Ahmann[1], T. N. Day[7], S. Mazzatenta[8], R. Turchi[9], E. Kaiser[10], K. L. Traub[11], D. L. Robins[11], H. Flynn[12], A. Klin[13], C. J. Newschaffer[14] and C. Lord[15], (1)George Washington University, Washington, DC, (2)Communication Science & Disorders, Florida State University, Tallahassee, FL, (3)Florida State University Autism Institute, Tallahassee, FL, (4)National Black Church Initiative, Washington, DC, (5)College of Medicine, Florida State University, Tallahassee, FL, (6)Emory University School of Medicine, Atl, GA, (7)Psychology, Florida State University, Tallahassee, FL, (8)Autism Institute, College of Medicine, Florida State University, Tallahassee, FL, (9)Drexel University, Philadelphia, PA, (10)Infant Toddler Community Outreach, Marcus Autism Center, Atlanta, GA, (11)AJ Drexel Autism Institute, Drexel University, Philadelphia, PA, (12)Florida State University, Tallahassee, FL, (13)Department of Pediatrics, Emory University School of Medicine, Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, GA, (14)A.J. Drexel Autism Institute, Philadelphia, PA, (15)Weill Cornell Medical College, White Plains, NY*

Background: There is a pressing need to improve the capacity of communities to detect ASD early to change developmental trajectories and improve outcomes. Although delays in social communication usually appear by 18-24 months, most children are not diagnosed until 4-5 years of age. Underserved families are identified even later and are underrepresented in intervention research. This new collaborative of 4 universities in partnership with the National Black Church Initiative (NBCI) has infused community-based participatory research and implementation science within a services research study to build consensus with stakeholders in the planning stages to lay the foundation for sustained utilization. The long-term project aim is to study effectiveness of mobilizing community systems using a web-based professional development platform with links to family resources and tools to increase family engagement and expedite receipt of screening, diagnosis, and early intervention services.
Objectives: To describe qualitative research findings from focus groups with families and providers designed 1) to identify challenges and barriers to early detection and access to early intervention (EI) for children under 24 months, and 2) to develop strategies to promote EI in underserved populations.
Methods: Focus groups with community stakeholders, including parents (n = 105) and professionals (n = 45), were conducted in Southwest Florida, Atlanta, Philadelphia, and NYC. Separate groups were held for primary care physicians, parents/grandparents from NBCI, and parents of children at-risk for developmental delay. Topics included: 1) barriers to early screening in primary care settings; 2) strategies to engage families and professionals and improve participation in the screening/referral process; and 3) information sharing about EI with families at the time of screening, diagnosis, and referral. Focus groups were audio-recorded and transcribed.
Driven by an iterative, grounded theory approach, researchers analyzed transcripts with an inductive, open-coding technique to identify emergent thematic dimensions, recurrent patterns and analytical categories. Focused coding of the remaining transcripts, using Dedoose software, identified major themes and frequency counts linked to core theoretical concepts. The use of multiple sites and the mapping of diverse stakeholder viewpoints within the same community (physicians, grandparents, and parents) onto themes allowed for increased dimensions of variation in this purposive sample, and for saturation of themes. Research team members completed five inter-rater reliability tests in Dedoose, resulting in very good agreement (average pooled Cohen's kappa=93.6). Further measures of inter-rater reliability included consensus coding, data review, and discussion and resolution of discrepancies.
Results: Sixteen major themes emerged from 1,709 excerpts, and illustrative quotes were drawn from diverse topics surrounding culture, early developmental milestones and red flags, family-physician trust, previous experience with individuals with autism/other disabilities, stigma, materials, resources, support, and practical and psychological/motivational barriers to accessing screening, assessment and intervention (Figure 1).
Conclusions: Topics for further exploration include the role of family power structures and processes impacting engagement in community screening, diagnosis and early intervention services; trusted materials and resources used in information gathering about ASD and developmental milestones; where families turn when traditional support systems fail; and family feelings, perspectives, and resistance to classifying a child who is continuously growing.

2:09 **52.003** Use of Smartphone Technology and Machine Learning to Improve Access to Care

Vaughan[1], (1)Cognoa, Inc., Palo Alto, CA, (2)Biomedical Engineering, University of Southern California, Los Angeles, CA

Background: The use of cell phones and other patient-centered technology is making an impact on the way people access and engage in their healthcare. Increased use of mobile platforms for healthcare delivery can also be effective in providing improved access for low income and minority populations who face greater healthcare disparities. This is particularly relevant to early screening of young children who may wait as long as 18 months to receive an early diagnosis despite the early warning signs of a developmental delay. Cognoa's evidence-based mobile tools leverage the use of big data and machine learning to give parents and providers an estimate of a child's risk of a developmental delay based on information that parents collect from the privacy of their homes. Providing clinicians with a child's results using a web-based user interface can help parents and providers flag concerning behaviors sooner and can help high-volume clinics with screening and triage.
Objectives: To determine whether Cognoa's mobile evidence-based risk assessment could be integrated into a high volume developmental clinic and evaluate parent and clinician satisfaction with the Cognoa interface and video-based platform.
Methods: In preparation for a multi-site clinical study, the Center surveyed over 400 families on their wait list to determine smartphone or tablet use. Of those that owned a smartphone/tablet, 356 were invited to complete the Cognoa flow prior to their clinic visit. Completion rates for Cognoa were compared to the standard clinic completion rate and qualitative ratings of parent and clinician satisfaction were obtained.
Results: Ninety-six percent (96%) of respondents surveyed owned a smartphone or tablet. Fifty-five percent (55%) had android phones, 35% iOS, and the remainder used a different kind of smartphone. The average completion rate was 50%, which was similar to the Center's average completion rate (p>.05). The majority of respondents (72%) were identified as having elevated risk of a developmental delay on the Cognoa questionnaire. Seventy-eight percent (78%) of those who received elevated risk on the questionnaire completed the video evaluation. Ninety-four percent (94%) of parents surveyed indicated that they were very happy with the experience and personalized results. Clinicians and staff found the clinician dashboard easy to use and a select number of high risk children were fast tracked by Center staff upon review of the video assessment. Sensitivity of the tool in this small pilot was .85.
Conclusions: Results demonstrate that the use of smartphone-based screening can be easily integrated in a clinic population. The use of mobile technology to engage parents is extremely promising and highlights the potential to develop high quality, rapid approaches to improve early detection and reach a more diverse population.

2:21 **152.004** The Effects of Autism Insurance Mandates on Treated Prevalence and Service Use

D. S. Mandell[1], *A. Epstein*[2], *M. Xie*[3], *S. 2. Marcus*[3], *K. Shea*[3], *K. T. Mullan*[3], *Z. Cidav*[4] *and C. Barry*[5], *(1)University of Pennsylvania School of Medicine, Philadelphia, PA, (2)Medicine, University of Pennsylvania, Philadelphia, PA, (3)University of Pennsylvania, Philadelphia, PA, (4)Center for Mental Health Policy and Services Research, University of Pennsylvania, Philadelphia, PA, (5)Johns Hopkins Bloomberg School of Public Health, Baltimore, MD*

Background: In the US, 42 states have passed autism insurance mandates that require commercial insurance plans to pay for autism-related services. These mandates have not been rigorously evaluated. The few studies of the mandates have not assessed their effects directly on the number of children diagnosed with autism or the services they received as a result of the mandates.
Objectives: To assess the effects of the autism insurance mandates on the treated prevalence of autism and use of and spending on behavioral therapies among children with autism.
Methods: We used data from the Health Care Cost Institute from 2008–2012. HCCI data includes health care claims from three large insurance companies in 50 states and the District of Columbia. A difference-in-differences design with state and year fixed effects was used to identify the independent effects of the mandates, separate from other state characteristics. Outcomes among four groups of children were compared: 1) children in states with an active mandate who had insurance subject to the mandate; 2) children in states with an active mandate whose insurance was not subject to the mandate; 3) children in states without a mandate whose insurance would have been subject to the mandate if one were active; and 4) children in states without a mandate whose insurance would not have been subject to the mandate if one were active. Additional analyses estimated the impact of mandates on treated prevalence in the first, second, and third or later years after implementation. Regression models also adjusted for patient age, sex, insurance plan type, and calendar month and standard errors were adjusted to account for clustering at the state level. A second set of analyses using a similar analytic approach will examine the effects of the mandates on service use among children diagnosed with autism.
Results: Analyses of the effects of the mandate on service use and spending are ongoing. Mandates were implemented in 29 states by the end of the study period. Mandate enactment increased the treated prevalence of autism overall by 12.2% (95% confidence interval [CI]: 6.1%, 18.63%) from a base of 2.4 per 1,000. Treated prevalence increased by an average of 9.9% (95% CI: 4.7%, 15.2%) in the first year after enactment, by 16.6% (95% CI: 7.1%, 26.0%) in the second year, and by 17.2% (95% CI: 8.6%, 25.8%) in the third or later year.
Conclusions: This study represents the most rigorous analysis to date of a widespread state-level insurance mandate policy in the US. We found that autism mandates have had a statistically significant but small effect on treated prevalence, which remains far below what would be expected based on community prevalence studies. Mandates may be a necessary but not sufficient policy for helping children obtain services reimbursed through private insurance. Analyses that will be completed prior to the conference will examine whether the mandates had an effect on use of behavioral health care, functional therapies, and other types of relevant care and total and out-of-pocket spending on these services paid for through private insurance.

Oral Session - 8B
153 - School and Community Deployed Randomized Trials
2:40 PM - 3:30 PM - Room 308

2:40 **153.001** Efficacy of the ASAP Intervention for Preschoolers with Autism Spectrum Disorder

B. Boyd[1], *L. R. Watson*[1], *M. Alessandri*[2], *G. T. Baranek*[3], *E. Crais*[1], *A. L. Donaldson*[4], *L. D. Johnson*[5], *A. Gutierrez*[2] *and S. S. Reszka*[6], *(1)University of North Carolina at Chapel Hill, Chapel Hill, NC, (2)University of Miami, Coral Gables, FL, (3)UNC Chapel Hill, Chapel Hill, NC, (4)Speech & Hearing Sciences, Portland State University, Portland, OR, (5)Educational Psychology, University of Minnesota, Minneapolis, MN, (6)UNC-Chapel Hill, Chapel Hill, NC*

Background: Behavioral interventions aimed at improving the social-communication and/or play skills of children with ASD have led to positive short- and longer-term outcomes. Yet, many of these interventions were implemented in clinic-based settings or by research staff. This presents a need to develop and examine the efficacy of interventions implemented by real-world practitioners in natural settings. The Advancing Social-communication And Play (ASAP) intervention targets these skill areas, with classroom educational teams implementing the intervention in public school-based, preschool classrooms.
Objectives: The objectives of this multi-site, four-year study were to examine the effects of the ASAP intervention for the (a) primary outcomes of social-communication and play, and (b) secondary outcomes of engagement and challenging behavior.
Methods: A cluster randomized trial design was used to assign classrooms to ASAP (n=40) or a “business-as-usual” (BAU) control (n=38) group. Eligible preschool-aged children within a classroom were consented prior to informing educational teams of their group assignment. For children in the ASAP group (n=85), their educational team had to consist of at least one teacher, teaching assistant, and related service provider. To support ASAP implementation, the team received intervention materials, didactic training and ongoing coaching throughout one school year. Children in the BAU control group (n=76) continued to receive their typical classroom instruction. Blinded observational coding was used to assess the primary outcomes of social-communication and play as well as the secondary outcome of engagement. Teacher report on the Caregiver-Teacher Rating Form (CTRF) was used to measure challenging behavior. Primary outcome measures were collected at three time points, while secondary outcome measures were collected at two time points.
Results: Random intercept mixed models or hierarchical linear models (HLM) were used to assess primary and secondary outcomes. The primary outcome models were three-level HLM with observations nested within child and child within classroom. The secondary outcomes, with two time points, were run as pretest controlled ANCOVA. These were two-level models with child nested in classroom. Based on preliminary findings, no significant group differences were found for the primary social-communication or play outcomes. However, significant differences in favor of the ASAP group were found for both engagement and challenging behavior. There were statistically significant differences and moderate to large treatment effects found for: unengaged (d=.71), some engagement (d=.50), and overall engagement (d=.59). By post-test, the ASAP group spent more time in the some engagement state, less time unengaged, and blind observers rated them higher for overall engagement compared to the BAU group (Table 1). Further, children in the ASAP group received significantly lower scores on the CTRF measure for externalizing behavior and total challenging behavior (Table 2).
Conclusions: When delivered in authentic settings by real-world practitioners, ASAP led to improvements in children’s ability to appropriately engage in classroom activities and decreased their level of challenging behavior. Although no group differences have been found for social-communication or play, from a theoretical standpoint it may be that changes in engagement (or challenging behavior) must be achieved first in order to lead to downstream changes in these core deficit areas.

Table 1. ***Engagement Outcomes (n=116)***

Effect	*Unengaged*	*Some Engagement*	*Overall Engagement*
Intercept	0.3(0.03)	0.59(0.04)	2.75(0.11)
Treatment	-0.09(0.04)*	0.08(0.04)*	0.28(0.12)*
Time (Post)	-0.08(0.03)**	0.09(0.03)**	0.3(0.09)**
Treat By Time	-0.12(0.04)**	0.1(0.05)*	0.32(0.13)*

Table 2. ***Challenging Behavior Outcomes (n=93)***

Effect	*Internalizing Est (SE)*	*Externalizing Est (SE)*	*Total Est (SE)*
Intercept	57.15(1.28)	58.75(1.07)	59.19(1.2)
Treatment (Intervention)	-5.26(1.85)**	-2.64(1.56)†	-3.63(1.74)*
Time (Post vs Pre)	-3.75(1.06)***	-2.38(0.76)**	-3.54(0.9)***
Treatment X Time	-2.51(1.55)	-2.49(1.12)*	-2.76(1.32)*

2:52 **153.002** Community-Partered Practice: Delivery of a Social Communication Intervention By Paraprofessionals with Toddlers with ASD

S. Y. Shire[1], *Y. C. Chang*[2], *S. Bracaglia*[3], *M. Kodjoe*[3], *W. I. Shih*[4] *and C. Kasari*[1], *(1)University of California Los Angeles, Los Angeles, CA, (2)California State University, Cerritos, CA, (3)New York Center for Child Development, New York, NY, (4)UCLA, Monrovia, CA*

Background: Disparities in bridging the research to practice gap may be greatest in low resourced settings that support child development programs for disadvantaged and developmentally delayed children. The present project aimed to bring an evidence-based early intervention module into a community program in order to improve child social and communication outcomes. Within a community partnered participatory framework, we focused on supporting the delivery of the intervention by non-specialists within the existing structure of the child development program. A randomized controlled intervention trial was conducted in which paraprofessionals from the community were taught to deliver the intervention. Outcomes included paraprofessional implementation and maintenance of strategies as well as child social communication and language outcomes.

Objectives: First, to explore the implementation of non-specialist delivery of a modular naturalistic developmental behavioural intervention- Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER: Kasari et al., 2008; 2014; 2015). Second, to examine if children receiving 30 minutes of JASPER intervention a day on top of center-based applied behaviour analytic (ABA) programming would show greater gains in joint attention gestures, language, play, and engagement over those receiving the ABA programming only.

Methods: 147 children age 2-3 years (mean age=31.5 months) were randomized to immediate treatment (IT) or wait list control (WL) for 11 weeks plus 1 month follow up.

137 children had received an autism spectrum disorder (ASD) diagnosis while 10 received other diagnoses. Forty-nine paraprofessionals (teaching assistants), 12 group supervisors and two research coordinators also participated. All but one paraprofessional and four children were members of an ethnic minority group.
Intervention. Paraprofessionals were provided with two weeks of in-vivo training with the research team to learn the social communication intervention: JASPER. Significant effects on joint engagement, joint attention gestures, play skills, and language outcomes have been demonstrated in multiple JASPER RCTs conducted in laboratory and community settings by specialists or parents (Kasari et al, 2008; 2010; 2014; 2015). This is the first study of implementation by non-specialists with ASD toddlers in center-based care. JASPER was delivered 30 minutes a day for children in IT for 11 weeks, while children in WL continued with 30 minutes of music and movement social group time.
Measures. Ten minute paraprofessional-child interactions at entry, exit, and follow up were coded for children's engagement and social communication and paraprofessionals' JASPER implementation. Independent assessors also administered assessments of play, joint attention, and language.
Results: Paraprofessionals in IT demonstrated significant gains in JASPER implementation scores over WL (f(1,91)= 239.94, p<.01) while children in IT made significant gains over WL in child-initiated joint engagement (f(1,70)= 46.13, p<.01), initiations of joint attention language (f(1,70)= 9.72, p<.01) and nonverbal skills (f(1,70)= 13.98, p<.01). Further gains in initiations of joint attention gestures transferred to independent assessments completed by assessors unfamiliar to the children (f(1,98)= 4.45, p=.038). All treatment gains were maintained at follow up.
Conclusions: Paraprofessionals' high strategy implementation scores, maintenance of strategies and positive child outcomes over control indicate that non-specialists can feasibly deliver and maintain previously determined evidence-based and specialized intervention for children with ASD.

3:04 **153.003** Evidence for Maintenance of Emotion Recognition Gains Using the Transporters Animated Series: Results of a Randomized Controlled Trial

***T. Gev**, R. Rosenan and O. Golan, Department of Psychology, Bar-Ilan University, Ramat-Gan, Israel*

Background: Emotion and mental state recognition (ER) difficulties are a core characteristic of ASD. Previous attempts to teach ER to individuals with ASD have often resulted in poor generalization and maintenance of acquired skills. The Transporters (TT) is an animated series that uses faced mechanical vehicles and social stories to expose children with ASD to facial expressions and emotions. A user guide offers parents additional activities aimed to enhance generalization. Previous evaluations of TT have demonstrated positive effects on children's emotional vocabulary and ER, compared to treatment as usual (Golan et al., 2010), and to an animated control series (Young & Posselt, 2012). However, the maintenance of acquired ER skills and the unique effect of the series, vis-a-vis parental support (PS) were not examined.

Objectives: (1) To evaluate TT vs. an animated control series in a RCT with preschoolers with high functioning ASD. (2) To examine the maintenance of acquired ER skills 3 months post intervention. (3) To examine the unique effects of TT and of PS on children's gains.

Methods: 77 Participants with high functioning ASD, aged 4-7 were randomly assigned into four intervention groups using a 2x2 design (TT/control series X with/without PS). Participants' emotional vocabulary and ER skills at 3 levels of generalization were tested, following Golan et al. (2010) before and after the intervention, with a follow-up 3 months after its completion. Each child in the intervention groups received an animation series (TT/Control), and watched it for 10 minutes per day for 8 weeks. Parents in the with PS conditions were asked to use activities from the parental guide on a daily basis, for at least 20 minutes per day. Parent and child fidelity were monitored on a weekly basis by the research team. A fifth group of 25 typically developing (TD) children, matched on mental age and gender was tested three times with no intervention.
Results: A Series (TT/control) by PS (with/without) by Generalization level (3 levels) by Time (pre/post/follow-up) MANOVA was conducted. The analysis yielded a significant time by series effect for the ER tasks, over and above level. Post-hoc analysis revealed the TT groups, that did not differ from the control series groups on ER pre-intervention, improved significantly post intervention, and maintained their gains at follow up. Furthermore, TT groups' ER did not differ from that of TD controls post intervention and at follow-up. No effect was found for parental support. Only time effects were found for the vocabulary task. Verbal ability and autism severity were generally related to ER, but not to intervention gains. No age effects were found, supporting the designated age range for the series.

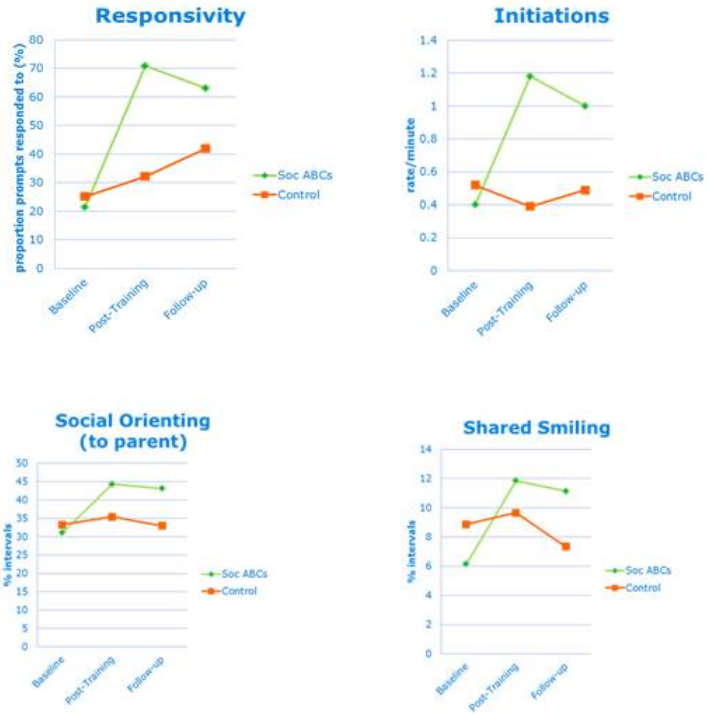
Conclusions: The results support The Transporters series as a an effective ER intervention for young children with ASD, with maintenance of acquired skills at 3 month follow-up. Improvement following series' use narrowed down users' developmental gap on ER skills. The lack of a PS effect on ER, suggests PS may have better effects on more generalized socio-emotional skills.

3:16 **153.004** Randomized Control Trial of the Social ABCs Parent-Mediated Intervention for Toddlers with Confirmed or Suspected ASD

***S. E. Bryson**[1], J. A. Brian[2], I. M. Smith[3] and L. Zwaigenbaum[4], (1)Dalhousie University, Halifax, NS, Canada, (2)Bloorview Research Institute, Toronto, ON, Canada, (3)Dalhousie University / IWK Health Centre, Halifax, NS, Canada, (4)University of Alberta, Edmonton, AB, Canada*

Background: The *Social ABC's* is a parent-mediated intervention based on empirically supported Pivotal Response Treatment (PRT; Koegel & Koegel, 2006). The main targets are early (vocal/verbal) communication and positive emotion sharing between child and parent among infants/toddlers who have suspected or diagnosed ASD. Bolstered by promising pilot findings (NAME REMOVED, in press), we have now completed an RCT.
Objectives: To compare groups (treatment vs. control) on post-training and follow-up gains in: (1) child communication, (2) parent-child positive affect sharing (shared smiling), and (3) child engagement (looking at parent's face).
Methods: 62 parent-toddler dyads were randomized into the *Social ABCs*(treatment) group or received treatment as usual (controls) across 2 Canadian research sites (Toronto, Halifax). Parents of toddlers aged 16 to 30 months received 8 weeks in-home, live coaching plus 4 weeks refresher and consultation, followed by 12-week parent implementation, and follow-up assessment (week 24). Video-coding occurred for 3 key time-points: Baseline (BL), Post-training (PT; week 12), and Follow-up (F-up; week 24). Positive Emotion Sharing, Social Orienting, and several indices of communication were coded at all 3 time-points. Repeated measures ANCOVAs were used to evaluate change across time-points and groups.
Results: This abstract presents findings from **interim analyses** (n=31-59), but full analyses will be completed in time for IMFAR. All group X time interactions favour the treatment group, including significant gains (BL vs. F-up) for Auditory Comprehension (receptive language) raw scores on the Preschool Language Scale-4, p =.023. Significant group X time interactions were obtained for several video-coded variables (see Figure 1), with medium-to-large effect sizes (ES): Responsivity (p < .001, ES = .71), Initiations (p < .001, ES = .32), Shared Smiling (p = .020) and a trend for child Social Orienting (p < .053). Parent fidelity of implementation was achieved, also with a group X time interaction in the expected direction (p < .001, ES = .73).
Conclusions: Significant gains, favouring the treatment group, were observed in children's communication on (proximal) video-coded measures, and a standardized measure of language comprehension, as well as increased shared smiling and child social orienting to their parent. Parents attained fidelity in use of the intervention techniques after 12 weeks of parent training. The parent-training model allows for the integration of intervention into daily activities, thus enabling very early intensive intervention. Next steps involve community translation of this portable, feasible, and cost-effective intervention (underway).

Figure 1a-d. Video-coded data for (a) child vocal/verbal responsivity to parent cues, (b) child-initiated language, (c) social orienting to parent, and (d) shared smiling with parent.



Oral Session - 9A
154 - Preparing Youth with ASD for Adolescence and Beyond
1:45 PM - 2:35 PM - Room 309

1:45 **154.001** Parents' Decisions to Disclose Their Child's Autism Spectrum Diagnosis to Their Child

C. Moody[1], *L. Berkovits*[1], *J. Blacher*[2] *and B. L. Baker*[3], *(1)University of California Los Angeles, Los Angeles, CA, (2)University of California - Riverside, Riverside, CA, (3)UCLA, Los Angeles, CA*

Background:
Although research exists on parents' experience in receiving an autism spectrum disorder (ASD) diagnosis for their child (Brogan & Knussen, 2003), there is a dearth of research on parents' experiences in relaying that diagnosis to their child. In one interview study, researchers identified diagnosis disclosure as an important theme present in the perceptions of high-functioning college students with ASD, who indicated that their families were aware of the ASD diagnosis before it was shared with them (Huws & Jones, 2008). What factors prompt families to share an ASD diagnosis at a specific time and how do parents explain the diagnosis to their children? Given the highly personal and vulnerable nature of this information, parents would likely benefit from more research on how and when to disclose, and what strategies may be most effective.
Objectives:
The aim of this study is to gather descriptive data about when, how, and why parents shared the ASD diagnosis with their now adolescent (age 15) son or daughter. A secondary objective will be to connect these factors to youth outcomes.
Methods:
Subjects included families of children with ASD (n=43) who were interviewed when the children were 15 years old. Parents were interviewed about various aspects of their son's or daughter's life including whether and when they have shared the diagnosis, how they described ASD, and why they chose that particular time. Interview responses were transcribed and coded for themes. Parents also completed questionnaires, including the CBCL and SCARED, on the youth's current functioning.
Results:
Results indicated that the majority of parents disclosed their child's diagnosis by the time the youth was age 15. The mean youth age at disclosure was 8.58 years old (*SD*=3.39; range: 1-13 years), supporting the presence of a discrepancy for many families between parent knowledge and child knowledge of the diagnosis. Parents reported a wide range of reasons why they chose a given time to share the diagnosis with their child. Most commonly, parents led the discussion; however, several children initiated the discussion with their parents. In parents' self report of how they described the diagnosis, parents included significantly more negative comments (e.g., explaining deficits) than positive comments (e.g., strengths), t=4.233, p<.001.
Preliminary analyses regarding youth outcomes indicated that children told in middle childhood (ages 8-10) showed higher levels of internalizing problems at age 15 than children told in early childhood (age < 7) or early adolescence (ages 11-13) by parent report on the SCARED, F=3.602, p=.038, and CBCL Internalizing, F=2.912, p=.068.
Conclusions:
The prevalence of ASD has dramatically increased over the past 20 years (CDC, 2014). As these children grow, more research needs to be targeted at when and how families should disclose this diagnosis to their children. These qualitative analyses indicated that parents vary with respect to how, when, and why diagnosis disclosure occurs. It is possible that there may be a developmental window that is optimal for a discussion of diagnosis with a child with ASD, but the current analyses are limited due to their cross-sectional nature.

1:57 **154.002** The Sword in the Soul: Meanings of Autism Spectrum Conditions Among Diagnosed Adolescents

E. Fein*, Psychology, Duquesne University, Pittsburgh, PA*

Background: As the rate of autism diagnosis continues to increase, a growing number of youth are coming of age diagnosed with autism spectrum conditions. Little is known about how the diagnosis affects the developing identities of these youth as they grow into adulthood (Petalas et al, 2013). Meanwhile, the kinds of meanings that the diagnoses hold for individuals affected have become increasingly diverse and contentious (Ortega, 2009; Bumiller, 2008; Bascom, 2012). Ethnographic research can reveal how the meanings of autism spectrum conditions are negotiated in particular contexts of daily life, and show some consequences of those meaning-making practices for those affected by autism (Solomon and Bagatell, 2010; Grinker and Cho, 2013).
Objectives: This study investigated how adolescents diagnosed with Asperger's Syndrome and related autism spectrum conditions define what autism is, and how it should be treated. In particular, the study foregrounded two popular models of autism in contentious conflict: the model of autism as a disease separate from the affected person, and the model of autism as a fundamental and often valued element of the affected person's neurogenetic identity (Sinclair, 1999; Solomon, 2008). How do youth coming of age

with an autism spectrum diagnosis reconcile these seemingly incompatible understandings of autism and the self?
Methods: The research consisted of two years of ethnographic fieldwork at sites where the meanings of autism spectrum conditions were being negotiated and put into practice in consequential ways: a public and a private school, a psychiatric clinic, and a community center/summer camp, all serving adolescents with Asperger's Syndrome and related ASC's. I also conducted 130 semi-structured interviews with people diagnosed with ASC's, their family members, and the professionals working with them.
Results: Youth on the spectrum who participated in this study tended to see autism as (as one participant put it) "a double-edged sword". It gives them cherished strengths, unique perceptual experiences, and terrifying vulnerabilities. It isolates them socially while also bringing them into fellowship and a sense of community with affected others. It helps make them who they are, but also profoundly disrupts their sense of self. In this presentation, I will describe how these youth often look outside of medicalized models of autism-as-disease and autism-as-identity to make sense of this experience, drawing instead on a folk mythology of embodied difference from roleplaying games, Japanese animation films, and other fantastical popular media. In their games, their art, and other informal creative practices, they playfully depict themselves as hybrid creatures: mutant antiheroes who are half human and half demon, pierced by shards of evil swords, or possessed by powerful ancestors. In doing so, they reconcile the valued and troubling elements of their experience.
Conclusions: Through a shared mythology that transcends the limitations of medical models, youth on the spectrum are better able to articulate the complexities and ambiguities of their condition. Attention to the subjective experience of autism in cultural context can help illuminate such unexpected and productive practices.

2:09 **154.003** How Adolescents with Autism and Their Parents Perceived the Chilled Program: A Treatment Acceptability Framework for Autism Researchers

T. C. Kidd[1], *R. Rooney*[2] *and T. G. Mazzucchelli*[3], *(1)Curtin University, Perth, WA, Australia, (2)Curtin University, Perth, Australia, (3)School of Psychology and Speech Pathology, Curtin University, Perth, Australia*

Background: To prevent researchers in the field of autism from making erroneous assumptions about the effectiveness of interventions, the subjective experience of individuals with autism, and their families, participating in randomised controlled trial interventions, warrants attention in autism cognitive and behavioural research. Currently, limited emerging evidence of participant adherence to and acceptance of cognitive behavioural therapy intervention exists, however a more comprehensive evaluation model of assessing social validity in autism research is warranted.
Objectives: To assess the social validity of an anxiety reduction program for adolescents with high functioning autism, and to devise a framework for clinicians and researchers to measure participant satisfaction and acceptability of psychosocial interventions.
Methods: A randomised controlled trial was employed to assess the social validity of a group, family-based, cognitive behavioural therapy intervention (CBT) for adolescents with high functioning autism spectrum disorder (HFASD), and co-occurring anxiety disorder/s (AD). Forty-four adolescent-parent dyads participated in the 12-session program, an adaptation of the 'Cool Kids' ASD anxiety program (Chalfant, Lyneham, Carrol, & Rapee, 2010). Both quantitative and qualitative methodology determined the social validity of treatment.
Results: The results will be presented in four parts a) adolescent quantitative feedback which consists of the overall ratings of the intervention, b) adolescent qualitative feedback which is comprised of responses to five open-ended questions, c) Parent quantitative feedback consisting of overall feedback about the program and any changes in their adolescent since completing the intervention, and d) qualitative feedback from parents comprising of three responses to open-ended questions.
Conclusions: High program adherence and acceptability of the Chilled program were found by both adolescents and their participating parent/s. A feasible model for effectively assessing the relevance and acceptability of behavioural interventions in autism research and practice will be presented.

2:21 **154.004** Life after High School: Trends in Post-Secondary Education and Employment for Individuals with ASD Across Virginia

S. Carr *and S. M. Prohn, Virginia Commonwealth University, Richmond, VA*

Background:
The U.S. Bureau of Labor Statistics reported that 68% of 2014 high school graduates enrolled in colleges or universities. By contrast, only 48% of students with ASD in Virginia enrolled in 2 or 4-year institutions of higher education. Generally, research has reported poor post-school outcomes for individuals with ASD (Henniger & Taylor, 2013). While the Interagency Autism Coordinating Committee (IACC) has identified a need for research on transition for students with ASD, relatively little is known about students with ASD who enroll in college.
Objectives:
To examine the Virginia Department of Education Indicator 14 Data (post-secondary outcomes) for students with ASD enrolled in public school across the state while paying close attention to racial and geographic disparities.
Methods:
This study utilized the current Virginia Department of Education Database from 2014. This secondary data analysis looked specifically at post-secondary outcomes for youth with Autism Spectrum Disorder across the Commonwealth.
Results:
By examining Virginia Department of Education's postsecondary transition data, and specifically the 511 students with ASD who left high school in the 2012-13 school year, it is clear that African American students and those from rural Virginia were less likely to attend college than white students or those from urbanized areas. Additionally, high school students with ASD who received alternative degrees were also less likely to attend college than students with regular or advanced degrees, results that are consistent with previous literature (Chiang, Cheung, Hickson, Xiang, & Tsai, 2012). Disparities in college enrollment among students with ASD also contribute to disparities in quality of life, present and future, with those enrolled in college reporting significantly higher life satisfaction.
Conclusions:
The achievement of students with ASD who receive special services lags far behind their non-disabled counterparts. Only 40% students with ASD in Virginia leave high school with a standard diploma. To reduce college enrollment gaps between those with and without ASD as well as within the ASD diagnoses, Virginia must further develop postsecondary education models that increase college accessibility for those with multitudinous support needs including geographical location.

Oral Session - 9B
155 - Quality of Life, Internalizing Symptoms, & Employment
2:40 PM - 3:30 PM - Room 309

2:40 **155.001** Characterizing Objective Quality of Life and Normative Outcomes in Adults with Autism Spectrum Disorder: A Latent Class Exploratory Analysis

L. Bishop-Fitzpatrick[1], *J. Hong*[1], *L. E. Smith*[2], *R. A. Makuch*[1], *J. S. Greenberg*[2] *and M. R. Mailick*[1], *(1)Waisman Center, University of Wisconsin-Madison, Madison, WI, (2)University of Wisconsin-Madison, Madison, WI*

Background: There is little consensus about how best to assess normative outcomes and objective quality of life (QoL) in adults with autism spectrum disorder (ASD). Past outcome research has found that very few adults with ASD achieve the conventional markers of adulthood – becoming employed and self-supporting, living independently, developing a network of friends, contributing to the community. Some have called for a reconceptualization of QoL for adults with ASD, but little empirical research has been conducted that can inform such a reconceptualization or identify strategies for improving the QoL of adults with ASD.
Objectives: The current study aims to construct a unified definition and conceptualization of normative outcomes and objective QoL for adults with ASD by: (1) characterizing the heterogeneity of normative outcomes and objective QoL; and (2) identifying predictors of positive normative outcomes and good objective QoL.
Methods: 180 adults with ASD between the ages of 23.72 and 60.47 (*M*=34.06, *SD*=7.99) were drawn from a longitudinal study (Adolescents and Adults with Autism). Three indicators of normative outcomes (employment, independent living, social engagement) and four indicators of objective QoL (physical health, quality of neighborhood, family contact, mental health issues) were assessed using a dichotomous scale and entered into an exploratory latent class analysis in order to determine groups of adults with ASD who were similar in their normative outcome and objective QoL profiles. A multinomial logistic regression then tested the association between intellectual disability (ID) status, age, daily living skills (Waisman Activities of Daily Living), autism symptomatology (Autism Diagnostic Interview-Revised), and executive functioning (Behavior Rating Inventory of Executive Function).
Results: Exploratory latent class analysis findings identified three discrete groups – Greater Dependence, Good Health, and Greater Independence – of adults with ASD in terms of normative outcomes and objective QoL. The Greater Independence group experienced the most favorable normative outcomes, while the Greater Dependence group experienced the worst. The Good Health and Greater Independence groups experienced the most favorable objective QoL while the Greater Dependence group experienced the worst. In addition, findings indicate that better daily living skills (Good Health vs. Greater Dependence: *exb(B)=1.110, p<.001*; Greater Independence vs. Greater Dependence: *exp(B)=1.175, p<.001*) and better executive function (Good Health vs. Greater Dependence: *exp(B)=.966, p<.05*; Good Health vs. Greater Independence: *exp(B)=.964, p<.10*) are associated with membership to outcome groups with better normative outcomes, when controlling for ID status, age, and autism symptomatology.
Conclusions: This research proposed a broad conceptualization of normative outcomes and objective QoL that takes into account many facets of life, is long-term in nature, and is variable over time. Our findings indicate that normative outcomes and objective QoL for adults with ASD may be quite nuanced; having good normative adult outcomes may not necessarily lead to good QoL, and vice versa. Notably, there appears to be a relatively strong association between better daily living skills and membership to a

group with improved normative outcomes and objective QoL. These findings have important implications for future research and for interventions designed to improve outcomes and QoL in adults with ASD.

2:52 **155.002** High Early Parental Expectations Predict Improved Independent Living and Quality of Life for Adults with Autism Spectrum Disorder

E. T. Schroeder[1], *P. S. Powell*[2], *E. M. Lamarche*[3], *M. R. Klinger*[4] *and L. G. Klinger*[5], *(1)UNC TEACCH Autism Program, Carrboro, NC, (2)University of North Carolina - Chapel Hill, Chapel Hill, NC, (3)UNC TEACCH Autism Program, Chapel Hill, NC, (4)University of North Carolina at Chapel Hill, Chapel Hill, NC, (5)Psychiatry, University of North Carolina TEACCH Autism Program, Chapel Hill, NC*

Background:
Previous studies examining the effect of parental expectations of children with autism spectrum disorder (ASD) have shown that expectations predict outcome, at least in the short –term (Chiang et al., 2012; Taylor et al., 2011). However, these studies provide conflicting findings on whether expectations serve as predictors across domains (educational, vocational, etc.), and no study to date has studied the relationship between parental expectations and long-term outcomes. The current study examined the relationship between early parental expectations of independence (living, education, and relationships) and long-term outcomes in these same children 20 to 40 years later.
Objectives:
The present study examined how early parental expectations relate to long-term outcomes in adults with ASD. It was predicted that higher parental expectations in childhood would relate to better outcomes in middle adulthood, regardless of childhood functioning.
Methods:
As part of a longitudinal follow-up study of families seen by the University of North Carolina TEACCH Autism Program between 1965 and 1999, 52 archival records of childhood parental estimates of current adaptive functioning and future adult outcome were obtained. Future estimates of adult outcome included expectations regarding living situation (e.g., group home, home, or independent), education level (e.g., special education, high school, college), and relationships (e.g., never date, date but not marry, married, married with children). These predictions were combined to produce an overall estimate of parental expectations. We compared these expectations to measures of adaptive behavior (Waisman Activities of Daily Living) and quality of life in the same children 20 to 40 years later.
Results:
A hierarchical linear regression with a stepwise progression was conducted using adult W-ADL as the dependent variable. The number of years between childhood and follow-up study (M = 29 years; range: 20-41 years) and parental estimates of childhood adaptive functioning (as a proxy for developmental level) were entered first into the model with adult outcome expectations as the last predictor to examine the impact of parental expectations of adult outcome after controlling for these other variables. Parental outcome expectations during childhood significantly predicted adult adaptive behavior (R^2_{change}=.07, p=.04). The same analysis was performed on quality of life with parental outcome expectations during childhood significantly predicting adult quality of life (R^2_{change}=.10, p=.01).
Conclusions:
Taken together, these findings suggest that higher parental expectations during childhood lead to higher levels of adaptive behavior and quality of life in adulthood. This was evident after controlling for parental perception of childhood adaptive behavior as a proxy for current developmental level and the length of time between childhood and adulthood evaluation. Given generally poorer outcomes for individuals with ASD, one might expect higher parental expectations to result in lower ratings of quality of life given the disparity between the expected and the actual outcomes. However, the current findings suggest that parental expectations are not only related to quality of life, but may be important for improving the level of independence in adulthood. These results suggest that parents should be encouraged to hold high expectations for their young children with ASD.

3:04 **155.003** Health Care Service Utilization in an Integrated Healthcare Delivery System Among Adults with Autism Spectrum Disorders

L. A. Croen*, O. Zerbo and Y. Qian, Division of Research, Kaiser Permanente, Oakland, CA*

Background: Adults with autism spectrum disorder (ASD) have a significantly higher burden of most major medical and psychiatric conditions compared to adults without ASD. The reasons for this are not known, but may be related to less adequate utilization of preventive healthcare services or poorer control of chronic conditions. Currently, very little is known about healthcare service utilization among this growing population.
Objectives: To compare healthcare utilization patterns of adults with ASD and adults without ASD among a large and diverse population of adults receiving healthcare services in an integrated healthcare delivery system.
Methods: The study population was drawn from the adult membership (≥ 18 years) of Kaiser Permanente in Northern California (KP) who were enrolled in the health plan for at least 9 months each year from 2008-2012. ASD cases (N=1,507) were adults with at least two ASD diagnosis (ICD-9-CM 299.0-299.8) recorded in the electronic medical record by December 2012. A control group of adults without any ASD diagnoses (N= 15,070) was sampled at a 10:1 ratio and frequency matched to cases on total length of KP membership, sex, and age. Health care utilization data were obtained from the KP inpatient and outpatient databases for the year 2012. Utilization occurring at KP facilities and authorized non-KP facilities was defined in terms of the percentage of patients with outpatient clinic visits, hospitalizations, emergency department visits, and specialty care visits in the study year. Proportions of each healthcare service utilization category were compared between cases and controls after adjusting for several covariates using multivariable logistic regression models. Covariates included age, sex, race/ethnicity, total length of membership, and eight categories of medical and psychiatric comorbidities (immune conditions, cardiovascular diseases, metabolic disorders, neurologic diseases, gastrointestinal disorders, sleep disorders, nutritional conditions, and psychiatric conditions).
Results: Compared to controls, adults with ASD had significantly higher utilization of outpatient visits for primary care (74% vs.59.1%), mental health (43.3% vs. 5.4%) and neurology (5.6% vs. 1.5%). Utilization of hospice/home healthcare (1.3% vs. 0.3%), skilled nursing services (0.6% vs. 0.1%) and speech therapy (0.8% vs. 0.1%) were uncommon but all significantly higher among adults with ASD compared to adults without ASD. The higher rate of utilization in these categories was evident among both men and women. Among men only, utilization of inpatient hospitalizations (4.8% vs. 1.9%) and laboratory services (55.5% vs. 38.9%) was significantly higher among ASD cases than controls, and utilization of physical or occupational therapy services was significantly lower (2.8% vs. 4.2%). Among women, utilization of gynecology services was significantly lower among ASD cases compared to controls (35.1% vs. 49.1%). Finally, for most healthcare service utilization categories, case-control differences were most pronounced for adults over 50 years of age.
Conclusions: With the exception of gynecologic service utilization among women, adults with ASD have higher utilization of most healthcare services compared to controls, even after controlling for medical and psychiatric comorbidities. More research is needed to determine reasons for these utilization differences and to develop strategies to improve delivery of health care to adults with ASD.

3:16 **155.004** Virtual Reality Job Interview Training and 6-Month Vocational Outcomes for Young Adults with Autism Spectrum Disorder

M. J. Smith*, Department of Psychiatry and Behavioral Sciences, Northwestern University Feinberg School of Medicine, Chicago, IL*

Background: Young adults with high-functioning autism spectrum disorder (ASD) have low employment rates and job interviewing presents a critical barrier to employment for them.
Objectives: To evaluate the acceptability, efficacy, and vocational outcomes for young adults with ASD who completed a virtual reality job interview training (VR-JIT) program compared to a treatment-as-usual (TAU) control group.
Methods: We conducted a randomized controlled trial with 16 participants randomly assigned to the VR-JIT treatment group and 10 participants randomized to a treatment-as-usual (TAU) group. The primary outcome measures were: 1) blindly rated video-recorded job interview role-plays (with professional actors) that assessed interview skill level as pre-test and post-test measures and 2) self-reported interviewing self-confidence. Acceptability measures included session attendance, total minutes spent using the intervention, and a self-report regarding VR-JIT's ease-of-use and perceived helpfulness at improving interview skills. Vocational outcomes at 6-month follow-up were determined by surveying: 1) if the study participants completed interviews for a competitive position (employed or volunteer), 2) accepted a competitive position, and 3)the number of weeks participants sought a competitive position. We used descriptive statistics to report the acceptability data for VR-JIT. We used repeated measures analysis of variance to assess if the VR-JIT group demonstrated improved interviewing skills between the pre-test and post-test interview role-plays. We used logistic regression to evaluate if training with VR-JIT was associated with a greater odds of attaining a competitive position (job or volunteer).
Results: Participants attended 90% of the lab-based training sessions, and more than 90% of participants reported that VR-JIT was easy-to-use, enjoyable, and prepared them for real-life interviews. VR-JIT participants had greater improvement during live standardized job interview role-play performances than the control group ($p<0.05$) and had greater improvement in interviewing self-confidence at the trend level ($p=0.06$). Eighty-eight percent of participants (23 of 26) completed the 6-month follow-up survey. Logistic regression indicated that the VR-JIT group, compared to the TAU group, had greater odds of attaining a competitive position (OR 7.82, $p<0.05$). Exploratory correlations revealed that, among VR-JIT participants, improvement in role-play performance between pre-test and post-test was correlated with completing more interviews at 6-month follow-up ($r= 0.55$, $p<.05$).
Conclusions: Vocational training in the community is a critical issue within the ASD community and this study provides initial evidence that VR-JIT may be a helpful intervention for young adults with ASD searching for a job or competitive volunteer work. Future directions include evaluating the community-based effectiveness of VR-JIT as well as modifying for VR-JIT for adolescents with ASD who are preparing to pursue employment.

Oral Session - 10A
156 - Exploring Cognitive Processes to Inform ASD Characteristics
1:45 PM - 2:35 PM - Room 310

1:45 **156.001** Exploring What's Missing: What Do Target Absent Trials Reveal about Autism Search Superiority?

B. Keehn[1,2] *and B. Joseph*[3]*, (1)Psychological Sciences, Purdue University, West Lafeyette, IN, (2)Speech, Language, and Hearing Sciences, Purdue University, West Lafeyette, IN, (3)Anatomy and Neurobiology, Boston University School of Medicine, Boston, MA*

Background: Individuals with autism spectrum disorder (ASD) excel at visual search, performing better than their typically developing (TD) peers across the lifespan. This disparity in performance generally becomes greater as target-distractor similarity increases and when the target is absent.
Objectives: First, to assess the roles of enhanced stimulus discrimination and peripheral selection in superior visual search among individuals with ASD, and, second, to examine the search mechanisms underlying the well-documented superiority of individuals with ASD to discern target absence.
Methods: We administered a paradigm in which distractors varied on difficulty of discrimination and selection to 22 school-age children and adolescents with ASD and an age- and non-verbal IQ-matched comparison group of 30 TD children. The stimulus array had a fixed set size of 24 items. The target was a circle and the distractors were "C" shaped figures. Peripheral selection was varied by increasing the line-width of distractors; discrimination between target and distractors varied by increasing the size of the gap in the distractor Cs (Figure 1a). The experiment was divided into four 40-trial blocks.
Results: Groups did not differ in error rate. Children with ASD were faster at visual search than their TD peers, $F(1,50) = 3.5$, $p = .068$. However, there were no significant interactions between group and discrimination, selection, or a three-way interaction between group, discrimination, and selection (all p>.05). Rather, consistent with the large majority of ASD visual search, group differences were mainly the effect of faster ASD performance on target absent trials, $F(1,50) = 6.7$, $p = .013$. Next, we conducted a series of analyses to examine the search characteristics that confer a unique advantage in absent trials to individuals with ASD. Faster RT to target absent trials was not due to speed-accuracy trade-off, response bias, quitting threshold, or post-error slowing (all p>.05). Instead, we found faster RT to targets appearing on the left side of the array for our TD group. However, this left-side bias was not present in individuals with ASD (Figure 1b-d). Consistent with our RT results, TD individuals, but not individuals with ASD, showed a leftward bias in saccadic endpoint (Figure 1e). Lastly, ASD symptom severity was positively associated with ASD search superiority (Figure 1f).
Conclusions: Consistent with previous reports, we found accelerated search in ASD, which was driven primarily by faster responses to target absent trials. Behavioral and eye-tracking results suggest that absent advantage may be due to reduced leftward search bias in ASD. Because target proximity is an important factor in determining subsequent target fixation and search termination, non-biased saccades are likely to make targets more accessible, facilitating search in ASD. These findings together with fewer fixations and reduced saccadic error in target present trials lends support to the hypothesis that enhanced perceptual load may contribute to superior search in ASD. Additionally, indices of target absent search and reduced search bias were related ASD symptom severity, indicating that mechanisms underlying absent search advantage may have explanatory significance with regard to the development of ASD social and communicative impairments.

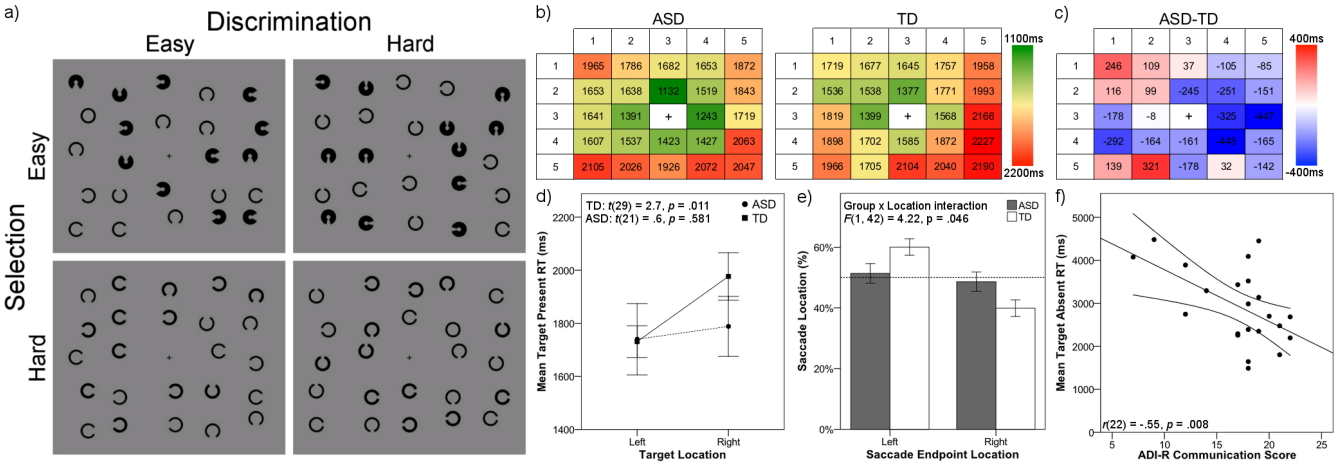
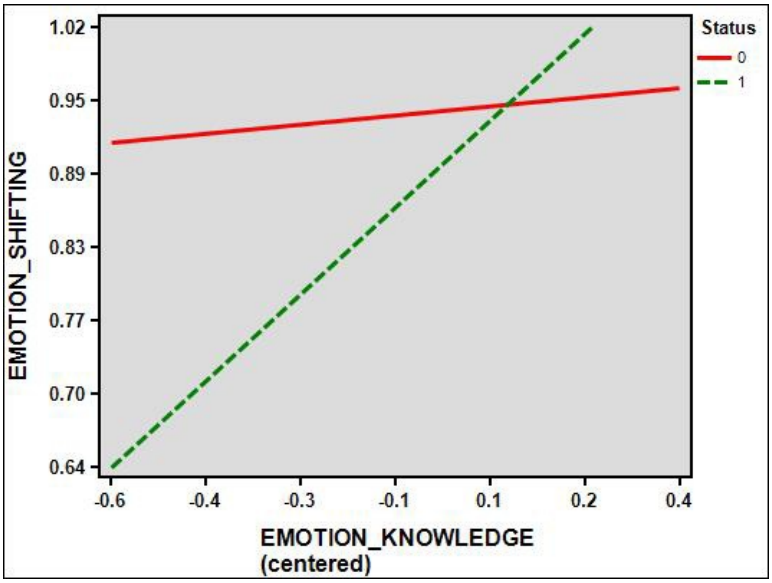


Figure 1. Illustration of search array for each trial type. Manipulation of gap size (discrimination) and distractor width (selection) were used to create four conditions: discrimination easy, selection easy (upper left), discrimination easy, selection hard (lower left), discrimination hard, selection easy (upper right), and discrimination hard, selection hard (lower right). The target (circle) is present for DESE and DHSH conditions, target absent for DHSE and DESH conditions (a). Heat maps representing RT for ASD and TD group (b). The difference between ASD and TD (ASD-TD) for RT at each possible target location (c). Cool colors (blues) represent target locations with faster RT for the ASD group; Warm colors (reds) represent target locations with faster RT for the TD group. Average RT for ASD and TD groups for targets appearing in left and right locations (d). Endpoint of initial saccades for ASD and TD groups on the left or right side of the search array (e). Scatter plot of absent RT and ADI-R Communication score (f). Error bars represent ± 1 SEM.

1:57 **156.002** Emotion Shifting, Emotion Knowledge and Inhibitory Control in Children with ASD

B. Wilson*, E. F. Geib, A. F. Lee and E. Bisi, Clinical Psychology, Seattle Pacific University, Seattle, WA*

Background:
Children's ability to shift attention between different emotional events predicts positive outcomes such as prosocial behavior, emotion regulation and academic competence in children with typical development (TD; Wilson, 2003; Wilson, Derryberry, & Kroeker, 2006). Children with autism spectrum disorders (ASD) tend to have difficulty with two skills thought to underlie emotion shifting skills, the ability to recognize emotions in others and shifting attention between different events (Swettenham et al., 1998; Wilson, 2003). Most prior research on attention shifting research has failed to include emotional stimuli.
Objectives:
We investigated whether the relation between children's status (ASD vs TD) and their emotion shifting skills would be moderated by their inhibitory control and emotion knowledge skills.
Methods:
Participants were ninety-six who were from 3 years to 6 years 11 months old. Fifty-four children were TD (61% male) and 42 children had ASD (83% male). Children's emotion shifting was assessed with the Children's Attention Shifting Task, a computerized task that requires children to move their attention between different emotion faces (CAST; Wilson, 2003; Wilson et al., 2006); emotion knowledge was measured with the Facial Expressions subscale of the Assessment of Children's Skills Emotions task (ACES); and inhibitory control with the Boy/Girl task (Diamond et al., 2002). Data were collected during a home visit and a laboratory session.
Results:
A multiple additive moderation analysis was conducted using PROCESS (Hayes, 2015) to examine the conditional effects of developmental status on emotion shifting based on inhibitory control and emotion knowledge. After controlling for children's age and verbal skills, children's developmental status, inhibitory control (IC) and emotion knowledge (EK) each explained unique variance in their emotion shifting skill. The main effect of developmental status on emotion shifting was significant (t = -4.52, p < .001). Although the contribution of IC as a moderator was nonsignificant, EK significantly moderated the relation between developmental status and emotion shifting while holding the moderating effects of inhibitory control constant (t = 3.57, p < .001). In other words, the relation between status and emotion shifting was moderated by children EK whereas their IC skills had an additive effect on children's emotion shifting skills. As can be seen in Figure 1, the emotion shifting skills of children with ASD were higher when their EK skills were higher, whereas emotion shifting skills in children with TD was not related to their EK skills.
Conclusions:
We found that emotion knowledge was more strongly associated with the emotion shifting skills for children with ASD than for children with TD. Our findings suggest that interventions that improve the emotion knowledge skills of young children with ASD may also facilitate their ability to shift attention effectively between different emotional events.



2:09 **156.003** Auditory Perceptual Capacity Is Superior in Autism

A. Remington[1] *and J. Fairnie*[2]*, (1)Centre for Research in Autism & Education, UCL IOE, London, United Kingdom, (2)UCL, London, United Kingdom*

Background:
Autism Spectrum Disorder (ASD) has an intriguing profile of both deficits and abilities. Individuals show enhanced pitch discrimination (e.g. Bonnel et al 2003), higher rates of absolute ('perfect') pitch compared to general population (Miller, 1999) and often find seemingly innocuous sounds distressing. In 2013, altered sensory processing was added to the diagnostic criteria for the condition (APA, 2013). It is essential to find ways to reduce auditory distraction and the negative impact that auditory stimuli have on individuals with ASD.
Objectives:
This study used two behavioural experiments to examine whether an increased capacity for processing sounds in ASD could be underlying both the negative and positive aspects of this behaviour.
Methods:
16 autistic adults and 16 neurotypical adults took part in the study. In Experiment 1, an inattentional-deafness paradigm was used. Participants listened to a scene containing characters preparing for a party and were asked to concentrate on a conversation between two women in order to answer subsequent questions. Halfway through, an additional male character walked through the scene, continually repeating ''I'm a gorilla''. After the scene, participants were asked whether they heard anything unusual. Experiment 2 examined the limits of auditory capacity in ASD by measuring detection of a critical stimulus (CS) under various levels of perceptual load. In this task, increased capacity would manifest as more task-relevant processing and enhanced task performance. Participants were asked to detect a target sound (dog/lion) among varying numbers of non-target sounds (other animals). Binaural sound recordings were used to position auditory components on an imaginary semi-circle in front of the head. A car noise (the CS) was also present on 50% of the trials, in positions that lay on an imaginary semi-circle of greater eccentricity than the animal sounds. Participants were asked to indicate which target was present (e.g. lion or dog) and whether the CS was present or absent on that trial.
Results:
In Experiment 1, 50% of autistic participants detected the 'gorilla', whereas only 12.5% of neurotypical controls did ($p = 0.022$). This suggests that autistic individuals process more irrelevant information from the auditory scene; evidence of increased perceptual capacity.
In Experiment 2, controls showed a significant reduction in detection sensitivity to the CS as the auditory load of the central task increased. In the ASD group, detection rates of the CS were significantly higher overall, and as auditory load of the central task increased rates did not drop to the same extent as for neurotypical controls .
Conclusions:
The experiments demonstrate that autistic people were better at detecting additional unexpected and expected sounds, suggesting that they have increased auditory perceptual capacity relative to non-autistic controls.
This offers an explanation for the auditory superiorities seen in autism (e.g. heightened pitch-detection). Somewhat counter-intuitively, this same 'skill' could result in the sensory overload that is often reported – which subsequently can interfere with social communication. These findings have important practical implications and could be used to develop intervention programs to minimise the distress that is often seen in response to auditory stimuli.

2:21 **156.004** Recognition Memory in Adults with Autism Spectrum Disorder – the Pupil Old/New Effect

M. Ring[1]*, D. M. Bowler*[2] *and S. B. Gaigg*[3]*, (1)City University London, London, England, United Kingdom, (2)Psychology, City University London, London, United Kingdom, (3)City University London, London, United Kingdom of Great Britain and Northern Ireland*

Background:
Memory in individuals with Autism Spectrum Disorder (ASD) has characteristic areas of strength and difficulty. ASD individuals show greater difficulty on less supported tests like free recall but are similar to typically developing (TD) individuals on more supported procedures such as recognition. Most of this research is however done with adults with average intelligence and language abilities. Research into less verbal or younger individuals is uncommon, partly because of methodological challenges. However, in typical as well as clinical populations, gaze measures are becoming popular as indices of memory function and are a good option to overcome these challenges. One such measure - pupil size - has shown robust effects and breakthroughs in terms of understanding the underlying neurochemistry of memory.
Objectives:
The aim was to establish whether pupil dilation indices would be sensitive to recognition memory processes in ASD adults. We used a wide range of materials to make the findings as generalizable as possible. We aimed to discover more about the utility of the current paradigm with less verbal ASD populations as well as its potential usefulness in the search for a biomarker for ASD.
Methods:
Data were available for 27 ASD and 30 TD adults aged between 22-64 years and IQs between 75-136. Participants were asked to study sets of 10 words, pictures, non-words and abstract shapes. Materials were black and white images matched for luminance presented one by one in the centre of a computer screen. After the study phase, participants' memory was tested with a 'Yes-No' recognition memory procedure. Pupil size data were measured with a Tobii TX300 remote eye-tracking screen. We calculated a pupil size ratio (pupil size for test item divided by baseline) to control for natural pupil size fluctuation and differences in pupil size between participants at baseline.
Results:
Both groups remembered visual materials (pictures and abstract shapes) better than verbal materials (words and non-words) and showed superior memory for meaningful over meaningless materials. We compared participants on a pupil size ratio for old (studied) and new (unstudied) materials and found larger pupil sizes for old materials ($M = 1.04$, $SD = 0.03$) compared to new materials ($M = 1.01$, $SD = 0.03$) for the TD group ($p < .0001$, Cohen's $d = 0.89$). This pupil old/ new effect was absent for the ASD group ($M_{old} = 1.03$, $SD_{old} = 0.04$; $M_{new} = 1.03$, $SD_{new} = 0.08$; $p = .80$, Cohen's $d = 0.04$).
Conclusions:
The current data suggest different underlying recognition memory mechanisms in ASD. Large effect sizes, consistency in findings as well as the dependent measure's independence from either language or conscious awareness suggest that the pupil size old/new effect might be a good measure to investigate memory in ASD further, especially in less verbally able individuals. In addition the current results give some indication for possible differences in underlying neurochemistry in ASD and therefore make changes in pupil size in ASD a candidate biomarker in autism research.

Oral Session - 10B

157 - Cognitive and Perceptual Influences on Learning and Daily Functioning

2:40 PM - 3:30 PM - Room 310

2:40 **157.001** The Role of Executive Function on Adaptive Behavior Skills

J. L. Mussey[1], *K. M. Dudley*[2] *and L. R. Guy*[1], *(1)TEACCH Autism Program, University of North Carolina at Chapel Hill, Greensboro, NC, (2)TEACCH Autism Program, University of North Carolina at Chapel Hill, Carrboro, NC*

Background:
Adaptive behavior abilities are the real-world everyday skills needed for independent living and social functioning, and are often impaired in individuals with ASD, even in those without co-occurring intellectual disability (ID). Impaired adaptive behavior skills have been shown to predict adult outcome over and above intellectual level, highlighting the critical importance for intervention in this area (Klinger et al., 2015 IMFAR panel presentation). In order to better understand the cognitive factors that impact adaptive functioning, research by Pugliese et al. (2014) has documented weaknesses in executive function (EF) skills, particularly initiation, working memory, organization of materials, and mental flexibility were associated with more impaired adaptive functioning.
Objectives:
The aim of the current study is to support and expand the previous work showing a relationship between EF and adaptive behavior in four ways: 1) using a different adaptive behavior measure, the Adaptive Behavior Assessment System (domains = Conceptual, Social, Practical) as most previous research has used the Vineland Adaptive Behavior Scales (domains = Communication, Daily Living, Socialization); 2) extending the age range across the lifespan to include both children and older adults; 3) including a measure of comorbid psychopathology; and 4) including a clinical non-ASD comparison group.
Methods:
This IRB-approved study is a record review of diagnostic evaluations of a clinically-referred population ages 5-66 years seen at a university-affiliated, community-based outpatient clinic. The ADOS-2 and experienced clinical judgment were used to determine ASD diagnosis, and the SRS-2 was used to describe ASD symptom severity. A standardized age-appropriate IQ measure was also administered. EF skills were assessed by parent/teacher/informant report on the BRIEF. The Achenbach scales for children and adults were used to assess co-occurring psychopathology.
Results:
Data collection and analyses are ongoing with a total anticipated n = 80-100. Current n = 46; children ages 5-18 (n=25) and adults ages 19-66 (n=21) with Full Scale IQ ranging from 57-138 (8% diagnosed with ID). 60% met ASD criteria while 40% received other diagnoses instead (e.g., anxiety, depression or ADHD). Preliminary analyses show a significant correlation between adaptive behavior composite and overall EF (r = -.71, p = .001) for those with ASD. In contrast, in the clinical non-ASD group, this relationship was not significant despite also having low adaptive and EF scores (p's > .29). Hierarchical regressions will be run to examine the contributions of age, IQ, EF, and comorbid psychopathology to adaptive behavior. Analyses for individual subgroups will be performed including stratifications across age.
Conclusions:
Preliminary data show relationship between EF and adaptive behavior skills is particularly important in ASD as compared to other developmental and psychiatric disorders. A better understanding of the cognitive and emotional processes that contribute to adaptive behavior can inform interventions that will likely lead to a better outcome for individuals with ASD. Intervention techniques targeting EF skills look promising. One such strategy is Structured TEACCHing, an evidence-based intervention framework that provides supports for deficits in several aspects of EF skills.

2:52 **157.002** Educational Implications of Auditory Processing Deficits in Students with High-Functioning Autism Spectrum Disorders

L. E. Swain-Lerro[1,2], *N. S. McIntyre*[2], *M. C. Zajic*[2], *P. C. Mundy*[3], *J. B. McCauley*[4], *H. K. Schiltz*[5] *and T. Oswald*[4], *(1)School of Education, UC Davis, Davis, CA, (2)University of California at Davis MIND Institute, Davis, CA, (3)Education and Psychiatry, University of California at Davis, Sacramento, CA, (4)University of California at Davis MIND Institute, Sacramento, CA, (5)Human Development, University of California at Davis, Davis, CA*

Background: Reading comprehension and math problem solving difficulties are areas of weakness that impact the academic success of students with higher functioning Autism Spectrum Disorder (HFASD). These academic difficulties are also common to students who suffer from Auditory processing disorders. Imaging studies have reported auditory abnormalities in individuals with autism. Few if any, studies, however, have investigated if auditory abnormities are related to educational difficulties in students with HFASD.
Objectives: This issue was addressed by: 1) Examining if 9- to 17-year-old HFASD students display more evidence auditory processing deficits than clinical and typical control samples, 2) Examining if auditory processing was associated with deficits in reading comprehension in the samples of students.
Methods: A sample of 138 students in four groups HFASD, ADHD, HFASD+ADHD symptoms, and typical development participated in this study. (Table 1). ASD symptoms were confirmed with the ADOS (cutoff score > 7) and ADHD symptoms were confirmed with the Conners-3 parent report (cutoff score >70). Audiological processing was assessed with the SCAN-3:C Tests for Auditory Processing Disorders for Children and reading comprehension was assessed as a latent variable assessed with both the Gray Oral Reading Tests-5 (GORT) and the Qualitative Reading Inventory-4 (QRI).
Results: A repeated measures MANCOVA with IQ as a covariate for the SCAN subtests [Auditory Figure Ground, Filtered Words, Competing Words Directed Ears, Competing Sentences, Competing Words, and Time Compressed Sentences] revealed a significant Diagnostic Group effect, Wilks Lambda= .66, F (21,365) = 2.66, p < 001, eta squared = .13. Pairwise comparisons revealed impairments of the HFASD+ADHD group from the TD and ADHD group on five of the six SCAN measures (see Figure 1). The ASD sample differed from the TD group on four measures but only differed from the ADHD and TD group on Time Compressed Sentences. The HFASD+ADHD group displayed the most consistent pattern of correlations of Reading Comprehension with the SCAN: Auditory Figure Ground r(45) = .43 p < .01, Auditory Reasoning, r(45) = .34 p < .02, Pseudo Word Decoding, r(44) = .33 p < .03, Competing Words Directed Ear r(43) = .40 p < .01, Auditory Reasoning r(43) = .37 p < .02, and Recalling Sentences, r(38) = .42 p < .01. ADOS Total Score was also correlated with SCAN Scores in the HFASD and HFASD+ADHD samples, r(44) = -.30 & -.36, p < .05, respectively.
Conclusions: This study provides evidence that Auditory Processing deficits may be common in HFASD students, related to ADOS symptoms, and contributes to the academic difficulties experienced by these children in elementary and secondary school. The HFASD+ADHD children displayed the greatest impact of Auditory Processing disturbances. Further research is needed to disentangle the degree to which auditory or attention impairments contribute to the poor SCAN responses in this subgroup of children with HFASD.

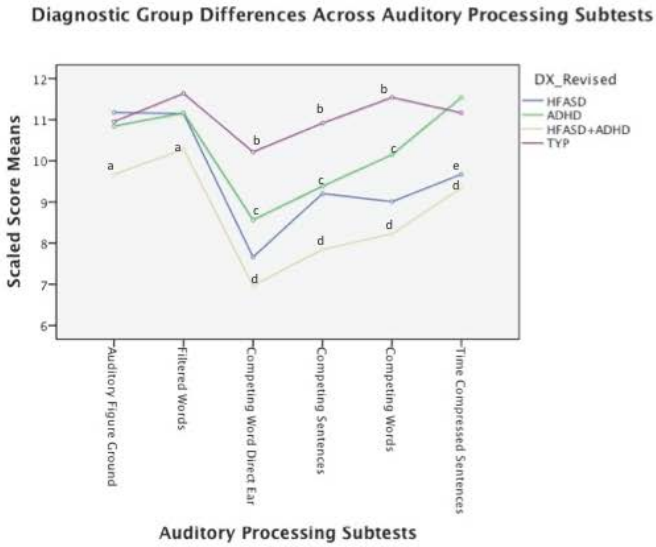
Table 1

Demographic Mean Data (with Standard Deviations in Parentheses)

	Diagnostic Group			
Variable	HFASD (N=22)	ADHD (N=33)	HFASD+ADHD (N=44)	TD (N=39)
Age	11.19 (2.08)	11.87 (2.36)	11.46 (2.04)	11.46 (2.31)
FIQ [a]	101.25 (13.65)	100.28 (15.74)	99.55 (13.69)	114.85 (13.51)
SCQ Total [a, c, e,f]	19.60 (8.43)	6.53 (5.96)	21.70 (6.32)	2.38 (2.18)
ASSQ Total [a,b,c,d]	14.65 (6.38)	8.46 (7.07)	20.41 (4.01)	1.94 (2.83)
SRS Total [a, b,c,d]	74.50 (12.28)	60.63 (14.90)	85.07 (8.06)	45.05 (8.78)
ADOS Total [b,c,d]	9.59 (2.11)	3.79 (3.72)	11.26 (4.17)	
Connor's total [a,b,c,d]	62.08 (8.54)	74.70 (11.77)	79.49 (11.06)	49.81 (11.06)
GORT Comprehension [a]	8.10 (2.73)	8.88 (3.14)	7.55 (2.72)	10.92 (2.40)

Group Differences: [a]TD group is significantly different than Diagnostic Groups $p < .05$
[b] HFASD group is significantly different than ADHD, HFASD+ADHD, and TD groups $p < .05$
[c] ADHD group is significantly different than HFA, HFASD+ADHD, and TD groups $p < .05$
[d] HFASD+ADHD group is significantly different than HFASD, ADHD and TD groups $p < .05$
[e] HFASD group is significantly different than ADHD and TD groups $p < .05$
[f] HFASD+ADHD group is significantly different than ADHD and TD groups $p < .05$

Diagram 1



Covariates appearing in the model are evaluated at the following values: FIQ = 104.043

a= ASD/ADHD group significantly different than all groups ($p < .05$)
b= TYP group significantly different than all clinical groups ($p < .05$)
c= ADHD group significantly different than ASD/ADHD and TYP groups ($p < .05$)
d= ASD/ADHD group significantly different than ADHD and TYP groups ($p < .05$)
e= ASD group significantly different than ADHD and TYP groups ($p < .05$)

3:04 **157.003** Metacognitive Support for Mathematics Learning in Children with Autism Spectrum Disorder (ASD)

K. L. Maras[1], *M. Brosnan*[2] *and T. Gamble*[2], *(1)Claverton Down, University of Bath, Bath, United Kingdom, (2)University of Bath, Bath, United Kingdom*

Background:
Metacognition is awareness of one's own cognition, sometimes termed 'learning how to learn'. One of the best predictors of mathematical achievement is metacognition, predicting outcomes better than IQ (Iacalano et al., 2014). There are different aspects of metacognition that underpin learning, such as monitoring when or where mistakes are made (metacognitive monitoring) and adjusting learning strategies accordingly (metacognitive regulation). Metacognitive tuition enhances mathematics learning among individuals within *and* below the 'normal' range of mathematical ability (Maxwell et al., 2014).
On average, mathematics ability is substantially lower among people with Autism Spectrum Disorder (ASD) than would be expected on the basis of IQ (Mayes & Calhoun, 2003; 2006). Previous research has shown that those with ASD are likely to make two distinct metacognitive monitoring errors when learning mathematical skills. Firstly, they are more likely than children without ASD to think that they have an answer correct when in fact they have answered it wrongly. Secondly, when informed that they have made an error, those with ASD are more likely to report that they meant to make the error (Brosnan et al., 2015; see also Williams & Happé., 2010). This indicates that learners with ASD need specific support for metacognitive monitoring (error awareness, judgments, intentions) in order to effectively adapt their learning strategies (metacognitive regulation).
Objectives:
The aim of the current research was to test computer-based metacognitive support for learners with ASD.

Methods:
Participants: 40 participants with ASD (mean age 13.3 years) and age- and ability-matched typical comparisons.
We developed a “maths challenge” computer program whereby, to maximise points won, participants needed to monitor their performance and adapt their strategy accordingly. The program comprised 7 levels of difficulty and each question answered correctly was worth points commensurate to that level. After each question, participants were asked metacognitive monitoring questions concerning whether they thought they had got the answer correct and whether they had meant to get the answer correct. Participants answered 4 blocks of 3 questions, beginning at level 4. After each block, participants were given the choice of whether to stay at the same level, move up a level to harder questions (worth more points if answered correctly), or move down a level (worth fewer points but easier) for the next bock until they had answered 12 questions in total. In the metacognitive support condition, continuous feedback was provided concerning the accuracy of each answer, and reinforcing the goal. This was absent in the ‘no support’ condition.
Results:
Participants with ASD demonstrated diminished metacognitive monitoring and they made more post-test intention errors (i.e., incorrectly attributing errors as intended). However, when provided with feedback about their performance and goal reminders, learners with ASD won more points by the end of the program than when no metacognitive support was provided (p <.05, d =3.36).
Conclusions:
Children with ASD employed more effective learning strategies when provided with the metacognitive support condition of the Maths Challenge program. Findings highlight the potential for metacognitive support to improve mathematics learning in classrooms.

3:16 **157.004** Vestibular Stimulation Improves Skill Learning in Minimally Verbal Children with ASD: A Comparative Study with ADHD and Typical Controls

G. Katz Nave[1], *Y. Adini*[2], *O. E. Hetzroni*[3] *and Y. S. Bonneh*[4], *(1)Special Education, University of Haifa, Haifa, Israel, (2)Vision Research Inst., Kiron, Israel, (3)University of Haifa, Haifa, Israel, (4)Bar-Ilan University, Ramat Gan, Israel*

Background: ASD and ADHD children share many symptomatic characteristics, such as deficits in sensory processing, attention and learning. All these may jeopardize motor skill learning, especially in the severe minimally-verbal individuals with ASD, who often fail to learn basic perceptual and motor skills for unknown reason. In the current study, we sought to characterize the skill learning deficit in ASD in comparison with ADHD and explore ways for improvement. Previous findings suggest beneficial effects of vestibular stimulation on sensory processing, attention and learning in the typical & ADHD populations, but the data regarding ASD are limited. Preliminary results from this study were reported in IMFAR last year, while the current report extends and consolidates the previous findings.
Objectives: To investigate the evolution in time of skill (sequence) learning and the modulatory effect of vestibular stimulation, in 3 groups of children ages 6-13, comparing minimally-verbal ASD with ADHD and typical development (TD) children.
Methods: All children (N=45) were trained on a touch version of the cognitive related visual-motor SRT task, with 10 short (<300 trials, few minutes) weekly practice sessions. In the task, a fixed sequence of 12 spatial locations, cyclically repeated 8 times in each block of trials, was introduced via visual cues on a touch tablet. The responses were made by rapidly touching the cued location with a finger, thus, unbeknown to the children, the cues introduced a sequence of lateral movements to be learned. The measures for learning were the median and the mean of the series response-time (RT). Each group was divided into two sub-groups, one of which received a vestibular stimulation prior to each training block.
Results: All groups showed gradual median RT improvement (Figure A) with significant speed gains across the training period. The ASD children (n=18) were overall slower (by ~200 ms), with initial intermittent pauses that required prompting to resume. Importantly, the ASD sub-group who received vestibular stimulation (n=10) had significantly larger median speed gains and fewer long pauses in comparison to ASD controls. Vestibular stimulation had no effect on TD and had a small reversed effect on the ADHD group.
Conclusions: These results suggest that vestibular stimulation has a positive effect on learning in minimally-verbal children with ASD, which may have important therapeutic implications. Furthermore, contrary to some previous findings, minimally-verbal children with ASD can acquire and consolidate procedural skills with few short training sessions, spread over weeks, and with a similar time course as non-ASD controls. We suggest cortical arousal as a possible mediating variable, explaining the vestibular effect. For the ADHD group, the lack of positive vestibular effect could be attributed to the short and non-demanding practice sessions we used. For the ASD group, increased arousal may overcome their known deficits in disengagement and reorienting of attention and enhance sequence learning.

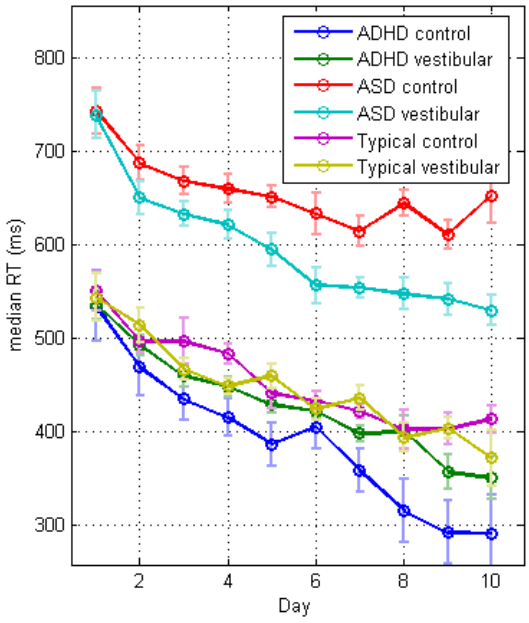


Figure A - The time-course of sequence learning (touch-SRT) in 6 groups of children. Median reaction times (RT) normalized and averaged across observers are plotted as a function of the training day. Error bars denote 1 SE of the average.

Panel Session
158 - Dissecting Comorbidity in ASD: Focus on Inattention, Hyperactivity and Impulsivity
3:30 PM - 5:30 PM - Room 307

Panel Chair: Adriana Di Martino, *Child Study Center, NYU Langone Medical Center, New York, NY*

Overwhelming evidence indicates that inattention, hyperactivity and impulsivity (I/HI), core characteristics of attention-deficit/hyperactivity disorder (ADHD), are among the most frequent psychiatric comorbidities in Autism Spectrum Disorder (ASD). Such comorbidity further compromises functioning and poses challenges for treatment. Yet, little is known regarding the mechanisms underlying the co-occurrence of ASD and I/HI symptoms. For example, it remains unclear if I/HI symptoms in ASD stem from distinct mechanism(s) from those in ADHD and whether assessment and treatment protocols should be identical. Research aiming to attain such knowledge can help advance neuroscientific models of ASD heterogeneity. Further, this work represents a critical step towards identifying individuals at greater risk of I/HI comorbidity, those more likely to respond to currently available treatments, and informing treatment development. This panel integrates state-of-the-art clinical and brain imaging research aimed to provide a nuanced understanding of the overlap of I/HI and ASD. In presenting empirical findings, we will highlight the processes of identifying clinically meaningful markers able to ‘stratify’ children with ASD and I/HI. The working

framework that we will present can inform a range of other efforts addressing sources of heterogeneity in ASD related to psychiatric comorbidities.

3:30 **158.001** Social-Communication and Repetitive Behaviors in Children with ADHD

S. L. Bishop[1], *A. Havdahl*[2], *R. Grzadzinski*[3] *and C. Lord*[2], *(1)Department of Psychiatry, University of California San Francisco, San Francisco, CA, (2)Weill Cornell Medical College, White Plains, NY, (3)Center for Autism and the Developing Brain, New York, NY*

Background: ADHD-like difficulties are present in a significant number of children with ASD. Similarly, children with ADHD have high rates of social difficulties and some authors suggest that, for at least a sub-group of these children, ASD symptoms may be at the root of their social problems. Despite previous restrictions on diagnosing ADHD and ASD together in DSM-IV, recent studies suggest that as many as 50-60% of children with ASD have been given a community diagnosis of ADHD (Blumberg et al., 2015). Recognizing that many children with ASD do indeed have ADHD symptoms that are not fully accounted for by the ASD diagnosis, DSM-5 now allows formal diagnosis of both disorders together. However, many questions remain about the boundaries and overlaps of these two disorders that have major implications for clinicians and researchers.
Objectives: This presentation will discuss symptom overlap between ASD and ADHD, with a particular focus on ASD symptoms that appear to best differentiate the two groups.
Methods: In addition to a discussion of recent literature debating issues of common symptom dimensions in ASD and ADHD vs. actual diagnostic overlap vs. different manifestations of one overarching disorder, new data will be presented from two samples of school-age children (N=50 per sample, FIQ≥80) with ADHD and matched comparisons with ASD. Participants completed ASD symptom measures, including the Autism Diagnostic Interview-Revised, Autism Diagnostic Observation Schedule, and Social Responsiveness Scale, as well as measures of IQ and behavior problems. One group of children with ADHD was comprised of clinical referrals to ASD specialty clinics who ultimately received ADHD diagnoses; the other was a group of children with previous diagnoses of ADHD who were recruited for a research study.
Results: Children with ADHD received elevated scores across standardized ASD symptom measures, with a significant minority meeting cut-offs on one or more of the instruments. Not surprisingly, children of parents seen at ASD specialty clinics (who were mostly self-referred) received much higher scores on parent-report measures of ASD symptoms than children with previous diagnoses of ADHD recruited. However, the two groups of children with ADHD were similar in terms of clinician-observed social-communication impairments and restricted and repetitive behaviors. Moreover, according to parents and clinicians, both clinically-referred and research-recruited children with ADHD exhibited particular impairments in higher level social behaviors (e.g., conversation, quality of overtures and responses), while impairments in basic social communication skills (e.g., eye contact, facial expressions) and social motivation were less frequently impaired in these children. Scores on the different ASD symptom measures showed different relationships with age, IQ, language, and behavior problems that sometimes varied between the two diagnostic groups.
Conclusions: These results raise several important points related to differential and comorbid diagnosis of ASD and ADHD in clinic settings. For researchers, information about how children with ADHD (without ASD) perform on ASD symptom measures must be carefully considered in studies designed to understand shared mechanisms in ASD and ADHD. Coordinated, multidisciplinary efforts to develop behavioral and biological measures of dimensions relevant to both disorders should be prioritized.

4:00 **158.002** Imaging the Connectome in Autism and ADHD: What' s Distinct and What's Shared?

A. Di Martino*, NYU Child Study Center, New York, NY*

Background: Although Autism Spectrum Disorder (ASD) and Attention-Deficit/Hyperactivity Disorder (ADHD) were conceptualized as distinct disorders, their symptoms co-occur more often than expected by the prevalence of each alone. On one hand, this is consistent with recent models highlighting the dimensional nature of psychopathological domains across diagnostic categories. On the other hand, whether these co- occurring conditions stem from similar underlying biological mechanisms remains unknown. Recent advances suggest pediatric imaging is well positioned to address this question. In particular, several lines of evidence support the notion that both ASD and ADHD are neurodevelopmental connectopathies, i.e., disorders that stem from anomalies in the connections between brain regions, rather than from localized anomalies. Unfortunately, however, with a few exceptions, most brain imaging studies have examined individuals with ADHD and ASD separately.
Objectives: To present our empirical work examining the extent to which abnormalities in the functional architecture of the connectome is shared between ASD and ADHD.
Methods: Findings from resting-state fMRI studies of over 150 children with ASD, ADHD and typically developing controls (aged 7-13 years) stratified by symptom domains will be presented and integrated with the current literature.
Results: Results from a full-brain exploration of the functional connectome using network centrality identified several loci of dysconnections; some appeared specific to ADHD or ASD, others were shared between these conditions. When we accounted for ADHD comorbidity in children with ASD, we identified ADHD-related network abnormalities beyond categorical diagnoses. Specifically, children with ADHD and those with ASD and comorbid ADHD showed increased degree centrality in cognitive and motor striatal regions relative to either ASD without ADHD comorbidity or TDC. Notably, the degree of abnormal connectivity was significantly related to dimensional measures of ADHD symptom severity. This initial study was not designed to also assess autistic traits in both children with ASD and ADHD. Accordingly, we examined functional connectivity between two 'social brain' nodes in an extended sample of children with ADHD and ASD. We found that reduced connectivity between the right fusiform face area and rostral anterior cingulate was reduced in children with ADHD presenting autistic traits similarly to those with ASD, regardless of ADHD comorbidity.
Conclusions: This initial work illustrates the utility of eschewing extreme comparisons (i.e., only focusing on ASD vs. TDC) as it allows identifying potential biomarkers specific to and shared across psychiatric conditions. When this is combined with stratifying participants as a function of the degree of psychopathology, additional shared dysfunctions are identified. This suggests that hybrid models of psychopathology (categorical AND dimensional) should be considered for brain imaging analyses as well as for identification and treatment.

4:30 **158.003** Dimensional Analysis of Executive Dysfunction Comorbidity in ASD and ADHD

C. J. Vaidya[1], *X. You*[2], *M. Norr*[3], *E. Murphy*[3], *W. D. Gaillard*[2] *and L. Kenworthy*[4], *(1)Department of Psychology, Georgetown University, Washington, DC, (2)Children's Research Institute, Childrens National Medical Center, Washington, DC, (3)Department of Psychology, Georgetown University, Washington D.C., DC, (4)Children's Research Institute, Children's National Medical Center, Rockville, MD*

Background: One challenge to understanding the neural basis of executive dysfunction comorbidity between Attention Deficit Hyperactivity Disorder (ADHD) and Autism Spectrum Disorder (ASD) is that executive function (EF) is multidimensional and extent of impairment highly heterogeneous within each disorder. Further, EF abilities vary greatly among typically developing children as well. Thus, which EF dimensions are most relevant to comorbidity is elusive.
Objectives: We first applied a novel data-driven graph theory method, community detection, to identify relevant EF dimensions across ADHD, ASD, and control children, and then examined their neural basis using task-based functional magnetic resonance imaging (fMRI). Our fMRI tasks were designed with the premise that controlling attention in an adaptive and flexible manner subserves EF.
Methods: We included 114 7-14 year-old children matched for age and IQ (35 ASD, 20 ADHD, 59 controls) and collected parent-report of 10 measures, Inattention and Hyperactivity/Impulsivity from ADHD Rating scale and 8 subscales selected from the BRIEF (Inhibit, Shift, Emotion Control, Initiate, Working Memory, Plan/Organize, Organization of materials, Monitor). Community detection was applied using a weight-conserving modularity algorithm not dependent on threshold, yielding 3 communities: #1 defined by worse planning and organizing but relatively better cognitive flexibility and hyperactivity/impulsivity (21 ASD, 6 ADHD, 29 Controls); #2 defined by worse cognitive flexibility but relatively better planning/organizing and hyperactivity/impulsivity (12 ASD, 4 ADHD, 16 controls); and # 3 defined by worse hyperactivity/impulsivity but relatively better planning organizing and cognitive flexibility (2 ASD, 10 ADHD, 14 Controls). Imaging was performed at 3T during 2 runs of a shape-classification task with right-hand response, in which distracters were flashed in the periphery. Runs differed in task-context, the first being stimulus-driven as distractors were irrelevant to the task, and the second requiring top-down control as a distractor was designated as target requiring left-hand response. Activation difference between the first to second run reflected attentional modulation by task-context, termed adaptive flexibility. Images were slice-time and motion-corrected, normalized to EPI template and resliced to 3mm, smoothed with 8mm FWHM and using stringent motion-criteria retained 88 subjects (51 controls, 26 ASD and 16 ADHD). We identified regions reflecting adaptive flexibility by Run x Distractor interaction in whole-brain ANOVA in SPM 8 ($p < .05$ Monte Carlo corrected; $p<.001$, $k=28$ voxels). For each cluster ROI, hierarchical linear regression tested whether clusters accounted for more variance than DSM-based groups.
Results:
Significant Run x Distractor interaction was observed in visual attention regions, bilateral middle frontal gyrus, bilateral insula and putamen, bilateral SPL-TPJ and postcentral gyrus, dorsal ACC, SMA, precuneus, right MTG and left visual cortex and community-based grouping accounted for more variance in right TPJ ($p=.04$) and right MFG ($p=.029$) than DSM groups, with greatest flexibility-related activation for community #1, scoring best on measures of attention and flexibility and worse on planning/organizing.
Conclusions:
Our results suggest that executive dysfunction variability across ASD, ADHD and control children is better conceptualized by three distinct functional profiles associated with variability in frontal-parietal cortical engagement during flexible attentional control

5:00 **158.004** ASD and Inattention: Multimodal Imaging Implicates the Salience Network

B. E. Yerys[1], *M. G. Mosner*[2], *L. Antezana*[3], *L. Kenworthy*[4], *B. Tunc*[5], *T. Satterthwaite*[5], *R. Verma*[6], *W. D. Gaillard*[7], *C. J. Vaidya*[8], *C. Davatzikos*[5] *and R. T. Schultz*[9], *(1)The Center for Autism Research, Philadelphia, PA, (2)University of North Carolina at Chapel Hill, Carrboro, NC, (3)Virginia Tech, Blacksburg, VA, (4)Children's Research Institute, Children's National Medical Center, Rockville, MD, (5)University of Pennsylvania, Philadelphia, PA, (6)Center for Biomedical Image Computing and Analytics, University of Pennsylvania, Philadelphia, PA, (7)Children's Research Institute, Childrens National Medical Center, Washington, DC, (8)Department of Psychology, Georgetown University, Washington, DC, (9)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA*

Background: Attention impairments are common in youth with autism spectrum disorder (ASD), and these impairments are associated with a number of negative outcomes. While stimulants are effective in reducing attention impairments, fewer children with ASD responded positively to stimulants (~50%) compared to children with attention deficit/hyperactivity disorder (70-90%). This suggests that in a sizable portion of children with ASD inattention may have a different underlying neural basis. There is limited data on the neural basis of inattention in the context of ASD across multiple imaging modalities, such as functional MRI (fMRI), resting state MRI (rsMRI), and diffusion tensor imaging (DTI).
Objectives: To characterize the neural basis of inattention symptoms in children with ASD using a modified flanker fMRI task, rsMRI, and DTI.
Methods: A total of 146 youth with ASD and 113 typically developing controls were enrolled across all three modalities. The flanker fMRI task (ASD n=36; TDC n=24) had three conditions: Neutral, Incongruent, and Congruent. Each trial started with a middle arrow surrounded by flanking stimuli. Participants responded to the direction of a middle arrow and ignored flanking diamonds (Neutral), flanking arrows pointing in the opposite (Incongruent), or the same direction (Congruent) as the target. We utilized a novel multivariate pattern analysis with the Interference Suppression contrast (Incongruent vs. Neutral) to identify unique brain signatures in the ASD group relative to the TDC group. For resting state data (ASD n=83; TDC n=83) and DTI data (ASD n=140; TDC n=109) we examined within and cross-network connectivity for regions distinguishing ASD subgroups in the fMRI analysis.
Results: The multivariate analysis found two distinct clusters within the ASD group. Cluster 1 was characterized by a prominent difference in the dorsal anterior cingulate that falls within the salience network, as well as middle cingulate, primary motor, left dorso- and ventrolateral prefrontal cortex, left orbitofrontal cortex, bilateral thalamus, bilateral hippocampus, and bilateral cerebellum. Cluster 2 was characterized by differences in the left inferior frontal and inferior parietal cortices associated with language, and the precuneus. Cluster 1 showed medium-to-large effects for more severe attention impairments and a larger interference suppression effect (RT) on the Flanker task. Resting state analyses demonstrated that the ASD group had lower within-network functional connectivity in the salience network, and this correlated with Inattention symptoms ($r=-.29$, $p<.05$). This correlation increased to $r=-.50$, $p<.05$ when probing the subset in Cluster 1. Finally, the DTI data revealed significantly reduced tracks between the salience and dorsal attention networks in youth with ASD and 6+ Inattention symptoms compared to the TDC group and youth with ASD and <6 Inattention symptoms.
Conclusions: Deviations in the salience network's function, and functional and structural connectivity associates with greater inattention symptoms in youth with ASD. Interestingly the salience network is not a primary target of stimulant medication. Thus this initial work provides insight into the neural basis of inattention for children with ASD. Moreover, we hypothesize the salience network may play a greater role for those who do not respond to stimulants.

Panel Session
159 - Translational Approaches to Abnormal Communication in ASD
3:30 PM - 5:30 PM - Hall B

Panel Chair: Laura Morett, *University of Pittsburgh, Pittsburgh, PA*

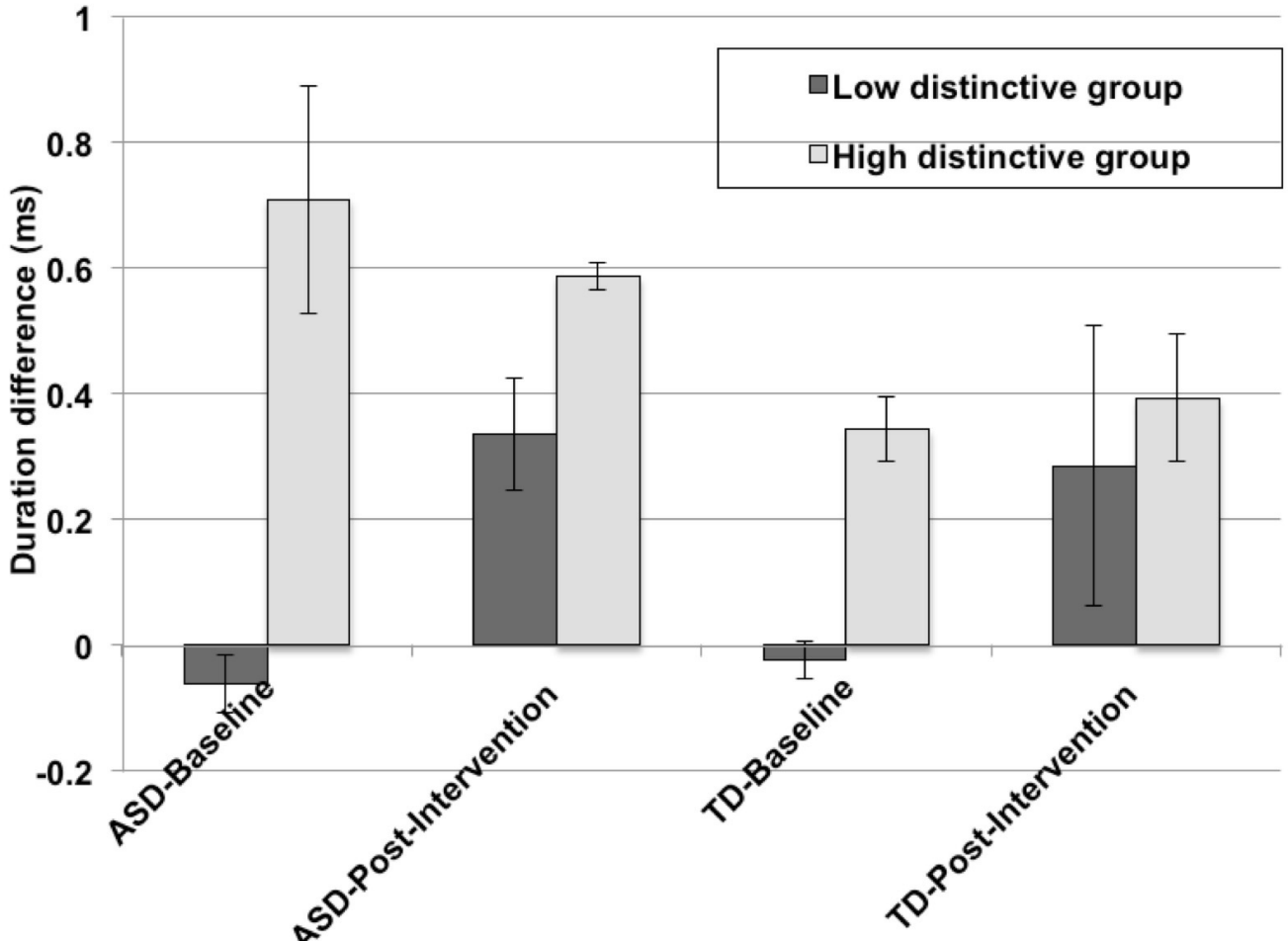
Discussant: Joshua Diehl, *LOGAN Community Resources, Inc., South Bend, IN*

According to the DSM-5, social communication impairments are one of two core diagnostic criteria for autism spectrum disorder (ASD), resulting in reduced ability to function independently. The goal of this panel is to show how basic research findings on communication deficits in ASD can improve the assessment and treatment of these impairments. This panel will present research on several aspects of abnormal communication in ASD, with particular attention to implications for diagnosis and treatment. One strand of research will focus on the use of vivo brain imaging techniques to reveal biomarkers of abnormal auditory processing, emotional language comprehension, and temporal gesture-speech integration. The ability of these biomarkers to improve impairment detection, individual stratification, and assessment of treatment efficacy will be discussed. Another strand of research will demonstrate the efficacy of a brief, low-cost intervention providing explicit instruction in prosodic phrasing. The implications of this intervention for theories of impaired communication in ASD will be discussed. A discussant who conducts research on communication in ASD and advises an organization providing evidence-based treatments for communication deficits in ASD will enrich discussion of the translational significance of the research presented in this panel, ensuring its informativeness for scientists, practitioners, and stakeholders alike.

3:30 **159.001** A Brief, Low-Cost Intervention for Prosodic Phrasing in High-Functioning ASD: Translating Science into Treatment

I. M. Eigsti[1] *and J. Mayo*[2]*, (1)University of Connecticut, Storrs, CT, (2)Psychological Sciences, University of Connecticut, Storrs, CT*

Background: Atypical prosody is frequently reported in autism spectrum disorder (ASD), and deficits have significant negative consequences for social and occupational functioning. They are also persistent: Even individuals who attain average expressive and receptive language skills (per standardized assessment) often have atypical prosody. Though novel methods have been developed (e.g., iPad applications), there is limited empirical evidence for these or other interventions for expressive prosody in ASD; this evidence points to the efficacy of explicit training on the nature and use of supra-linguistic cues, including prosody.
Objectives: We examined spontaneous ("baseline") production of prosodic cues, and compared these to productions following a brief intervention involving *explicit discussions* of prosody and opportunities for structured imitation and practice.
Methods: Participants included adolescents with ASD and typical development (TD; n=15 per group). Groups did not differ in age, IQ (>80), or gender, p's > .50. Participants were told to instruct a "partner" (a research assistant) to perform actions using small toys (Snedeker & Yuan, 2008). Eight critical trials had syntactically ambiguous phrasing; to provide a clear instruction, subjects had to rely on prosodic cues (*pause lengthening, clause duration*). We asked whether subjects were aware of the syntactic ambiguity, and what strategies they employed for disambiguation. Subjects then participated in a five-minute intervention, consisting of visual slides with a voiceover, that gave direct instruction to clarify the presence of the ambiguity, provided explicit instruction about prosodic phrasing, and prompted subjects to imitate prosodic phrasing. Finally, subjects completed "post-intervention" trials containing the same syntactic ambiguity (with trial-unique stimuli). Trials were recorded and analyzed using Praat. In addition, naïve college student raters listened to recordings and chose a syntactic match for each.
Results: Interestingly, there were *no* mean group differences in acoustic variables, at baseline; naïve raters were at chance in interpreting the ambiguity. Following the intervention, *all* participants increased pause length and clause duration, and raters were significantly *better* than chance at interpreting the ambiguity. While there were no mean group differences, there was a subset of participants, in the ASD only, who were unaware of the ambiguity. Following the intervention, naïve raters were above chance in interpreting productions of the "unaware" group. Also, a subset of subjects across groups ("low distinctiveness") was initially ineffective at producing prosodic cues; this subset was indistinguishable from the "high distinctive" group following intervention (Figure 1).
Conclusions: Results suggested intact groupwise performance for expressive syntactic prosody, consistent with reports that atypical prosody is not universal in ASD (Shriberg et al., 2001). Acoustic analyses indicated no group differences at baseline or after intervention. However, a subset of participants with ASD was initially unable to use prosodic cues effectively; they made *significant gains* in prosodic phrasing following intervention. Participants in *both* ASD and TD groups demonstrated more effective expressive prosodic phrasing following a brief, targeted intervention. Future research must examine generalizability of these findings to lower-functioning individuals and to other syntactic phrases, and efficacy of long-term retention. These promising results suggest that a low-cost, brief intervention may yield clinically-meaningful effects.



3:55 **159.002** MEG Measures of Auditory Processing in ASD: Prognostic Biomarkers

T. P. Roberts[1,2], *R. G. Port*[2], *L. Blaskey*[1] *and J. C. Edgar*[1], *(1)Children's Hospital of Philadelphia, Philadelphia, PA, (2)Neuroscience Graduate Group, Biomedical Graduate Studies, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA*

Background: Biomarkers for ASD have been discussed in terms of their potential *diagnostic* utility and as a biologically-based rationale for population *stratification* with potential implications for patient management. Among a broad spectrum of approaches, candidate measures proposed as such biomarkers derive from imaging and, promisingly, electrophysiologic techniques (such as EEG and MEG). The latter have attractive features in terms of high temporal resolution, sensitivity for neuronal electrical activity and, importantly, mechanistic interpretation including anomalies of central conduction velocity and local circuitry functionality. This study extends prior studies of auditory processing using MEG and specifically focuses on *latency* and *spectrotemporal* indices (gamma-band oscillatory activity) as prognostic biomarkers in a *longitudinal*design over up to 5 years.
Objectives: To determine whether MEG measures of auditory processing, specifically the "M100" component latency and the evoked gamma-band power mature over a 2-5 year observation period, whether they are associated with behavioral measures, and whether baseline measures predict unique variance at follow-up.
Methods:
36 children (27 ASD, 9 TD, mean age 8yrs) underwent MEG examination (including auditory evoked responses) and clinical behavioral assessment (including ADOS, SRS, CELF-4 and IQ). 2-5yers later they repeated the combination assessment. Briefly, MEG assessments included characterization of the auditory evoked M100 response latency elicited by sinusoidal tone stimuli presented binaurally at 45dB SL while subjects underwent whole head MEG using a 275-channel device. Clinical/behavioral assessments were used to confirm ASD diagnosis as well as score dimensionally axes of autism spectrum (using the social responsiveness scale, SRS), language impairment (CELF-4) and general cognitive ability (WISC-IV). Linear mixed modeling was used to assess the association between MEG and behavioral measures. Hierarchical regression was used to assess the predictive value of baseline MEG in determining follow-up behavioral scores *above and beyond* that predicted by baseline scores and age alone.
Results: Consistent with previous reports, a main effect of Diagnosis on M100 latency (TD=119±7.9ms; ASD=139±5.0 ms; p <0.05) and gamma-band activity (TD=61.5±6.4% change from baseline; ASD=38.4±4.7%; p<0.01) was seen. Maturational shortening of M100 latency and increase in gamma-band activity was also observed over the 2-5year follow-up.
M100 latency showed a significant association with SRS, with longer latencies associated with higher scores (r=0.53, p<0.001). No association was observed between M100 latency and scores of language or general cognitive ability. Baseline M100 latencies did, however, predict additional variance in follow-up language (CELF-4) (p<0.05) and cognitive (WISC-IV) measures in a model that included baseline values of the behavioral measures.
Conclusions: MEG measures of auditory processing, including temporal and spectrotemporal (gamma-band) indices offer *prognostic* insight and behavioral correlation, in addition to their previously-suggested roles in diagnosis and stratification. The multiple biomarker roles served by such measures of neuronal function in ASD, coupled with suggested biological underpinnings and evidence of translatability to preclinical models, enhance the potential value of these measures in evaluating and characterizing the development of brain activity and behavioral sequelae in children with ASD.

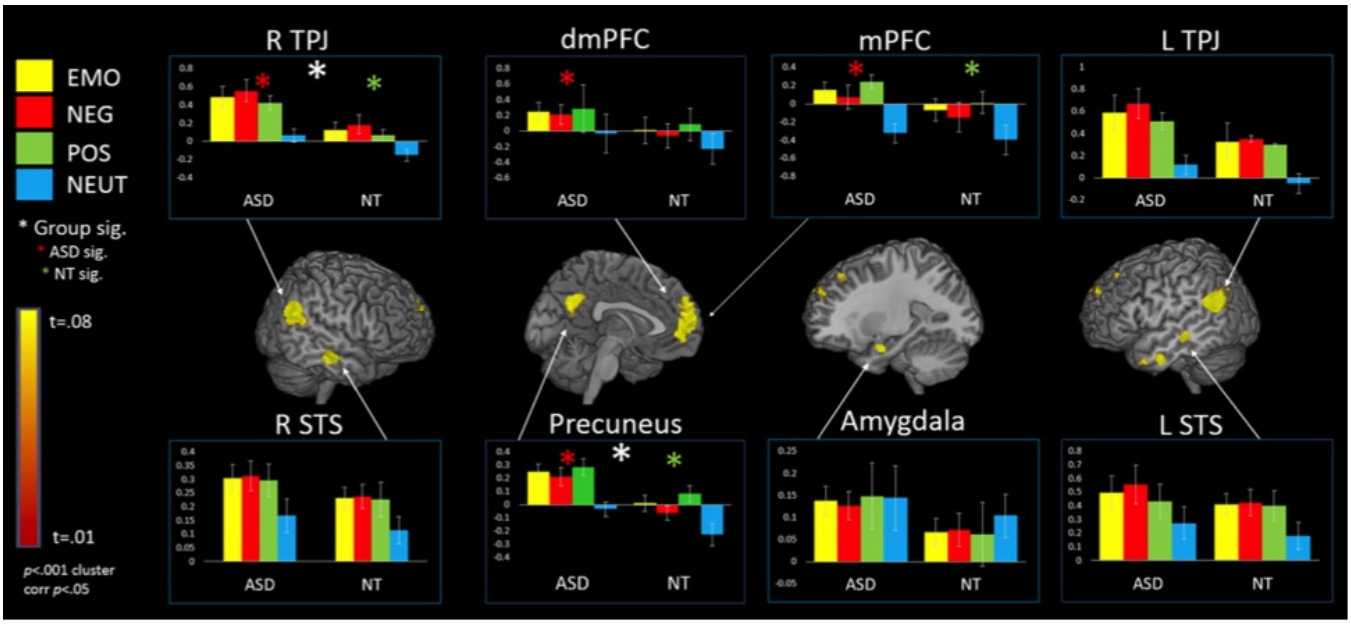
4:20 **159.003** Emotional Language Processing in Individuals with and without Autism

L. A. Sand[1], *E. Redcay*[2], *T. Zeffiro*[3] *and D. J. Bolger*[1], *(1)Human Development & Quantitative Methodology, University of Maryland, College Park, MD, (2)Department of Psychology, University of Maryland, College Park, MD, (3)Neurometrika, Potomac, MD*

Background: A fundamental aspect of successful social interactions is the ability to accurately infer others' intent through verbal communication, often including information related to the speaker's feelings. Autism (ASD) is characterized by atypical language and social-emotional processing, including aberrant neural responses to socially-relevant stimuli like faces, eyes, and prosody. While findings are mixed regarding the nature of emotional language processing in autism, existing evidence suggests that comprehension skills are generally stronger than expressive abilities.
Objectives: We investigated whether the process of making emotional inferences from spoken language in autism is associated with atypical neural activity in the brain regions subserving emotion processing, including anterior cingulate cortex (aCC), medial- and ventromedial prefrontal cortex (mPFC, vmPFC), and amygdala. A secondary question involved whether autistic individuals engage compensatory activity in areas typically involved in inferential language processing, including aSTS, pCC, dorsal medial prefrontal cortex (dmPFC), inferior frontal gyrus (IFG), or the superior temporal gyrus (STG) bilaterally.
Methods: Functional MRI data was collected from 15 ASD individuals and 16 controls (NT; 15-30yrs) on an emotional inference task (EIT). Activity changes were estimated during two epochs: hearing positive, negative, and neutral scenarios, and during responses to a related T/F question. Accuracy and response time were recorded. We used an accelerated multiband (MB) echo planar imaging (EPI) protocol that provides both high temporal and spatial resolution, thus enabling more accurate measurement of functional responses.
Results: For both groups, behavioral and neural results show that participants' reactions varied depending on sentence valence and congruency, but with differential effects. Behaviorally, both groups showed overall faster and more accurate responses to emotional relative to neutral scenarios, as well as for congruent compared to incongruent judgments. However, in comparison to the typicals, the ASD group showed greater difficulty evidenced as slower and less accurate responses for incongruent judgements,

especially in the negative (RT: ASD 1.57sec, NT 1.23sec; accuracy: ASD 87.9%, NT 95.3%) and neutral (RT: ASD 1.66sec, NT 1.45sec; accuracy: ASD 86.3%, NT 93.2%) valence conditions. Brain responses of the ASD group also differed from controls. Our main findings reveal similar activity patterns between groups, but with significant between-group effects including increased activity in individuals with ASD in right TPJ and precuneus for emotional but not neutral scenarios. Brain-behavior correlations showed that greater recruitment of rSTS was related to better social abilities as measured by the “Empathy Quotient” (EQ) and “Reading the Mind in the Eyes” (MinE) in controls, but this effect was not seen in ASD. In the autism group, improved social skills from EQ, MinE and the Autism Quotient (AQ) predicted greater amygdala and mPFC activity.

Conclusions: Our results suggest that autistic individuals are able to correctly identify others’ feelings from language that lacks overt prosodic elements or emotionally-charged words. Furthermore, like neurotypical individuals, their neural activity patterns are enhanced to positive compared to neutral valence conditions. However, in contrast to typicals, the autism group showed overall greater task-related brain activity, possibly suggesting that the task is more effortful for them.



4:45 **159.004** Biomarkers of Abnormal Temporal Gesture-Speech Integration in ASD

L. Morett[1], *B. A. Coffman*[1], *Y. Li*[2,3], *B. Luna*[1] *and A. S. Ghuman*[1], *(1)University of Pittsburgh, Pittsburgh, PA, (2)Center for the Neural Basis of Cognition, Carnegie Mellon University, Pittsburgh, PA, (3)Department of Neurological Surgery, University of Pittsburgh, Pittsburgh, PA*

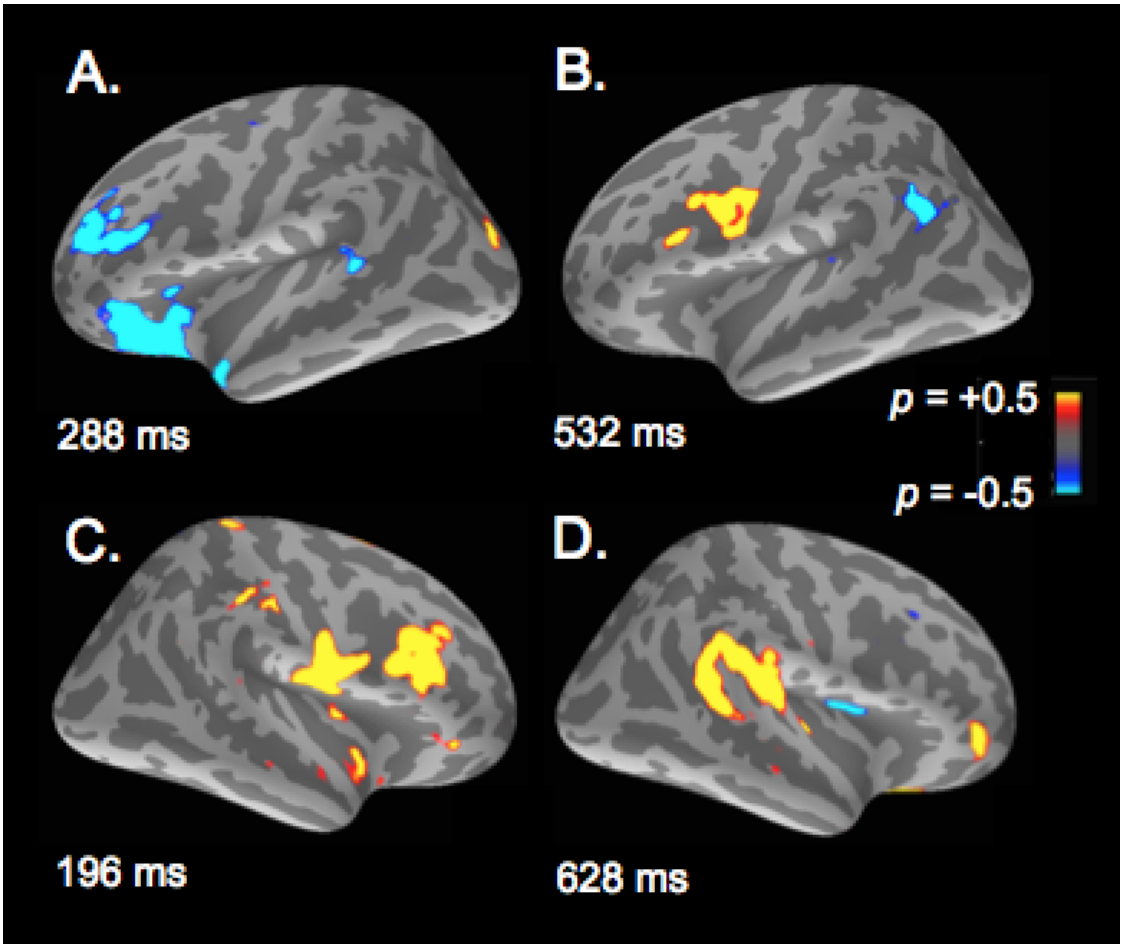
Background: Ineffective communication via speech and gesture (meaningful hand movements) is a primary diagnostic characteristic of Autism Spectrum Disorder (ASD). Typically developing (TD) individuals are highly sensitive to temporal asynchrony of gesture and speech. However, individuals with ASD show decreased sensitivity to temporal asynchrony of visual and verbal stimuli. Currently, it is unclear how this decreased sensitivity to temporal asynchrony affects gesture-speech integration in ASD, and whether it is reflected in the neural signal.

Objectives: The objectives of this research were (1) to examine temporal gesture-speech synchrony in ASD and (2) to determine whether neural activity reflects sensitivity to temporal gesture-speech asynchrony. It was predicted that gestures and speech produced by individuals with ASD would show greater temporal asynchrony than those of TD peers. Additionally, it was hypothesized that posterior superior temporal sulcus (pSTS) and inferior frontal gyrus (IFG), two brain regions critical to language and multimodal processing, would demonstrate sensitivity to temporal gesture-speech asynchrony.

Methods: Participants in study 1 included 18 high-functioning ASD and 23 TD individuals matched in age, gender, and verbal IQ (all *p*s < .05). In this study, participants viewed a brief cartoon video and retold its events to an experimenter while being tacitly video recorded. Gestures and speech were later transcribed and coded by two raters unaware of the experimental design and predictions (ICC=.79 for speech onset; .89 for gesture onset). To control for group differences in speech production, rate of gestures was normalized for speech production. Participants in study 2 included 15 TD individuals. In this study, participants viewed clips excerpted from a longer video of a speech, such that a beat (simple rhythmic) gesture always occurred at 1.5 s. Accompanying audio clips were presented either simultaneously with or 500 ms preceding video clips. Neural data was collected continuously using magnetoecepholagraphy (MEG), a neurophysiological method with high spatiotemporal accuracy, and was temporally synched to gesture onset for analysis.

Results: In study 1, individuals with ASD produced more temporally asynchronous gestures than TD individuals (p=.05). In study 2, less activity was observed in pSTC and IFG in left hemisphere during concurrent speech and gesture processing than during processing of speech preceding gesture by 500 ms ($p < .05$, corrected; see Fig. 1). In contrast, more activity was observed in these regions in right hemisphere during concurrent gesture-speech processing than during the processing of speech preceding gesture ($p < .05$, corrected).

Conclusions: The results of study 1 demonstrate greater temporal asynchrony in gesture-speech production in ASD than in TD, suggesting that insensitivity to temporal asynchrony in ASD is reflected in gesture-speech production. The results of study 2 show that activity in pSTC and IFG reflects sensitivity to temporal gesture-speech asynchrony. Furthermore, they indicate that laterality of activation in these regions reflects the directionality of this sensitivity. These results form the basis of future research that will use the methods employed in study 2 to examine the neural bases of temporal gesture-speech integration in ASD, which will reveal biomarkers of abnormal receptive communication in this disorder.



Panel Session
160 - The Well-Being and Potential Service Needs of Siblings of Youth with Autism Spectrum Disorder
3:30 PM - 5:30 PM - Room 308

Panel Chair: Megan Tudor, *Yale Child Study Center, Yale School of Medicine, New Haven, CT*

Discussant: Denis Sukhodolsky, *Yale Child Study Center, Yale School of Medicine, New Haven, CT*

As the number of youth with an autism spectrum disorder (ASD) diagnoses rises (Kim et al., 2011), the number of youth growing up with a brother or sister with ASD also multiplies. Research attempting to characterize these youth and identify distinctive patterns of their well-being and adjustment has yielded mixed and sometimes contradictory findings (e.g., Orsmond & Seltzer, 2007). This literature often examines the presence of a child with ASD in the family as a sole predictive factor of sibling outcomes, while ignoring other potentially relevant variables (e.g., Hodapp, Glidden, & Kaiser, 2005). This panel will aim to broaden the lens of sibling outcome research by exploring novel predictive factors, such as sibling relationships and maternal psychological functioning, which may inform sibling outcome pathways across families, rather than identify a singular sibling profile. Findings draw from parent and sibling-report in various contexts (e.g., across the lifespan, pre- and post- intervention groups). Ultimately, this panel will provide a framework for this "new wave" of sibling research that allows for a more multifaceted approach to studying both risk and resilience for siblings, as well as providing effective services for the subset of these youth that may be in need of clinical supports.

3:30 **160.001** Psychosocial Outcomes Among Adult Siblings of Individuals with ASD and Other Developmental Disorders: Support for Potential Risk/Protective Factors and Points of Intervention

T. S. Tomeny[1], *L. K. Baker*[1], *S. W. Eldred*[1], *J. A. Rankin*[1] *and T. D. Barry*[2], *(1)Psychology, The University of Alabama, Tuscaloosa, AL, (2)Psychology, Washington State University, Pullman, WA*

Background: Typically-developing (TD) adult siblings are often tasked with caring for their siblings with ASD or other developmental disability, both during childhood and in adulthood (e.g., Heller & Kramer, 2009). Given genetic (e.g., broader autism phenotype) and environmental (e.g., increased burden) risk factors, conventional thinking suggests that TD adult siblings may be at increased risk for negative outcomes. However, research on TD child siblings has found wide variability in childhood psychosocial constructs (e.g., Meadan et al., 2010; Orsmond & Seltzer, 2007). These discrepancies suggest that negative outcomes only occur under certain conditions; however, little research has examined TD siblings during adulthood.
Objectives: This presentation aims to provide descriptive information about psychosocial outcomes among a sample of adult siblings of individuals with ASD and/or intellectual disabilities (IDs). Possible risk and protective factors and points of intervention will be discussed. Finally, examination of differences according to sibling disability type and indirect effects of diagnostic group inclusion through sibling relationship attitudes on psychosocial outcomes will be presented.
Methods: 105 TD siblings (*M*age = 33.04, *SD* = 14.13) completed a demographic form, the Depression Anxiety and Stress Scale (DASS; measure of distress in siblings), the Parentification Inventory (PI, measure of childhood parentification), the Interpersonal Support Evaluation List (ISEL, measure of social support), the Lifespan Sibling Relationship Scale (LSRS; measure of sibling relationship attitudes) and the Satisfaction with Life Scale (SLS; measure of life satisfaction).
Results: Descriptive statistics and correlations among the variables of interest will be presented to provide context. For specific mediation analyses, covariates were determined *a priori* and entered into the models where necessary. A series of multiple regression analyses revealed that sibling relationship attitudes predicted several outcomes in TD siblings across both groups: level of assistance provided, $\Delta F(5, 76) = 7.65$, $p = .01$, $\Delta R^2 = .07$; life satisfaction, $\Delta F(3, 78) = 6.39$, $p = .01$, $\Delta R^2 = .07$, depression $\Delta F(3, 77) = 9.33$, $p = .003$, $\Delta R^2 = .09$, and stress, $\Delta F(3, 78) = 4.78$, $p = .03$, $\Delta R^2 = .05$. TD siblings in the ASD group reported significantly fewer positive sibling relationship attitudes compared to siblings in the ID group. Using bootstrapping analytical methods via Hayes's PROCESS macro (Hayes, 2013), indirect effects of group membership on assistance [point estimate = -.93 (95% CI [-2.26, -.22])], depression [point estimate = 2.00 (95% CI [.52, 4.53])], and stress [point estimate = 1.52 (95% CI [.25, 3.61])] in TD siblings through sibling relationship attitudes were identified (Figure 1).
Conclusions: Overall, TD siblings' report of outcomes varied, with some differences related to the type of disability (ASD or ID) experienced by the affected sibling. Over and above demographic correlates, sibling relationship attitudes appear to be an important predictor of psychosocial outcomes among TD adult siblings. Moreover, the identified indirect effects suggest that sibling relationship attitudes may be a particularly salient point of intervention for improving sibling functioning, particularly among siblings of individuals with ASD. Clinical implications of other identified risk- and protective-factors (e.g., low or high social support) will also be discussed.

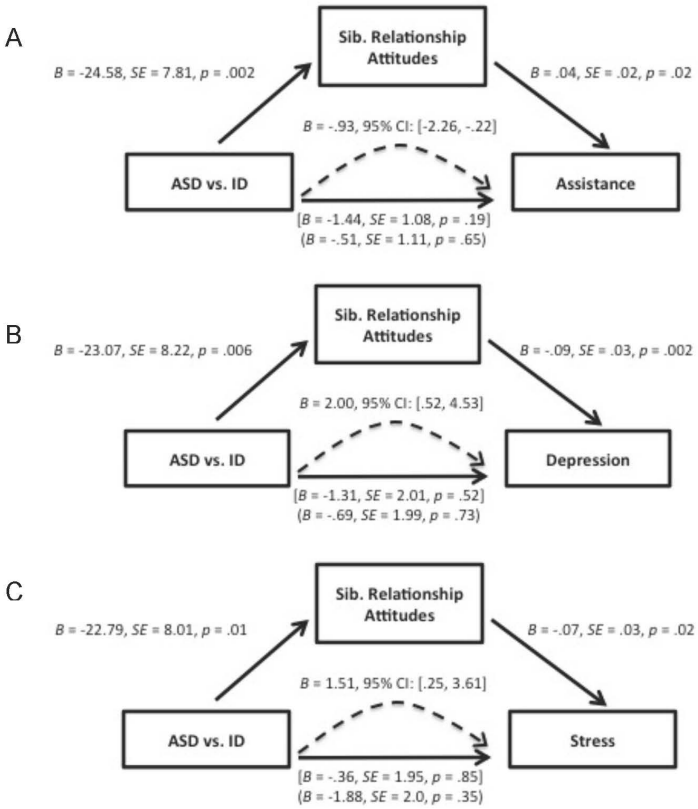


Figure 1. Mediated outcomes on TD sibling assistance provided (panel A), depression (panel B), and stress (panel C) showing indirect effects of group membership through sibling relationship attitudes. *Note:* Propensity scores were entered as a control variable for all three panels. For panel A, birth order, race (dichotomized: 1 = white, 0 = nonwhite), geographic distance, and sibling age difference (absolute value) were additional covariates. For panel B, TD sibling marital status (dichotomized: 1 = living with significant other, 0 = living alone) and TD sibling income were additional covariates. For panel C, birth order and TD sibling income were additional covariates. Unstandardized regression covariates are reported. Statistics in brackets show the total effect of the predictor on the outcome; statistics in parentheses show the direct effect of the predictor on the outcome, after controlling for the indirect effect of the mediator. Each indirect effect (depicted above each curved, dashed arrow) was significant based on an asymmetric 95% confidence interval with 5000 resamples with replacement (Hayes, 2013).

3:55 **160.002** Enhancing the Sibling Relationship: Outcomes of a Support Group for Brothers and Sisters of Children with Autism

M. Coffman[1], *A. Muskett*[1], *R. S. Factor*[1], *L. Delk*[1], *A. Trubanova*[2], *N. Kelso*[1], *A. Scarpa*[3], *J. A. Richey*[1] *and J. M. Wolf*[4], *(1)Virginia Tech, Blacksburg, VA, (2)Virginia Polytechnic Institute and State University, Blacksburg, VA, (3)Psychology, Virginia Polytechnic Institute and State University, Blacksburg, VA, (4)Yale Child Study Center, New Haven, CT*

Background:
Sibling relationships are typically the longest-lasting relationships in an individual's life. Siblings of children with autism spectrum disorder (ASD) often take on increased responsibility in the home and become the primary caregiver of their affected sibling in approximately 73% of cases (Gidden, 2007). These stressors may have negative impacts on the unaffected siblings (UAS), such as feelings of guilt or shame. Support groups specifically for this population remain limited (Tudor and Lerner, 2015).
Objectives:
In the current study, we present data from three 10-week support groups for UAS of children with ASD. We hypothesize that as a result of participating in the support group, UAS will a) develop a more positive relationship with their sibling with ASD, b) show a decrease in internalizing problems (e.g., depression and anxiety), and c) gain increased understanding of ASD.
Methods:

Sixteen children (ages 5-12) who have a brother or sister with ASD participated in one of four 10-week support groups based off of the SibShop model (Meyer, 1994). One group is currently in progress, and will be completed in December, 2015. As such, current data only include the three completed groups. Curriculum was developed to provide psychoeducation, problem-solving skills, and coping strategies. Parents and participants completed several questionnaires pre- and post, regarding the relationship between the UAS and the sibling with ASD the: Sibling Relationship Questionnaire, and Satisfaction with the Sibling Relationship Questionnaire. Parents reported on the UAS's internalizing symptoms on the Behavioral Assessment System for Children – 2. Participants completed a semi-structured interview to assess their understanding of ASD: The Understanding of Autism Interview.

Results:

Analysis of data from participants (N=12) indicate that UAS reported increased satisfaction with their relationship with their sibling with ASD (Cohen's *d*=2.4), but decreased pro-sibling behavior by their sibling with ASD (*d*=1.09). Parents noticed an increase in pro-sibling behavior from the UAS (*d*=0.5) and child with ASD (*d*=1.6). Parents reported that UAS showed increased adaptability (e.g., better ability to change plans; *d* =1.05). Additionally, pre-group interviews indicated that 25% of the participants thought that ASD could be 'caught,' although none of the children believed this after the conclusion of the group. Effect sizes, rather than *p* values are presented due to the low sample size, and as yet insignificant results.

Conclusions:

Participants noted improved satisfaction with their sibling and the relationship. This, coupled with the improved understanding of ASD, indicates that the support group provides adequate psychoeducation to help improve the sibling relationship. Parents observed an increase in UAS ability to change routines, as well as increased pro-sibling behavior from the sibling with ASD. Additionally, these results indicate that parents also noticed this improved relationship, including more positive interactions from both the UAS and their child with ASD.

Interestingly, UAS reported decreased pro-sibling behavior from their sibling with ASD. It could be possible that participant's increased understanding of autism led to reappraisal of their siblings' behavior, resulting in increased ability to take changes in stride, as well as improved perception of the sibling relationship.

4:20 **160.003** Quality of Sibling Relationships When One Child Has ASD: Parent-Child Agreement and Contributions of the Affected Vs. Unaffected Child

***J. M. Wolf**, Yale Child Study Center, New Haven, CT*

Background: Research suggests that the quality of the sibling relationship is impacted, both positively and negatively, when one sibling has autism spectrum disorder (ASD). While there is general agreement between parents and unaffected siblings regarding the quality of the sibling relationship, there is some evidence that unaffected siblings view the relationship more positively than do their parents (Rivers and Stoneman, 2003; Diener et al., 2015). However, the specific domains in which parents and siblings may differ have not previously been investigated. Furthermore, little research has examined the behaviors of affected vs. unaffected siblings that may differentially impact the sibling relationship.

Objectives: 1) To evaluate agreement between parents and unaffected siblings regarding the quality of the sibling relationship when one sibling has ASD. 2) To examine differences in the behaviors of affected vs. unaffected siblings within the context of the sibling relationship.

Methods: The Sibling Relationship Questionnaire (SRQ; Slomkowski et al., 2001) was administered to parents (N=32) and siblings (N=22) of children with ASD to evaluate the quality of the sibling relationship. The SRQ asks about the unaffected child's behaviors toward the affected child, as well as the affected child's behaviors toward the unaffected child, in both positive and negative domains.

Results: Responses of parents and unaffected siblings on the SRQ were positively correlated, suggesting general agreement in their ratings of sibling relationship quality. Likewise, there were few significant differences between parent and child ratings. The only exception was with regard to hitting behavior, in which children reported more hitting directed at them by their sibling with ASD than parents reported (p=.004). Both parents and children rated the unaffected child as demonstrating more positive behaviors within the sibling relationship than the affected child (parents: p=.002; children: p=.08). Specific positive behaviors exhibited by unaffected siblings tended to fall in the domains of providing help and support to the sibling with ASD. While overall negative behaviors did not differ between affected and unaffected siblings, unaffected siblings reported a trend toward being hit by their sibling with ASD more frequently than they themselves hit their sibling (p=.09).

Conclusions: Unaffected siblings exhibit more positive behaviors within the sibling relationship than do their siblings with ASD, largely in domains pertaining to help and support. This is consistent with prior literature suggesting that unaffected siblings often take on a caretaker role toward their sibling with ASD (Benderix & Sivberg, 2007; Angell et al., 2012; Diener et al 2015). Parents and siblings of children with ASD generally agree about the quality of the sibling relationship; however, there may be critical areas (e.g. aggression) in which siblings are perceiving challenges of which parents are not aware. Prior literature has suggested that aggression is a significant stressor for unaffected siblings (Ross & Cuskell, 2006), often causing siblings to feel unsafe (Benderix & Sivberg, 2007). This is an important target area of intervention, particularly if parents are unaware of the extent to which aggression is being directed at the unaffected sibling.

4:45 **160.004** Getting to Know Siblings of Youth with Autism Spectrum Disorder: Family Predictors and Clinical Outcomes

***M. Tudor**[1] and M. D. Lerner[2], (1)Yale Child Study Center, Yale School of Medicine, New Haven, CT, (2)Stony Brook University, Stony Brook, NY*

Background: Current research findings remain unclear as to whether or not siblings of youth with ASD present with consistent emotional, behavioral, or social "adjustment" difficulties (e.g., Cuskelly, 1999). Many studies have attempted to examine what risks may be associated with this unique sibling experience, but no consistent clinical profile is supported, perhaps due to a narrow view of having a sibling with ASD as a risk factor for these youth (e.g., Orsmond & Seltzer, 2006; Stoneman, 2005). This current status of the literature is especially relevant in light of the growing number of therapy and support programs directed at siblings (Tudor & Lerner, 2015). Thus, there is an apparent need for a clearer understanding of of sibling functioning, as well as potential predictive factors thereof (McHale, Updegraff, & Feinberg, 2015).

Objectives: The goal of the current study was to examine family factors that may predict outcomes for siblings of youth with ASD. A theoretically-based model of these factors was proposed drawing from both TD and ASD literatures (e.g., Goodman & Gotlib, 1999; Feinberg et al., 2012).

Methods: A total of 239 mothers of youth aged 6-17, including one youth with ASD (*M*=11.14 years; simplex families) and at least one other youth (*M*=11.74 years), completed a questionnaire battery. Measures reflected familial factors: ASD severity and problem behavior of affected sibling, maternal depression and stress, differential attention towards siblings, family social support, and sibling relationship quality. Mothers also reported on demographic characteristics, such as number of children in family, presence of second parent, and SES, as potential model covariates. An initial theoretical model was proposed. A final model was obtained using confirmatory path analysis and progressive model fitting.

Results: Overall, only 6%-23% of siblings were identified within the clinical range of emotional, behavioral, or social functioning (see Table 1). The final model (see Figure 1) demonstrated that maternal depression positively predicted clinical outcomes while maternal stress predicted less clinical elevations. More positive sibling relationships were associated with poorer emotional, behavioral, and social functioning. Contrary to expectation, ASD symptom severity and ASD problem behavior were not direct predictors of TD sibling outcomes but, rather, predictors of other areas of familial functioning that ultimately predicted TD sibling outcomes.

Conclusions: The current sample represents the largest study of sibling emotional, social, and behavioral functioning to date, and suggests that the majority of siblings are demonstrating emotional, behavioral, and social functioning similar to the general population of youth. Particular family factors may be of especial importance in understanding why some youth may be in need of support or intervention – family factors that have been largely ignored in sibling research to date. The current model is presented as a base for the development of future research and evidence-based programs for supporting the apparent resilience and strengths of siblings while also identifying and serving those who may be at risk.

Table. *Model Intercepts Estimated by AMOS Software.*

	Estimate (Standard Error)	*p*-value
Main variables		
SRS	103.79 (2.84)	<.001
BASC-2 Externalizing - ASD	2.22 (.06)	<.001
BASC-2 Externalizing - TD	79.27 (16.21)	<.001
BASC-2 Internalizing - TD	56.81 (21.58)	.008
BASC-2 Social Skills – TD	1.26 (.02)	<.001
QPQ Conflict	-.38 (.15)	.01
SIB	50.60 (20.46)	.01
WDW	2.71 (2.16)	.21
FSS	.73 (.02)	<.001
PSI	-228.89 (36.25)	<.001
BDI	-.58 (.67)	.02
Covariates		
Presence of father	.92 (.05)	<.001
Income level	.00 (.05)	1.00

Note: ASD = Autism Spectrum Disorder; TD = typically developing; SCQ = Social Communication Questionnaire; SRS = Social Responsiveness Scale (T-score); BASC-2 = Behavior Assessment System for Children, Second Edition (T-score) - Ext = Externalizing subscale; Int = Internalizing subscale; SS = Social Skill WDW = Who Does What? Standardized discrepancy; QPQ = Quality of Play of Questionnaire – Conflict subscale; SIB = Sibling Inventory of Behavior; BDI-II = Beck Depression Inventory, Second Edition; PSI = Parenting Stress Index

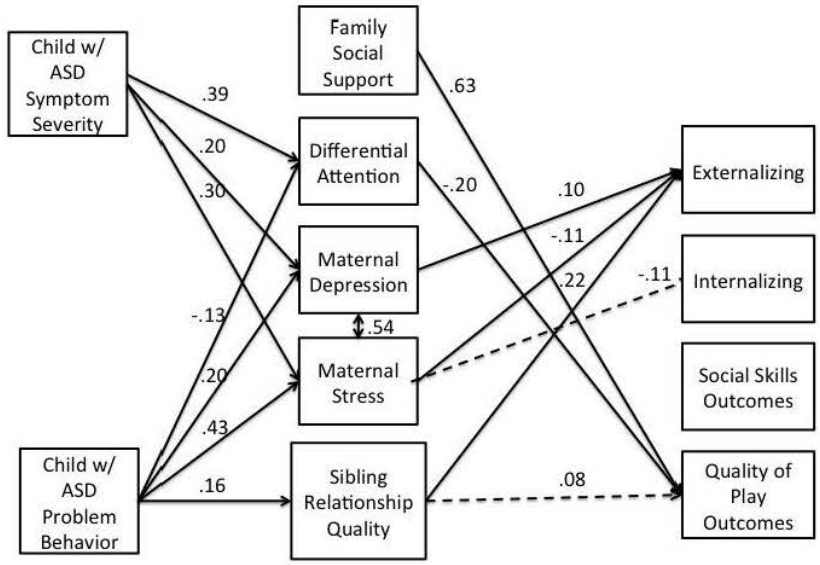


Figure. Model of best fit after respecification (IFI = .960, CFI = .959, RMSEA = .07). Note: Solid lines = $p < .05$; dotted lines = $p > .05$

Panel Session

161 - From Animal Neurocognitive Trials to Humans: How Do We Find the Most Appropriate Outcome Measures and Trial Designs for Tuberous Sclerosis Complex and Other Genetic Disorders?

3:30 PM - 5:30 PM - Room 309

Panel Chair: Petrus de Vries, *Division of Child & Adolescent Psychiatry, University of Cape Town, Cape Town, South Africa*

Discussant: Elizabeth Berry-Kravis, *Pediatrics; Biochemistry; Neurological Sciences, Rush University Medical Center, Chicago, IL*

Tuberous Sclerosis Complex (TSC) has become a powerful model to study a range of TSC-associated neuropsychiatric disorders (TAND), including autism spectrum disorder (ASD) and specific neuropsychological deficits. Given the success of mTOR inhibitors to treat SEGA (subependymal giant cell astrocytomas) and renal angiomyolipomas, there has been growing interest in molecularly-targeted treatments of TAND. However, translation from animal trials to humans has not been straightforward in other genetic disorders such as Fragile X and Neurofibromatosis Type 1, in spite of strong pre-clinical findings. In this panel we will discuss translation from pre-clinical to clinical trials to consider possible challenges in this effort. Our first presentation will be a recent pre-clinical study of neurocognition and social behavior in the Tsc2+/- (Eker) rat. Next, we will explore current clinical trials of

neurocognition and ASD in TSC and consider what we have learnt along the way. In the third presentation we will examine executive deficits in normally-intelligent adults with TSC to reflect on neuropsychological profiles and the impact of different analysis approaches. In our final talk, we will present a study of resting state EEG as potential biomarker for TSC-associated and non-syndromal ASD.

3:30 **161.001** mTOR Inhibitor Reverses Autistic-like Behaviour in Tsc2+/- Rats with Developmental Epilepsy

*M. Schneider[1], P. J. de Vries[2], K. Schönig[1], V. Rößner[3] and **R. Waltereit**[3], (1)Central Institute of Mental Health, Mannheim, Germany, (2)Division of Child and Adolescent Psychiatry, University of Cape Town, Cape Town, South Africa, (3)Child & Adolescent Psychiatry, University Hospital Carl Gustav Carus, Dresden, Germany*

Background: Developmental epilepsy is a major risk factor for autism spectrum disorder (ASD) and complicates clinical manifestations and management of ASD significantly. Tuberous Sclerosis Complex (TSC), caused by TSC1 or TSC2 mutations, is one of the medical conditions most commonly associated with ASD and has become an important model to examine molecular pathways associated with ASD. Previous research showed reversal of autism-like social deficits in Tsc1+/- and Tsc2+/- mouse models by mammalian Target of Rapamycin (mTOR) inhibitors. However, at least 70% of individuals with TSC also have epilepsy, known to complicate the severity and treatment-responsiveness of the behavioural phenotype. Tsc2+/- (Eker)-rats express autism-like social deficits similar to Tsc2+/- mice, with additive social deficits from status epilepticus during development.
Objectives: Here we hypothesised that the mTOR inhibitor everolimus would exert beneficial effects on social interaction and cognition in Tsc2+/- (Eker)-rats with previously induced developmental epilepsy.
Methods: The experimental group that modelled TSC pathology carried the Tsc2+/- (Eker)-mutation and was challenged with pharmacologically induced status epilepticus at postnatal days (P) 7 and P14 (n=12). The control group consisted of wild-type carriers from the Eker rat line and did not receive developmental epilepsy (n=10). At the age of four months, all animals were investigated in the pre-treatment behavioural analysis (T1). They were then treated for one week every other day with 1 mg/kg everolimus per bodyweight by intraperitoneal injection. Finally, they were retested in the post-treatment behavioural analysis (T2).
Results: Everolimus successfully treated the social interaction and social cognitive deficits in Tsc2+/- (Eker)-rats with status epilepticus induced during development. The drug was well tolerated and did not affect body weight. Non-social activity behaviour was not changed by everolimus. The mTOR-inhibitor specifically rescued the autistic-like phenotype of impaired social exploration behaviours. It also reversed the deficits in social recognition memory.
Conclusions: Our findings suggest that mTOR-inhibitors may be a potential treatment of autistic-like behaviours not only associated with a TSC mutation but also of social deficits associated with epilepsy in TSC. Results suggest that mTOR inhibitors may therefore be a potential treatment also of social deficits associated with other seizure-related disorders.

3:55 **161.002** Clinical Investigations in TSC

***M. Sahin**[1], M. Bebin[2], J. Y. Wu[3], H. Northrup[4], A. W. Byars[5], A. Sadhwani[6], K. Kapur[7], P. J. de Vries[8] and D. Krueger[5], (1)Department of Neurology, Boston Children's Hospital, Boston, MA, (2)University of Alabama, Birmingham, AL, (3)UCLA, Los Angeles, CA, (4)University of Texas, Houston, TX, (5)Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (6)Boston Children's Hospital, Boston, MA, (7)Neurology, Boston Children's Hospital, Boston, MA, (8)Division of Child and Adolescent Psychiatry, University of Cape Town, Cape Town, South Africa*

Background: Rare genetic diseases that affect behavior and cognition provide a unique opportunity to study the mechanisms of neurodevelopmental disorders through the examination of animal models, which can lead to development of hypotheses and treatments testable in human beings. Tuberous sclerosis complex (TSC) is an autosomal dominant disease that presents with autism, epilepsy, and intellectual disability. TSC can be diagnosed very early in life before autism symptoms arise. This provides a unique opportunity to study the pathogenesis underlying autistic symptoms in TSC and identifying signaling pathways that may be targeted for novel treatments.
Objectives: A series of knockout mouse models have been used to examine the role of Tsc1 and Tsc2 genes in neuronal development and function. These studies all indicate the mTORC1 inhibitors are effective in improving the neurological deficits in the animal models, including epilepsy and autism-like behaviors. Now, the challenge is to translate these funding to TSC patients.
Methods: As an initial step, we launched a Phase II clinical trial testing the efficacy of an mTOR inhibitor on improving neurocognition in children with TSC (NCT01289912). Children with TSC between the ages of 6 and 21 years were recruited to this study.
Results: One of the key issues that remain unanswered in the translation from preclinical to clinical trials is the selection of primary outcome measures. For this trial, the primary endpoint is neurocognition; secondary endpoints are autism, epilepsy and sleep disturbances. Inclusion criteria included an IQ cut off of 60 and higher so the subjects could complete the neurocognitive battery. 47 subjects were randomized; 32 patients were enrolled in the treatment group and 15 patients in the placebo groups. The two groups were comparable in terms of demographics and past medical history. Testing was performed at 0, 3 and 6 months. Analysis of the results is ongoing.
Conclusions: Single gene disorders with high penetrance of autism such as TSC provide powerful model systems to study the roles of individual molecules and associated signaling pathways in the genesis of autism, epilepsy, cognitive impairment and neuropsychiatric symptoms. Future trials need to incorporate translational biomarkers that can be employed in both animal models and patients. These diseases are leading to disease-modifying human therapies that may eventually translate to wider therapeutic strategies for autism.

4:20 **161.003** Executive Function Deficits in Adults with Tuberous Sclerosis Complex: Implications for Clinical Practice and Clinical Trials

***L. Leclezio**[1], D. L. McCartney[2] and P. J. de Vries[3], (1)Division of Child & Adolescent Psychiatry, University of Cape Town, Cape Town, South Africa, (2)Cancer Research UK Clinical Trials Unit, University of Birmingham, UK, Birmingham, United Kingdom, (3)Division of Child and Adolescent Psychiatry, University of Cape Town, Cape Town, South Africa*

Background: Tuberous Sclerosis Complex (TSC) is a genetic disorder with multi-system involvement. The lifetime prevalence rates of TSC-associated neuropsychiatric disorders (TAND) are in the region of 90% and lead to significant burden of disease. TAND includes a range of neuropsychological manifestations, including executive deficits. There are, however, few studies that have investigated executive skills in the disorder, either by group-wise comparisons or by examining the profile of executive deficits. There has also been interest in clinical trials with neurocognition as primary outcome in TSC and other genetic disorders, but given the novelty of the field, much is still unknown in terms of selection and analysis of neurocognitive outcomes, such as of executive functions.
Objectives: The aim of this study was to examine four components of executive skills in normally-intelligent adults with or without TSC and to analyze findings in two different ways – a group-wise analysis, and an individual profile analysis. We hypothesized that the TSC group would perform significantly worse than a non-TSC control group, and that a specific set of executive deficits to target in trials may be identified.
Methods: The sample consisted of 21 adults with TSC and a gender-, age- and performance IQ-matched control sample of 18 non-TSC adults. Four subtests of the Cambridge Neuropsychological Test Automated Battery (CANTAB) were used to assess simple spatial working memory (SSP task), self-ordered spatial working memory (SWM task), planning (SoC task), and attentional set-shifting (IDED task). Data were analysed for group difference. In addition, the individual profiles of the TSC group were examined to identify the rates and pattern of clinical executive deficits (performance <5th Percentile).
Results: Results showed significant group-wise differences on the Spatial Span (SSP) task and the Between Error Score of Spatial Working Memory (SWM), but not on the other tasks. Individual profile analysis revealed different results. None of the TSC participants were impaired on the spatial span (SSP) task, ten percent (10%) were impaired on the self-ordered spatial working memory (SWM) task, 20% on the planning (SoC) task, and 30% on the extra-dimensional aspects of the set-shifting (IDED) task. Overall 52% of TSC individuals scored in the impaired range on one or more of the executive function tasks.
Conclusions: We confirmed that a significant proportion of adults with TSC presented with clinically significant deficits on various executive functions, but without a pattern that suggested a 'target' executive deficit. Interestingly, group-wise comparisons gave a different impression of executive weaknesses in TSC. The study highlighted the importance not only of performing group-wise comparisons but also of investigating profiles of clinical deficits in those with TSC and other genetic disorders. Findings suggest that the variability of neuropsychological profiles, and the differences between 'group-based' and individual profile analysis should be considered in determining clinical trial design and analysis methods of molecularly-targeted trials with neurocognition as primary outcome in TSC and other genetic disorders.

4:45 **161.004** Recurrence Quantification Analysis of Resting State EEG As Risk Biomarker for Non-Syndromal and Syndromal ASD

***T. M. Heunis**[1], C. Aldrich[2], M. Nieuwoudt[1,3], S. S. Jeste[4], M. Sahin[5], J. M. Peters[6] and P. J. de Vries[7], (1)Mechanical and Mechatronic Engineering, Stellenbosch University, Stellenbosch, South Africa, (2)Mining Engineering and Metallurgical Engineering, Western Australian School of Mines, Curtin University, Perth, Australia, (3)South African DST/NRF Centre for Epidemiological Modelling and Analysis (SACEMA), Stellenbosch University, Stellenbosch, South Africa, (4)Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA, (5)Department of Neurology, Boston Children's Hospital, Boston, MA, (6)Division of Epilepsy and Clinical Neurophysiology, Department of Neurology, Boston Children's Hospital, Boston, MA, (7)Division of Child and Adolescent Psychiatry, University of Cape Town, Cape Town, South Africa*

Background: There has been growing interest in electroencephalography (EEG) as an investigational tool for biomarker development in autism spectrum disorder and other neurodevelopmental disorders. However, one of the key challenges lies in the identification of appropriate multivariate, next-generation analytical methodologies that can characterise the complex, nonlinear dynamics of neural networks in the brain. Recurrence quantification analysis (RQA) may be a potential next-generation approach for the identification of individuals 'at risk' of ASD. A proof of principle study, comprising 7 ASD and 5 typically developing (TD) subjects (8-17 years), showed that linear discriminant analysis (LDA) of RQA features could classify subjects as ASD or TD with 83.3% accuracy, 85.7% sensitivity and 80.0% specificity. The sample size was, however, small, and

did not consider age, gender and intellectual ability as potential confounders. Furthermore, a robust biomarker for ASD should be able to differentiate ASD not only from TD, but also from other neurodevelopmental aberrations, as seen in genetic syndromes, for example.
Objectives: Here we present further exploration of this method in a larger dataset comprising non-syndromal ASD, Tuberous Sclerosis Complex (TSC) with ASD (syndromal ASD), TSC without a concurrent diagnosis of ASD, and TD subjects.
Methods: Raw resting state EEG (rsEEG) data were filtered and preprocessed, artefact contaminated segments were manually rejected and semi-automated ocular artefact correction was performed using independent component analysis. Data were extracted in continuous 5 second segments. RQA features were extracted from recurrence plots of multivariate embedded rsEEG data. LDA, multilayer perceptron (MLP) neural network and support vector machine (SVM) classifiers were used to classify the RQA feature vector. A leave-one-subject-out approach was utilised to simulate the diagnosis of an unseen subject. Biomarker performance was evaluated in three samples, each matched for age, gender and intellectual ability, where possible. Multiple segments per subject were evaluated to determine test-retest reliability. Study 1 analysed 666 segments from 7 ASD (mean age 3.96 years) and 7 TD (mean age 3.93 years) subjects. Study 2 analysed 1202 segments from 5 TSC+ASD (mean age 5.92 years) and 5 TSC-ASD (mean age 5.99 years) subjects. Study 3 analysed 832 segments from 6 ASD (mean age 3.90 years) and 6 TSC+ASD (mean age 3.89 years) subjects.
Results: In study 1, 92.9% accuracy, 100% sensitivity, and 85.7% specificity was achieved using an SVM classifier. Study 2 showed 90% accuracy, 80% sensitivity, and 100% specificity, using a MLP classifier. In study 3 both the SVM and MLP classifiers achieved 100% accuracy, sensitivity and specificity.
Conclusions: Results suggested that RQA may be a reliable approach to classify individuals with syndromal and non-syndromal ASD. Age, gender and intellectual ability were identified as potential confounders for classification performance in poorly matched samples. With comparison of the non-syndromal and TSC+ASD sample population, epilepsy and medication use were also identified as possible confounding factors. Rigorous investigation of each of these factors in a well matched and larger sample population will be required with further biomarker development. Consistent test-retest reliability will also need to be established.

Panel Session
162 - Biomarker Development in the Era of Rdoc: Common and Distinct Mechanisms of Function and Dysfunction in ASD and Schizophrenia
3:30 PM - 5:30 PM - Room 310

Panel Chair: James McPartland, *Yale School of Medicine, New Haven, CT*

Discussant: James McPartland, *Child Study Center, Yale School of Medicine, New Haven, CT*

Autism spectrum disorder (ASD) and schizophrenia spectrum disorders (SZS) are both characterized by atypical social behavior and cognition. Common genetic pathways and neural processes are implicated in both disorders, but few studies have directly compared clinical populations with ASD and SZS. For this reasons, shared and distinct characteristics are poorly understood. This panel presents four studies applying complementary methods at multiple levels of analysis, spanning brain structure to neurophysiology to psychophysiological assessment of behavior to clinical observation and self-report. These novel approaches are applied to converge upon functional processes related to core features of both disorders: social-communication, gaze perception, neural connectivity, and sensory processing. At the level of clinical symptomatology, results concord with behaviorally defined diagnostic categories. In contrast, measures of specific neural mechanisms and functional processes indicate significant overlap in ASD and SZS, aligning with performance at both clinical and subclinical levels rather than diagnostic taxon. Discovery of shared neural bases of phenomenologically distinct disorders holds promise for understanding specific strengths and vulnerabilities and offers straightforward clinical implications. Panel discussion focuses on relevance to a dimensional characterization of neurodevelopmental disorders and its implications for biomarker development in ASD.

3:30 **162.001** Common and Distinct Neuroanatomical Abnormalities in Adult ASD and Schizophrenia

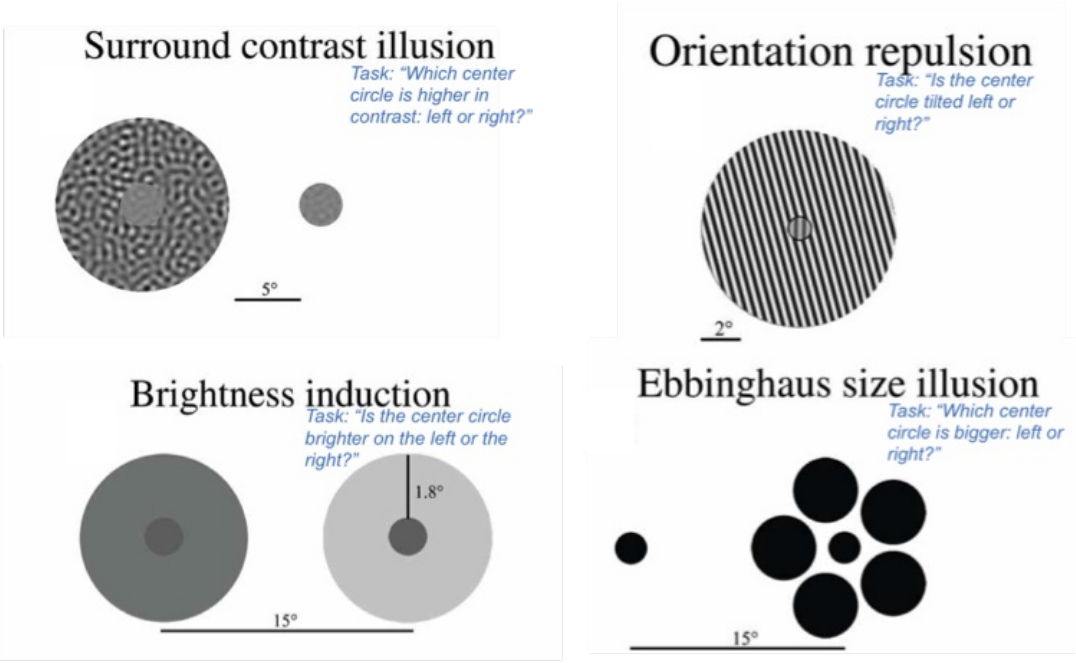
S. M. Eack[1] *and N. J. Minshew*[2]*, (1)School of Social Work, University of Pittsburgh, Pittsburgh, PA, (2)Department of Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA*

Background: Autism spectrum disorder (ASD) and schizophrenia are characterized by significant impairments in social and non-social information processing, which may reflect similar underlying brain abnormalities, yet few studies have directly examined convergence in the neuroanatomical basis of these conditions.
Objectives: The purpose of this study was to use high-resolution structural magnetic resonance imaging to identify and compare regional gray matter morphological abnormalities between adults ASD and schizophrenia relative to healthy volunteers.
Methods: A cross-sectional, cross-diagnostic case-control structural neuroimaging study was conducted with 14 verbal adults with ASD, 42 stabilized adult schizophrenia outpatients, and 20 healthy adult volunteers. Regional measurements of gray matter volume were collected using high-resolution structural magnetic resonance imaging using a 3T Siemens Trio whole-body scanner and head coil. Broad fronto-temporal regions of interest were defined using Wake Forest University Pickatlas including relevant areas of the prefrontal cortex, medial-temporal lobe, and superior and middle temporal gyri based on previous studies of ASD and schizophrenia. All data were preprocessed and analyzed using Statistical Parametric Mapping, version 12.
Results: Adults with ASD demonstrated significant and broadly increased gray matter in the bilateral middle temporal gyrus (all $k > 100$, all $p < .001$) and insular cortex (all $k > 158$, all $p < .001$) relative to healthy volunteers. In addition, a significant cluster of increased gray matter in the left medial prefrontal cortex was also present in adults with ASD ($k = 162$, $p < .001$) compared to healthy individuals. Individuals with schizophrenia demonstrated similarly increased gray matter volume in the left middle temporal gyrus ($k = 66$, $p = .001$), although this finding was less pronounced than in ASD. In contrast to adults with ASD, patients with schizophrenia also showed significantly reduced amygdala volume bilaterally (all $k > 20$, all $p < .003$). When comparing ASD and schizophrenia directly, individuals with ASD had significantly greater gray matter volume in a bilateral medial-temporal cluster encompassing the amygdala and parahippocampal gyrus (all $k > 130$, all $p < .001$). Increased right putamen volume was also observed in ASD relative to patients with schizophrenia ($k = 49$, $p = .001$).
Conclusions: Autism and schizophrenia are associated with neuroanatomical abnormalities in medial-temporal regions that are only partially overlapping along the middle temporal gyrus implicated in social information processing. Overall, ASD was characterized by widespread increases in cortical gray matter not observed in schizophrenia, which was primarily associated with reduced amygdalar volume. These findings support models of distinct neurodevelopmental processes converging on shared social disability in people with ASD and schizophrenia.

3:55 **162.002** Dissociating Visual Correlates of Context Modulation in ASD and Schizophrenia

J. H. Foss-Feig[1]*, B. D. Adkinson*[2]*, W. J. Park*[3]*, E. J. Levy*[4]*, N. Santamauro*[5]*, C. Schleifer*[6]*, K. Deckert*[4]*, V. Srihari*[5]*, J. Krystal*[7]*, D. Tadin*[3]*, J. McPartland*[1] *and A. Anticevic*[5]*, (1)Child Study Center, Yale School of Medicine, New Haven, CT, (2)Department of Psychiatry, Yale School of Medicine, New Haven, CT, (3)Brain and Cognitive Sciences, University of Rochester, Rochester, NY, (4)Yale Child Study Center, New Haven, CT, (5)Yale University School of Medicine, New Haven, CT, (6)Yale University, New Haven, CT, (7)Yale University - Psychiatry, New Haven, CT*

Background: Theoretical and empirical accounts implicate altered contextual modulation as an underlying brain dysfunction in both ASD and schizophrenia spectrum disorders (SZS). Both disorders are also characterized by altered sensory processing, including differences in visual perception. In ASD, much attention has been paid to global-local interactions and perceptual biases, and in schizophrenia inability to filter information from the surround has been attributed to neural disinhibition associated with an excitatory/inhibitory imbalance. Contextual modulation reflects the way in which a visual feature is perceived dependent on the surrounding spatial context. There is some evidence that contextual modulation is impacted in both ASD and SZS; however, it has never been tested concurrently in both clinical populations.
Objectives: Examine behavioral correlates of visual context processing in young adults with ASD, in comparison to both adults with SZS and healthy controls.
Methods: Preliminary analyses included 9 adults with ASD, 9 with early-course SZS, and 14 controls, matched on relevant demographic variables. Recruitment is ongoing with an anticipated final sample size of 20 per group. Participants completed a visual contextual modulation battery (**Fig.1)**. Following prior studies examining center-surround interactions (Yang et al., 2013), we used staircase procedures to measure psychophysical thresholds during forced choice comparisons of stimuli assessing surround modulations in: a) contrast, b) luminance, c) orientation, d) size. For each participant, the point of subjective equality (PSE) was computed for each task, quantifying the influence of the surrounding context. Group differences were assessed using one- and two-way ANOVAs.
Results: Across tasks, results revealed significant main effects of context (ps<0.001), indicating significant influence of the surrounding context (i.e., contextual modulation occurs) for all groups. In the orientation task, relative to controls, surround suppression was reduced in ASD but decreased in SZS (F=2.117, p=.13). In the Ebbinghaus (size) illusion, contextual effects on size perception were increased in ASD but decreased in SZS relative to controls (F=2.924, p=.07). When comparing contrast, surround suppression was lower in both ASD and SZS relative to controls, though the interaction did not approach significance (F=1.254, p=.30). Finally, in the luminance task, neither individuals with ASD nor SZS showed differential surround suppression relative to controls (F=0.473, p=.63). Work is ongoing to relate patterns of context modulation to specific clinical features transdiagnostically.
Conclusions: Results revealed that patterns of contextual modulation differentiate ASD from SZS under specific conditions, whereas the two disorders are comparable in other contextual conditions. Specifics patterns of dissociation versus overlap may provide clues to underlying neural processes affected by context processing and neural excitation and inhibition within and across disorders. Future work directly measuring brain response during visual context processing will be crucial for teasing apart the extent to which this mechanisms characterizes ASD and related disorders where sensory, perceptual, and social deficits are key.



4:20 **162.003** Neural Correlates of Emotion Processing during Simulated Social Interactions in Adults with Autism Spectrum Disorder and Schizophrenia

K. Deckert[1], *J. H. Foss-Feig*[2], *A. Naples*[2], *E. J. Levy*[1], *K. K. Stavropoulos*[2], *M. Rolison*[2], *L. Mohamed*[1], *C. Schleifer*[3], *N. Santamauro*[4], *A. Anticevic*[4], *V. Srihari*[4] *and J. McPartland*[2], *(1)Yale Child Study Center, New Haven, CT, (2)Child Study Center, Yale School of Medicine, New Haven, CT, (3)Yale University, New Haven, CT, (4)Yale University School of Medicine, New Haven, CT*

Background: Both autism spectrum disorder (ASD) and schizophrenia (SCZ) are characterized by social deficits, including in emotional recognition, eye contact, and theory of mind. Previous research utilizing electrophysiology and measuring event-related potentials (ERPs) shows atypical structural encoding of faces, as indexed by N170 amplitude and latency, in both adults with ASD and SCZ.
Objectives: Using gaze contingent ERP in response to happy and fearful faces that responded to participant gaze, the current study examined emotional processing and ERP components (N170, P300) in adults with ASD, SCZ, and typical development (TD). We examined diagnosis-specific findings as well as transdiagnostic associations between neural processes and behavioral correlates of emotion recognition abilities. These results address divergence between disorders but also highlight common biological processes underlying disorders characterized by social communicative deficits.
Methods: 42 adults (TD=16, ASD=12, SZ=14) completed EEG, along with self-report questionnaires and direct assessment clinical measures. Groups were matched on IQ, age, and sex. Emotion recognition was assessed using the Reading the Mind in the Eyes Task (RMET). EEG was recorded with high density 128 channel Geodesic Sensor Nets with concurrent eye tracking, in response to neutral faces that dynamically changed to express either happy or fearful emotional expressions upon participant gaze towards the eyes. ERP was time-locked to emotion onset. N170 amplitude and latency were analyzed over bilateral occipitotemporal electrodes; P300 was analyzed over midline parietal sites. A repeated measures ANOVA was conducted to analyze amplitude and latencies of ERP components (within-subject factors: Hemisphere, Emotion; between-subjects factor: Diagnosis). Bivariate correlations with RMET scores were also conducted.
Results: Adults with SCZ showed longer N170 latency compared to controls, $F(2,39) = 2.67$, $p = .081$. Irrespective of diagnostic group, right hemisphere N170 amplitude ($r = -.324$, $p = .038$) and latency ($r = -.410$, $p = .007$) were correlated with emotion recognition ability, with faster and more robust N170 responses in individuals with better emotional identification. In the left hemisphere, N170 response to happy versus fearful faces showed greater amplitude in ASD relative to SCZ and controls, $F(2,39) = 5.49$, $p = .008$. Left hemisphere N170 latency did not differ by group, but happy faces elicited a faster N170 response across groups, $F(2,39) = 5.04$, $p = .031$. P300 amplitude was enhanced to fearful versus happy faces in ASD and TD, but not in SCZ, $F(2,39) = 4.95$, $p = .012$. SCZ was characterized by attenuated P300 amplitude across emotions, $F(2,39) = 2.73$, $p = .077$.
Conclusions: Our results show that individuals with ASD and schizophrenia have altered neural responses to emotional face stimuli. A nuanced pattern of results indicates both common and distinct mechanisms in these disorders; moreover, delayed and attenuated neural response to faces is associated with reduced emotion recognition abilities across clinical and non-clinical populations alike. These findings have important implications in determining the neurobiological underpinnings of emotion recognition and social functioning deficits in ASD and other disorders affecting social cognition and for the utility of diagnostic taxonomies based on behavioral symptoms versus dimensional measurement of specific functional processes.

4:45 **162.004** Comparing Social Skills Between Adults with ASD and Schizophrenia

N. J. Sasson[1], *K. E. Morrison*[2] *and A. Pinkham*[3], *(1)University of Texas at Dallas, Richardson, TX, (2)The University of Texas at Dallas, Dallas, TX, (3)School of Behavioral and Brain Sciences, The University of Texas at Dallas, Richardson, TX*

Background: Although Autism Spectrum Disorder (ASD) and Schizophrenia (SCZ) are both characterized by social dysfunction, their non-shared features and different developmental trajectories suggest that the pathways and mechanisms underlying this impairment may differ. Systematically-matched comparisons of the two groups can help identify disorder-specific features that are missed when simply comparing each clinical group to typically-developing (TD) controls.
Objectives: While an increasing number of studies have compared ASD and SCZ on social cognitive abilities and their neural correlates (for a review, see Sasson et al., 2011), no work has yet compared the two on social behavior. This project sought to examine how social skills are similar and different between ASD and SCZ relative to TD adults.
Methods: 164 individuals (54 ASD; 54 SCZ; 56 TD) participated. The groups were matched on gender (all 87% male), and comparable on age (group means between 25.69-28.68 years), ethnicity (80-89% Caucasian), educational attainment (group means between 13.45-13.89 years), and IQ (group means between: 103.32-106.02). Participants completed the Social Skills Performance Assessment (SSPA; Patterson et al., 2001), a structured three minute role-play involving a social interaction scenario (meeting a new neighbor). Eleven social skills were coded on a one-to-nine scale (Pinkham & Penn, 2006): verbal clarity, verbal fluency, meshing, involvement, asks questions, gaze, appropriate affect, flat affect, appropriate content, social anxiety, and overall social skill. Additionally, three codes were added for their relevance to ASD: repetitive verbal content, repetitive nonverbal content, and verbosity. Two coders, blind to the diagnostic category of the participants, were trained to adequate reliability (ICC>.7 for all codes).
Results: As measured by the PANSS (Kay et al., 1987), the SCZ group had greater positive, negative, and general symptoms relative to the ASD group (*p*s <.001). Only negative symptoms correlated with overall social skill (r=-.56, p<.001), and thus were co-varied in analyses. Both clinical groups were rated lower on each of the 14 social skills relative to the TD group (all *p*s<.05), with the exception of SCZ not differing from controls on two ASD-specific items (repetitive verbal and nonverbal content), ASD not differing on verbal clarity, and both groups not differing from controls on meshing. When directly compared, the SCZ group was rated as higher on overall social skill than the ASD group (p=.001). The SCZ group also asked more questions (p=.004), were rated as more involved (p=.008), demonstrated less repetitive nonverbal (p=.002) and verbal (p=.050) content, and trended towards more appropriate affect (p=.064) and content, and less anxiety (p=.077). IQ correlated with overall social skill in SCZ (r=.35, p=.011) but not in ASD (r=.15, p=.271).
Conclusions: Both ASD and SCZ are characterized by significant social skill impairments relative to controls. When directly comparing the clinical groups, ASD demonstrated poorer social skills, both overall and within several specific areas (reciprocity, appropriate content and affect, and repetitive behaviors). These results underscore the significant social impairment experienced by intellectually-capable adults with ASD. Future work will examine how these patterns of social skills relate to social cognition and other areas of social functioning.

Poster Session

163 - Adult Outcomes: Medical, Cognitive, Behavioral

5:30 PM - 7:00 PM - Hall A

1 **163.001** A Mixed Methods Study of Employment Perspectives of Youth and Young Adults on the Autism Spectrum

*L. A. Crabtree[1] and **B. B. Demchick**[2], (1)Towson University, Lutherville, MD, (2)Occupational Therapy & Occupational Science, Towson University, Towson, MD*

Background: Participation in employment experiences in the community is a rite of passage to adulthood. A majority of transition-aged individuals with autism have identified goals to obtain gainful employment, although fewer than 20% are able to obtain employment after exiting the educational system (Wehman et al., 2014). Furthermore, those who are employed are typically under-employed, and they face higher rates of poverty, obliging many to be financially dependent on their families (Lindstrom, Kahn, & Lindsey, 2013). However, barriers to employment participation have not been fully explored, and it is unclear how perceptions of individuals with autism may contribute to poor employment outcomes.
Objectives: The purpose of this pilot study was to explain perspectives of youth and young adults with autism regarding employment participation in order to support improved methods of employment preparation. Specifically, two research questions were identified.

1. What are the perspectives of youth and young adults with autism regarding employment?
2. How do perspectives help and hinder success in preparation for, transition to, and participation in the workplace?

Methods: An explanatory sequential mixed methods design was used to identify patterns of perceptions, followed up with qualitative data collection to explain identified patterns. Researchers used a recently piloted and revised instrument based on items from the *Career Maturity Inventory*(Crites and Savikas, 2011) to survey 29 individuals with autism aged 16-28, followed by interviews with 8 young adults with autism. Descriptive statistical analysis was used to identify patterns of perceptions regarding employment, comparing those with and without employment experiences. Qualitative coding and thematic development, with constant comparative methods were used to analyze transcribed interviews.
Results: Survey results indicated that nine youth with employment experience (EE) identified positive perceptions of employment, but 56% of those in this group identified difficulties in the workplace. Twenty without employment experience (WE) indicated perceptions of worry about employment and lack of knowledge about employment constructs, although they indicated a desire to pursue employment opportunities. Themes from qualitative analysis of interviews with individuals from both groups (EE and WE) identified motivating factors of money and participation, as well as challenges of sustainability, social interactions, and transportation. Through comparative analysis of both data sets, two consistent patterns that restricted the employment opportunities for transitioning youth with autism were identified. 1) Lack of knowledge and 2) limited experiences. Youth in this study had limited knowledge of the constructs of employment, including knowledge of what entailed full-time employment. At the same time, they described very limited employment experiences.
Conclusions: With significant increases in both the number of youth with autism entering adulthood and the rising cost of vocational services, it is important to ensure that program supports lead to positive outcomes for both individuals with autism and for society at large (Burgess & Cimera, 2014). Preliminary results of this pilot study identify two key aspects of programming to support better employment outcomes. Specifically, by providing explicit knowledge and practical experiences related to meaningful employment opportunities for youth with autism, vocational programs can become more effective.

2 **163.002** A Statewide Needs Assessment Survey for Adults with Autism Spectrum Disorder

***L. O'Regan**[1], S. Srinivasan[2], S. Trost[1], A. Ekbladh[3], B. Freedman[4,5] and A. N. Bhat[2], (1)Physical Therapy, University of Delaware, Newark, DE, (2)University of Delaware, Newark, DE, (3)Center for Disability Studies, University of Delaware, Newark, DE, (4)University of Delaware Center for Disabilities Studies, Newark, DE, (5)Center for Disabilities Studies, University of Delaware, Newark, DE*

Background:
Autism Spectrum Disorder (ASD) is a lifelong multisystem neurological disorder that affects social communication, perceptuo-motor, cognitive, and behavioral skills of individuals across the lifespan (Roux et al., 2015). In spite of the growing number of children with autism entering adulthood every year, surprisingly, there is a dramatic decline in access to services for these youth and adults. Around 40% of youth with autism do not receive any medical services, mental health counseling, or speech therapy once they reach early adulthood (Shattuck et al., 2011).
Objectives:
In 2011, the Center for Disabilities Studies (CDS) at the University of Delaware conducted a statewide comprehensive needs assessment survey for adults with ASD. This survey was designed to obtain information about critical areas related to the health and life status of individuals with ASD in order to develop a strategic plan to improve adult services for ASD.
Methods:
91 caregivers of adults with ASD as well as 18 high-functioning adult self-advocates with ASD between 20 and 50 years of age filled out a caregiver survey in online or paper form. The survey covered several aspects of the lives of individuals with ASD including their primary diagnosis, additional comorbidities, health service needs, educational status, employment status, living conditions, and participation in the community.
Results:
90% of the low-functioning group had a primary diagnosis of ASD whereas 67% of the high-functioning group had a primary diagnosis of Asperger Disorder. More than 60% of individuals in both groups had additional comorbidities, most commonly developmental delay, learning disability, anxiety, intellectual delay, depression, and attention deficit hyperactivity disorder. In the low-functioning group, over 75% of individuals lived with parents or in group homes, only around 50% of individuals had managed to obtain some high school education, and around 50% of individuals were unemployed. This group was independent in basic activities of daily living (ADLs) such as feeding, dressing, and toileting but required help in instrumental ADLs such as cooking meals, managing money, and getting around in the community. In the high-functioning group, around 50% of individuals continued to stay with parents, around 75% of individuals had some high school or college education, and only around 25% had a part time or full time job. In addition, this group had poor participation in community-based activities. Both groups identified the need for several different health care services including socials skills training, behavioral interventions, vocational training, mental health counseling, neurological services, and medication management.
Conclusions:
Results of the survey confirmed the lifelong nature of impairments in individuals with ASD. Adults with ASD continued to demonstrate multisystem impairments that interfered with their ability to independently engage in activities of daily living, pursue meaningful employment opportunities, and participate in activities within the community. Our findings highlight the need for continued services into adulthood for youth and older adults with ASD.

3 **163.003** ASD and Juvenile Justice Training for Judges, Magistrates and Probation Officers

***T. Hughes**, Counseling, Psychology and Special Education, Duquesne University, Pittsburgh, PA*

Background:
Due to the unique social and communication challenges, individuals with ASD can also be at risk of committing socially inappropriate actions that reach the level of illegal, offending behaviors. For example, the social deficits associated with autism may impact psychosexual development to a degree where inappropriate pursuits, interests or touching may result in an act that is unlawful. Further, communication deficits may also impact expressed anger to a degree where violent and aggressive behaviors rather than more appropriate verbal exchanges result. Relatedly, emotion dysregulation, executive function deficits as well as co-occurring psychiatric symptoms may also be related to the probability of individuals with ASD committing illegal acts (Newman & Ghaziuddin, 2008). Indeed, researchers have found, the number of individuals with ASD who are classified as offenders in the criminal system is more than expected (Haskins & Silva, 2006). One state facility, open to housing offenders with complex comorbid diagnosis, found among 37 adolescents adjudicated delinquent for sexual offenses, 22 (or 60%) met the diagnostic criteria for an ASD (Sutton, et.al., 2013).

While the acts themselves may be unlawful, the intent driving the act may not be similar to antisocial attitudes commonly found in offender populations. That is, social deficits (associated with a developmental delay) rather than social maladjustment (associated with psychopathy characteristics such as callous and unemotional traits where behavior is controlled) may distinguish these groups. Indeed, “counterfeit deviance” as described by Hingsburger, Griffiths and Quinsey in 1991 highlights how “behaviors that are the result of a pervasive lack of social skills, a core naïveté, or a lack of accurate knowledge are not deviant behaviors per se.” Thus, a primary aim of this presentation is to inform relevant juvenile justice personnel about the treatment needs for juveniles with ASD who are adjudicated.
Objectives: This presentation shows a training program for judges, magistrates, and probation officers that is designed to meet the community safety priorities of those offices while advocating for appropriate deterrent programing. A video case of probation officer working with an adolescent with ASD highlights the challenges unknown to many professionals.
Methods: Pre-post training data for 49 probation officers with one to thirty-five years of experience show statistically significant increase in their knowledge across all groups a) probation officers with autism experience, b) probation officers without autism experience, c) probation officers with previous autism training and d) probation officers without previous autism training.
Results: Discussion about how to approach training for various juvenile justice personnel is provided. Coordinating professional development across all relevant parties from police contact, through probation and the adjudication process in the context is considered.

Conclusions: Meeting the needs of individuals with ASD who are in contact with the juvenile justice system requires training for key decision makers. Trainings must identify relevant leverage points useful for selecting intervention protocols tailored to meet the needs of individuals with autism.

4 **163.004** ASD and Sexuality Education

***R. L. Loftin**, Autism Assessment, Research & Treatment Services Center, Chicago, IL*

Background:
There is an urgent need to teach people with ASD about sexuality. Individuals with ASD are at increased risk of sexual victimization (Selever, Roth & Gillis, 2013). People with ASD may also be at increased risk of problematic sexual behaviors that can include undesired touching, public masturbation and other illegal activity (Hellemans et al., 2007). Legal cases involving people with ASD often have a sexual component. In this clinician's practice alone, legal allegations have included viewing pornography in public locations, possession of child pornography, pedophilia, and inappropriate touching/ sexual advances toward other adults. Inappropriate sexual behaviors can limit employment and inclusion opportunities (Sullivan & Caterino, 2008), as well as opportunities for relationships. Many illegal or otherwise inappropriate sexual situations experienced by people with ASD could have been prevented with adequate sex education. One of the biggest challenges in developing appropriate sexuality education for people with ASD has been bridging the gap between people who know about sexuality education and people who know about ASD (Mesibov, 2012). The proposed presentation assessed use of a manual for sexuality education that was developed by ASD specialists and a consultant from Planned Parenthood.
Objectives:
This presentation will outline the research investigation of a sexuality education curriculum and practical implications for practice.
Methods:
Ten young men with ASD completed a 14-week sexuality education courses in a community-based center. A published curriculum in sexuality education for people with ASD served as the manual (Davies & Dubie, 2012). Planned Parenthood's standards, adapted from the federal standards for sexuality education, were used as a framework for reorganizing the Davies & Dubie manual. Supplementary lessons were created for additional areas of need that were not fully addressed.

All participants participated in pre and post-testing that included measures of social validity, knowledge questionnaires and vignettes of social situations. Additionally, feedback from participants, course leaders and parents was collected to assess acceptability of the intervention.

Results:
The final post-tests are occurring in October, and data will be analyzed in November and December. Participants are expected to demonstrate learning. Attendance in groups was good, and the acceptability of the intervention is expected to be high among attendees. Because it can be very difficult to motivate people with ASD to participate in activities outside of the home, the extent to which the young people are willing to learn about these topics will be very informative. The feasibility aspect will provide important information about whether the proposed intervention is relevant and sustainable in the community. If it is found to be feasible, it should be exportable.
Conclusions:
There is a tremendous need for interventions for young adults with ASD and, in particular, for appropriate, comprehensive sexuality instruction. Sexuality education in adolescence is particularly important because they are forming a sense of gender, identity and values (Goldman, 2011). Further, sexuality education can help future adults with ASD to be safer, more independent, and to have more opportunities for integration (Gerhardt & Lainer, 2010).

5 **163.005** Adapting the Social Skills Performance Assessment (SSPA) for Assessing Social Skills for Adults with ASD in Vocational Training Settings

*M. J. Baker-Ericzen[1,2], **M. M. Jenkins**[1], M. Fitch[3] and M. Kinnear[2], (1)Child and Adolescent Services Research Center, Rady Children's Hospital San Diego, San Diego, CA, (2)Rady Children's Hospital San Diego, San Diego, CA, (3)Child & Adolescent Services Research Center, Rady Children's Hospital, San Diego, San Diego, CA*

Background:
Difficulties with social communication are a main characteristic of individuals with autism spectrum disorders (ASD) that continues into adulthood. Consequently a need to treat and adequately assess social performance is of utmost importance. Currently most social skill assessments for adults with ASD are questionnaires or interviews, both being subject to over or under-estimation biases (Norton et al, 2010). Adults also often lack available informants to complete responses on their social abilities for accurate assessment. Behavioral observations, by means of role plays, have been found to be appropriate for adults with ASD (Verhoeven et al 2013). However, few observational measures have been studied for this population. The Social Skills Performance Assessment (SSPA), developed and tested for schizophrenia, may also be useful for ASD research and clinical assessment.
Objectives:
This study used a community-based participatory research (CBPR) approach to 1) qualitatively investigate the suitability and adapt the Social Skills Performance Assessment (SSPA) for ASD research within vocational settings and 2) pilot test the adapted SSPA.
Methods:
The CBPR group was made up of researchers, educators, public agency administrators (Department of Rehabilitation and Development Disabilities), community providers, family members and individuals with ASD. Study involved qualitative data collection on role-play scenes, administration and scoring suitability. Quantitative study included pilot testing the adapted measure with 9 participants to date (15-20 additional participants by April), aged 18-28 years old, participating in a vocational training program. The majority of participants were male (78%), white race/ethnicity (78%) and all graduated with a high school diploma.
Results:
Qualitative study: The group determined it was suitable but required adaptation. Two new scenes (chatting with a coworker and asking a boss for time off) were created to be relevant for vocational settings. Administration changes of increased standardization was recommended and 6 additional codes (eye contact, intonation and pattern of speech, body language, facial expression, reading social cues, & perspective-taking) were developed to score to capture common social skill targets in ASDs.
Quantitative study: Analyses consisted of calculating means for each scene (1,2,3 & 4) and comparing the 2 new scenes (3 & 4) to the original scenes (1 & 2) within group and comparing the means of the original scenes across groups with published studies of ASD and normal populations. Effect sizes were calculated to measure group differences (Refer to Tables). Administrators and raters were trained to criterion. Reliability was calculated. Scores ranged from 1-5 with lower numbers indicating more social impairment. Adults with ASD in this community sample performed the worse. They also had significantly lower fluency and overall conversation scores with the new "chatting with coworker" scene compared to other scenes. Participants and administrators reported ease in administration and scoring on new scenes and codes.
Conclusions:
The SSPA measure, an observational social performance measure commonly used in schizophrenia studies, shows promise for ASD research as well. The adaptations suggested by a research-community collaborative for use with adults with ASD in vocational settings appear to assess social performance and provide a potential for accurate measurement of social ability.

Table 1. Social Skills Performance Assessment Measure Sample Comparisons

SSPA	ASD			Non-ASD
	Current sample mean n=9	Published sample mean n=24	Effect size *Cohen's d*	Normal sample mean n=20
SSPA Total Score	65.89 (10.5)	72.13 (5.71)	- .77	78.40 (4.24)
SSPA Scene 1 Total	30.78 (3.8)	34.38 (2.76)	- 1.1	37.30 (2.25)
SSPA Scene 2 Total	35.11 (7.06)	37.75 (3.34)	- .51	41.10 (2.47)
Scene 1 interest/disint.	4.55 (.73)	3.58 (.97)	.79	4.45 (.61)
Scene 2 interest/disint.	4.78 (.44)	4.5 (.51)	.59	4.55 (.51)
Scene 3 interest/disint.	4.89 (.33)			
Scene 4 interest/disint.	4.89 (.33)			
Scene 1 fluency	3.22 (.83)	3.79 (1.18)	- .57	4.55 (.61)
Scene 2 fluency	3.44 (1.23)	3.96 (1.0)	- .47	4.40 (.60)
Scene 3 fluency	2.78 (.83) *			
Scene 4 fluency	3.44 (1.01)			
Scene 1 clarity	4.0 (.50)	5.0 (.0)	-2.0	4.90 (.45)
Scene 2 clarity	3.89 (.93)	4.96 (.20)	- 1.9	4.95 (.22)
Scene 3 clarity	3.89 (.78)			
Scene 4 clarity	4.11 (.93)			
Scene 1 focus	4.11 (.78)	4.21 (.72)	- .13	4.30 (.66)
Scene 2 focus	4.44 (1.01)	5.0 (.00)	-.55	5.0 (.00)
Scene 3 focus	4.0 (1.0)			
Scene 4 focus	4.11 (.93)			
Scene 1 social appropriateness	3.78 (.83)	4.92 (.28)	- 2.1	4.70 (.66)
Scene 2 social appropriateness	4.0 (1.0)	4.54 (.72)	- .63	4.50 (.69)
Scene 3 social appropriateness	3.67 (1.0)			
Scene 4 social appropriateness	3.22 (1.09)			
Scene 1 overall conversation	3.22 (.83)	3.83 (.76)	- .77	4.5 (.51)
Scene 3 overall conversation	2.89 (.93)*			
Scene 2 negotiation ability	3.56 (1.33)	3.33 (.87)	.26	4.40 (.60)
Scene 4 negotiation ability	3.22 (1.20)			
Scene 2 submission/persistence	4.0 (1.0)	3.79 (1.10)	.20	4.70 (.47)
Scene 4 submission/persistence	3.78 (1.3)			
Scene 2 overall argument	3.56 (1.24)	3.46 (.78)	.10	4.30 (.47)
Scene 4 overall argument	3.33 (1.0)			
Scene 1 grooming	4.56 (.52)	4.79 (.42)	- .49	4.90 (.31)

Table 2. Social Skills Performance Assessment (SSPA) New Scoring for ASD

New Scoring Codes	Scene 1	Scene 2	Scene 3	Scene 4
eye contact	3.66 (1.11)	n/a	3.67 (1.0)	3.67 (1.22)
intonation and pattern of speech	3.44 (1.33)	3.33 (1.41)	3.33 (1.11)	3.22 (1.09)
body language	3.33 (.87)	n/a	3.11 (1.05)	3.33 (1.12)
facial expression	3.78 (.83)	n/a	3.78 (1.09)	3.44 (.88)
reading social cues	3.67 (1.12)	3.78 (1.20)	3.44 (1.30)	3.67 (1.18)
perspective-taking	3.44 (1.33)	3.44 (1.13)	3.78 (.97)	3.22 (1.09)

6 **163.006** Adults with ASD in Community Mental Health Settings: Evidence for the Services Cliff

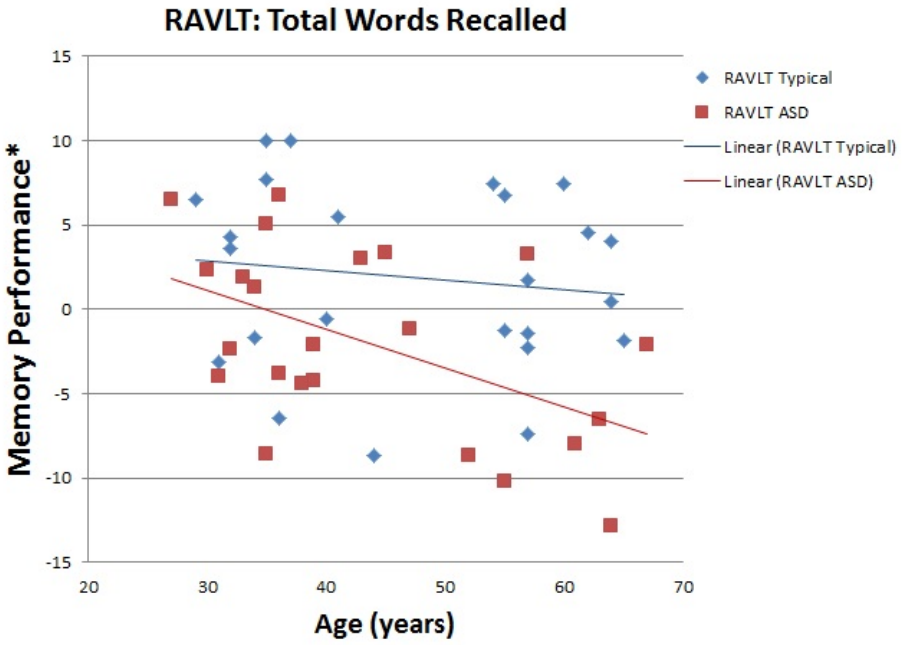
B. B. Maddox[1], *E. S. Brodkin*[2], *M. E. Calkins*[2], *J. Miller*[1], *K. T. Mullan*[2], *K. Shea*[2] *and D. S. Mandell*[3], *(1)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (2)University of Pennsylvania, Philadelphia, PA, (3)University of Pennsylvania School of Medicine, Philadelphia, PA*

Background: Most adults with autism spectrum disorder (ASD) struggle with mental health problems and require considerable support throughout the lifespan. Given this high rate of psychiatric comorbidity, adults with ASD may be overrepresented in mental health settings. Community mental health (CMH) centers serve a large number of adults with a variety of mental health problems, along with many school-age youth with ASD and co-occurring psychiatric disorders; however, the number of adults with ASD receiving CMH services in the United States is currently unknown. Evidence suggests that ASD often is missed or misdiagnosed among adults receiving psychiatric care, so a thorough investigation is needed to accurately determine the prevalence of adults with ASD in the CMH system.
Objectives: This study aims to estimate the prevalence of adults with ASD in outpatient CMH settings.
Methods: As part of the screening phase, staff from three CMH centers completed the Social Responsiveness Scale, Adult version (SRS-A) and the Autism Spectrum Disorders in Adults Screening Questionnaire (ASDASQ) for their adult clients. Our research team then conducted chart reviews to extract information found to discriminate adults with ASD from adults with other psychiatric disorders in prior studies (e.g., developmental history, substance use). A subset of these clients, stratified to heavily recruit participants with SRS-A scores > 60, completed in-person evaluations. The in-person assessment included Module 4 of the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2), a brief clinical interview about ASD related characteristics not assessed by the ADOS-2, and the Overview and Psychosis modules of the Structured Clinical Interview for DSM-IV-TR Axis I Disorders (SCID). The clinical evaluation team was blind to results from the SRS and ASDASQ. Clinical case conferences were conducted for all participants to make a final determination of ASD.
Results: To date, screening packets have been collected for 1134 clients, and 321 charts have been reviewed. We have currently completed in-person evaluations with 58 participants (39 males; mean age = 48.6 years old). An additional 35 evaluations are expected by May 2016. Of the 58 participants, 2 males met diagnostic criteria for ASD (3.45%).
Conclusions: Despite weighting our sample with high SRS-A scores, we have found a remarkably low number of adults with ASD in general outpatient CMH settings. Although CMH centers play an important role in treating school-age youth with ASD and co-occurring psychiatric disorders, our preliminary findings suggest that there are not many individuals with ASD (previously diagnosed or not) in general outpatient care. Our results support the growing public health concern that there may be significant unmet mental health needs experienced by adults with ASD. The extent of this problem will only increase as more and more children with ASD transition to adulthood. Clinical and policy implications will be discussed, including (1) possible reasons why general outpatient CMH service use decreases when adolescents with ASD become adults, and (2) the importance of identifying where adults with ASD can access appropriate mental health care.

7 **163.007** Age-Related Changes in Processing Speed and Free Recall in Middle-Age and Older Adults with ASD

P. S. Powell[1], *N. Peyravian*[2], *A. T. Meyer*[3], *L. G. Klinger*[4] *and M. R. Klinger*[5], *(1)University of North Carolina - Chapel Hill, Chapel Hill, NC, (2)Psychology, University of North Carolina - Chapel Hill, Chapel Hill, NC, (3)University of North Carolina, Carrboro, NC, (4)Psychiatry, University of North Carolina TEACCH Autism Program, Chapel Hill, NC, (5)University of North Carolina at Chapel Hill, Chapel Hill, NC*

Background:
Little is known about age-related changes in cognitive functioning in middle-age and older adults with ASD. However, two previous studies of cognitive aging in ASD show smaller or absent age-related changes on standardized measures of explicit memory suggesting that older adults with ASD may be buffered against some of the deleterious effects of aging (Geurts & Vissers, 2012; Lever & Geurts, 2015).
Objectives:
The primary objective of this study was to further examine age-related effects on cognition across two measures of cognitive function, processing speed and free recall, which have consistently revealed patterns of age-related decline in studies of normal aging.
Methods:
Twenty-three adults with ASD and 24 adults with typical development were recruited for this study (age range: 27 to 67); data collection is ongoing. Participants were provided with a measure of processing speed (e.g., Trail Making Test; TMT) and a measure of explicit memory (e.g., Ray Auditory Verbal Learning Test; RAVLT). The TMT administration was taken directly from the Delis-Kaplan Executive Function System (D-KEFS). In the number-letter switching subtest, participants connect the circles in ascending order by switching from a number to a letter (e.g. 1-A-2-B-3-C-4-D). Each subtest is timed. The RAVLT involves three trials of immediate free recall after listening to a list of 15 unrelated words.
Results:
Results from the TMT number-letter switching subtest were examined using a hierarchical linear regression. Full scale IQ (FSIQ) was entered first followed by diagnosis as a categorical predictor, then age, and finally an age by diagnosis interaction term. This analysis found diagnosis and age significantly predicted performance on the TMT (R^2_{change}=.13, p=.003; R^2_{change}=.11, p=.003, respectively). There was no age by diagnosis interaction indicating similar rates of decline across diagnoses.
The same regression analysis was performed on the RAVLT with total number of items recalled as the dependent variable. This analysis revealed diagnosis and age to be significant predictors of performance (R^2_{change}=.11, p=.01; R^2_{change}=.07, p=.05, respectively), and a non-significant age by diagnosis interaction
Conclusions:
The present findings demonstrate both diagnostic differences and age-related declines in processing speed and explicit memory in adults with ASD. Current findings demonstrated a similar rate of decline with age for adults with ASD as adults with typical development. However, evidence of poorer overall performance in adults with ASD coupled with age-related decline suggest that older adults with ASD may reach a level of performance that is markedly lower leading to impaired functioning at younger ages than those with typical development. Thus, increased caregiving needs associated with cognitive decline in typical adults may be needed sooner for adults with ASD.



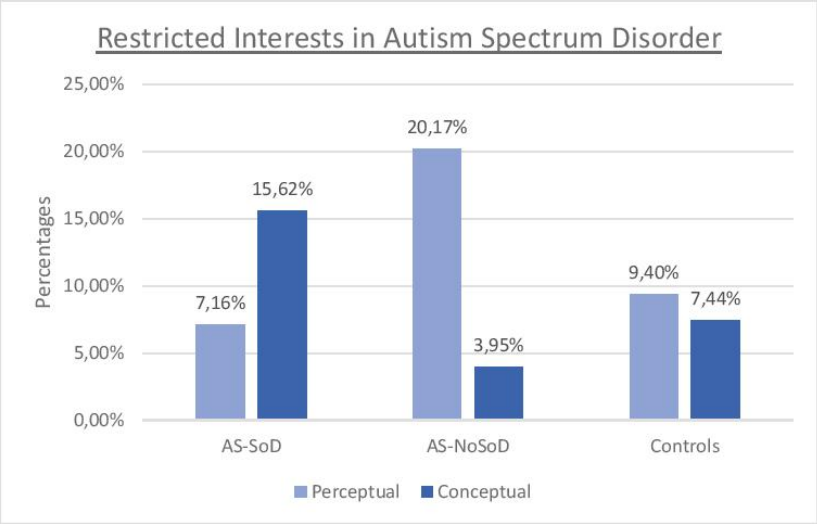
*Unstandardized Residual of Memory Performance with effect of IQ regressed out

8 **163.008** An Analysis of Restricted Interests in Autism Spectrum Disorder with Versus without Speech Onset Delay: The Importance of Perceptually Versus Thematically Organized Interests

L. Chiodo[1], *S. Majerus*[2], *S. Eusèbe*[2] *and L. Mottron, M.D.*[3], *(1)Université de Liège, 4000 Villers-St-Simeon, Belgium, (2)Université de Liège, Liège, Belgium, (3)Centre d'Excellence en Troubles Envahissants du Développement, Montréal, QC, Canada*

Background:
Recent findings (Bonnel et al, 2010; Barbeau et al, 2013) indicate that autistic people with/without speech delay can be differentiated on the basis of the perceptual vs. non-perceptual nature of their ability peaks. Neuroimaging findings support this hypothesis, by showing that autistic people with or without speech onset delay can be contrasted by the perceptual versus linguistic nature of the cortical areas displaying overactivation during the presentation of visual and auditory material (Samson et al, 2013, 2015).
Objectives:
In the light of these findings, the present study aims at exploring the nature of restricted interests in these two autistic populations, by examining whether autistic people with/without speech delay can be differentiated on the basis of the perceptual versus thematic nature of their interests.
Methods:
30 adult participants with autism spectrum disorder (based on ADI / DSM-4R criteria) participated in this study, and were allocated to AS-SOD (speech onset delay; N=15) or AS-NoSOD (no speech onset delay; N=15) subgroups, while being matched for IQ (> 70; Raven's SPM, 1981) and age. 13 typically developing controls, also matched for age and IQ, were recruited on the basis of presenting specific interests while being free of symptoms of autism spectrum disorder. Information about restricted interests was obtained by having participants answer to 19 questions based on the Yale survey of special interests (Klin & Volkmar, 1996) and the semi-structured interview by Mercier et al. (2000). Data were qualitatively analyzed with NVivo 10 textual analysis software in order to segment and categorize the content of the verbal reports provided by the participants.
Results:
A repeated measures ANOVA revealed that the proportion of thematically organized interests (interests with a rich semantic organization) was significantly higher in AS-NoSOD participants relative to both AS-SOD participants and controls (Figure 1). Conversely, the proportion of perceptually organized interests (interests based on accumulation of factual information such as historical dates, car license plates) was significantly higher in AS-SOD participants relative to both AS-NoSOD participants and controls.
Conclusions:
Restricted interests in AS-SOD are characterized by perceptually organized structures while these interests present a rich conceptual organization in AS-NoSOD individuals. These differences in the nature of restricted interests may provide important clues with respect to the mechanisms of information processing characterizing autism with speech delay as opposed to autism without speech delay. Our findings may also have implications for the definition of optimal and differentiated educational learning tracks in these two subgroups of autism spectrum disorders.

Figure 1



9 **163.009** Associations Between Compulsive Internet Use and the Autism Spectrum

C. Shane-Simpson[1], *P. J. Brooks*[2], *R. Obeid*[3], *E. G. Denton*[4] *and K. Gillespie-Lynch*[5], *(1)The Graduate Center & College of Staten Island, New York, NY, (2)College of Staten Island, Staten Island, NY, (3)CUNY Graduate Center, New York, NY, (4)Psychology, The College of Staten Island, Staten Island, NY, (5)CUNY Graduate Center, Brooklyn, NY*

Background: Research suggests that people in the general population with heightened autistic traits (Finkenauer et al., 2012; Romano et al, 2013; 2014) and people with ASD (MacMullin et al., 2015) are at increased risk for compulsive Internet Use (CIU). Researchers have interpreted associations between autistic traits and CIU as evidence for the *social compensation hypothesis* wherein individuals with social challenges use the Internet to compensate for social difficulties. However, ASD is defined not only by

social difficulties, but also by restricted interests and repetitive behaviors (RIRB; APA, 2013). Prior work has not evaluated whether observed associations between autistic traits and CIU are attributable to social symptoms or RIRB or examined if CIU is elevated among college students with ASD in particular.
Objectives: Study One examined whether CIU was associated with (1) social difficulties or RIRB, and (2) different functional uses of Facebook. Study Two evaluated if (1) associations between autistic-like traits and CIU replicated among college students with ASD, and (2) whether students with ASD reported greater CIU than matched peers without ASD.
Methods: In Study One, 597 undergraduates (316 women, 281 men) took an online survey measuring CIU (Meerkerk et al., 2009), autistic-like social symptoms and RIRB (SRS-2; Constantino & Gruber, 2012), self-esteem (Rosenberg, 1965), and Facebook connection strategies (Ellison et al., 2011). Study Two measured CIU and autistic traits among college students with (*n*=33) and without (*n*=33) ASD matched on age, gender, ethnicity, and self-esteem.
Results: Study One: Heightened CIU was associated with greater social symptoms ($r_s(532)=.415$, $p<.001$), greater RIRB ($r_s(532)=.455$, $p<.001$), and lower self-esteem ($r_s(545)=-.330$, $p<.001$), replicating previously documented associations between autistic-like traits and CIU. When entered into a binary logistic regression model predicting high vs. low CIU, only RIRB was associated with high CIU ($R^2=.196$, $X^2(4)=76.86$, $p<.001$). When Facebook connection strategies were entered into a binary logistic regression predicting high vs. low CIU, only information-seeking (but not initiating or maintaining contact) was associated with high CIU ($R^2=.062$, $X^2(3)=23.74$, $p<.001$). Study Two: Among participants with ASD, associations between CIU and social symptoms ($r_s(31)=.347$, $p=.048$), and between CIU and RIRB ($r_s(31)=.377$, $p=.031$) were observed. Although students with ASD exhibited heightened social symptoms and RIRB relative to students without ASD ($ps<.05$), students with and without ASD did not differ in CIU ($p=.102$).
Conclusions: Findings suggest that non-social traits (RIRB) and functions of Internet use (i.e., information seeking on Facebook) contribute more strongly to CIU than autistic-like social challenges and social uses of Facebook (initiating and maintaining contact). Although people with heightened RIRB may be susceptible to CIU due to opportunities to explore focused interests online, only some interests can most effectively be explored through the Internet. Indeed, participants with ASD in Study Two exhibited heightened RIRB, but not elevated CIU. Findings suggest that concern about CIU among individuals with ASD should be tempered by attention to developmental level and the nature of people's interests.

10 **163.010** Autism and Sleep: Understanding Insomnia in Adults with Autism Spectrum Disorder

M. M. Jenkins *and M. J. Baker-Ericzen, Child and Adolescent Services Research Center, Rady Children's Hospital San Diego, San Diego, CA*

Background: Little research has examined insomnia in adults with autism spectrum disorder (ASD). Insomnia symptoms include difficulty falling or staying asleep, early morning awakenings, sleep dissatisfaction, and distressed or impaired daytime functioning from sleep disturbance (American Psychiatric Association, 2013). Insomnia is associated with significantly lower quality of life (LeBlanc et al., 2007), greater risk for accidents (Léger et al., 2002), and high rates of psychiatric comorbidities (Morin & Jarrin, 2013). Children with ASD are prone to insomnia (Sivertsen et al., 2012; Souders et al., 2009), particularly difficulties with sleep initiation and sleep continuity (Richdale, 1999). Adults with ASD also likely experience insomnia (Tani et al., 2003); however, this line of research is still in its infancy.
Objectives: The present study examines the prevalence of insomnia in young adults with ASD using the Insomnia Severity Index (ISI). A secondary goal is to explore perpetuating factors of insomnia.
Methods: Nineteen adult participants, ages 18-29, with an ASD diagnosis, have been enrolled in a community-based intervention targeting social, cognitive and vocational domains. At least 15-25 additional participants will enroll by April 2016. Participants and their parents/caregivers complete a comprehensive assessment including sleep functioning. Participants complete the ISI (Morin et al., 2011), a widely used measure of insomnia with well-established reliability and validity. The ISI assesses severity of insomnia as well as satisfaction with sleep pattern, effect of sleep on daytime and social functioning, and concern about current sleep. A score of ≥10 indicates insomnia (86% sensitivity; 88% specificity) with 4 severity categories: 0-9 (none); 10-14 (mild); 15-21 (moderate); and, 22-28 (severe). Parents/caregivers complete the ISI reporting on participant sleep.
Results: Preliminary findings reveal participant (n=19) ratings on the ISI ranged from 0 (none) to 19 (moderate insomnia). Parent/caregiver (n=19) ratings ranged from 0 (none) to 27 (severe insomnia). Table 1 indicates how many participants exceeded the clinical cutoff for insomnia and the severity of their insomnia. Table 2 characterizes the type of insomnia (i.e., early, middle, late) and the related severity. Participant and parent report on the ISI demonstrated a small to medium positive association, $r=.42$, $p=.07$. Qualitative data indicate participants most commonly stay in bed and use electronics inside their bedroom when they cannot sleep. To compensate for poor sleep, participants most commonly sleep late and take naps.
Conclusions: We are aware of no previous studies using the ISI in adults with ASD. By participant report, >20% are above threshold for insomnia. By parent/caregiver report, >50% are above threshold. More research is needed to better understand how to best assess insomnia in ASD populations including how to maximize informant report. It is also important to further explore perpetuating factors of insomnia in this population (i.e., factors maintaining or exacerbating insomnia), as these are treatment targets for CBT for Insomnia, the frontline treatment. Improving the detection of insomnia in adults with ASD is an important yet largely unexplored area that could have a meaningful impact on research and clinical practice.

Table 1. Examining ISI scores over the clinical cutoff and severity of insomnia.

Informant	*Above Threshold Insomnia*	*Mild*	*Moderate*	*Severe*
Participant	21%	5%	16%	0%
Parent	53%	16%	26%	11%

Table 2. Characterizing type of insomnia and severity of sleep difficulty.

	Mild 30-45 minutes	*Moderate 45-90 minutes*	*Severe 90 -120 minutes*	*Very Severe >120 minutes*
Participant				
Difficulty Falling Asleep	26%	11%	11%	11%
Difficulty Staying Asleep	16%	11%	0%	0%
Problems Waking Too Early	26%	0%	0%	0%
Parent/Caregiver				
Difficulty Falling Asleep	17%	6%	22%	11%
Difficulty Staying Asleep	11%	22%	6%	6%
Problems Waking Too Early	33%	0%	6%	6%

11 **163.011** Autonomic Symptoms Endorsed By Adults with Autism Spectrum Disorders

B. K. Woodruff[1]*, J. Adams*[2]*, M. Temkit*[3] *and B. Goodman*[1]*, (1)Neurology, Mayo Clinic Arizona, Scottsdale, AZ, (2)Arizona State University, Tempe, AZ, (3)Research Biostatistics, Mayo Clinic Arizona, Scottsdale, AZ*

Background: Autonomic features such as abnormal skin conductance and pupillary responses have been reported in individuals with autism spectrum disorders (ASDs), but to our knowledge no systematic approach to identifying autonomic symptomatology has been conducted in adults with ASDs.
Objectives: To quantify autonomic symptoms endorsed by a sample of adults with ASDs on the Compass 31, a survey instrument that captures multiple autonomic symptoms.
Methods: The Compass 31, a quantitative measure of autonomic symptomatology was administered anonymously to 48 adults with ASDs. Subjects were recruited at local

autism community meetings or were mailed the instrument after expressing interest in participation. The latter subjects were identified from a database maintained by the Arizona State University Autism/Asperger's Research Program.
Results: Weighted Compass 31 total and subscale scores [mean (SD), (range)] were as follows: Total score (Maximum = 100) - 23.5 (16.1), (2.8-60.7); Orthostatic intolerance subscale (Maximum = 40) - 9.5 (9.8), (0.0-28.0); Vasomotor subscale (Maximum = 5) - 0.6 (1.2), (0.0-4.2); Secretomotor subscale (Maximum = 15) - 3.7 (3.2), (0.0-10.7); Gastrointestinal subscale (Maximum = 25) - 6.2 (3.8), (0.0-18.7); Bladder subscale (Maximum = 10) - 1.2 (1.5), (0.0-6.7); Pupillomotor subscale (Maximum = 5) - 1.8 (1.3), (0.0-5.0). The most commonly endorsed subscales (weighted subscale score > 0) in this sample were Gastrointestinal (97.9%) and Pupillomotor (83.3%).
Conclusions: Autonomic symptomatology was not uncommon in this sample of adults with ASDs, with gastrointestinal and pupillomotor symptoms commonly endorsed. Such symptomatology may represent autonomic dysfunction amenable to therapeutic intervention, which will need to be confirmed in future studies including clinical autonomic testing. Amelioration of such symptomatology may help to improve quality of life for a subset of individuals with ASDs.
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12 **163.012** Basic Auditory Processing Difficulty in the Youth with Autistic Feature

H. Song[1], *M. K. Kwon*[2] *and M. Park*[3], *(1)Graduate school for the professional therapeutic technology, Seoul Woman's univeristy, Seoul, South Korea, (2)Autism Center of Excellence, University of California, San Diego, La Jolla, CA, (3)Graduate school for the professional therapeutic technology, Seoul Woman's University, Seoul, South Korea*

Background: The population with ASD is hypersensitive to simple stimuli. This atypical perceptual processing is observed in both visual (Bertone, 2005) and auditory modalities (Lepisto, 2008). One explanation for this hypersensitivity is internal noise in neurons. According to this hypothesis, the complexity of stimuli influences the ability to perceive/discriminate basic perceptual properties. However, it is difficult to assess the 'internal noise' at the behavioral level. In addition, it is still unclear how this internal noise is related to ASD people's social skills.
Objectives: The present study was designed 1)to assess 'internal noise' in young adults with Autistic feature using the modified auditory Go-NoGo task (Song & Kwon, 2015), and 2)to examine whether basic auditory processing predicts the severity of Autistic feature, even after controlling for IQ and visual processing.
Methods: Participants were 102 undergraduate students (Mean Age =21.43; 40 males and 62 females). IQ(M = 12.49 for Block design, M=11.94 for Vocabulary), EQ (Baron-Cohen & Wheelright, 2004; Her & Lee, 2011), and AQ (Baron & Cohen, 2001) were assessed. Based on their performance on the AQ test, we divided the subjects into two groups: high AQ group (the top 30% (AQ>22)) and low AQ group (the bottom 30% (AQ <14)). None of gender, age and IQ differed across the two groups. The visual processing was assessed by using Bertone et al's (2005) Orientation Identification Task, and the auditory processing was assessed by using the modified auditory Go-No Go task (Song & Kwon, 2015). The modified auditory Go-No Go task required the ability to inhibit their dominant response (e.g. pressing an arrow key) when a softer sound was presented right after the first sound was presented. Their performance level was evaluated by assessing individual thresholds to reach 70% accuracy. A low threshold meant a high sensitivity. A half of the trials contained simple tones and the other half contained complex tones.
Results: We conducted hierarchical multiple regression analyses to analyze the relationships among IQ, the visual processing and the auditory processing. There were interesting group differences between the high AQ group and the low AQ group. In the high AQ group, their IQ score was positively associated with the visual processing ($r=.545$, $p<.05$) and their performance on the Go-NoGo test in both pure tone and complex tone conditions predicted their EQ (social function) scores respectively ($t=-.2.235$, $p<.05$ for pure tone; $t=-2.103$, $p<.05$ for complex tone), even after controlling for IQ and the visual processing. In contrast, none of significant relationships for the same tests was observed from the low AQ group.
Conclusions: Basic auditory processing is a significant predictor of the social function in the youth with ASD feature, even after controlling for IQ and visual processing. In addition, the Go-Nogo task was proved to indirectly represent the internal noise-related function. ASD people's difficulty in inhibiting a response to a softer volume could be a valuable variable in developing a method for the early detection and intervention.

13 **163.013** Changes in Social Activities for Youth with Autism Spectrum Disorders during the Transition to Adulthood

ABSTRACT WITHDRAWN

Background: Although low rates of social participation are common among youth with autism spectrum disorders (ASD), it is not known how leaving high school impacts their social/recreational activities, or whether changes in social activities have mental health implications.
Objectives: This study uses a longitudinal design to examine changes in social/recreational participation for youth with ASD from before to after high school exit. We also examined whether changes in activities were related to internalizing symptoms.
Methods: Participants were 33 youth with ASD and their families. Data were collected two times: when youth were in their last year of high school, and 6-12 months after high school exit. Youth averaged 18.8 years of age at the start of the study (range = 17-22). Most (84.8%) were male and the majority was white non-Hispanic (90.9%). Just over 30% had an intellectual disability. Parent respondents included 29 mothers and 4 fathers, who were generally well-resourced (although 25% had incomes < $40,000).
At both time points, parents reported how often their son/daughter participated in 10 activities (from 0 = less than yearly/never to 4 = several times a week). Activities were grouped into three areas: unstructured social activities (social time with relatives, friends/neighbors, or with people from school/work); structured social activities (religious services, church social events, formal/informal recreational activities, playing sports with others); and other activities (working on hobbies, travel, exercise). Average participation and a count of the number of activities were calculated for each area. Internalizing symptoms were measured both times using Achenbach's Adult Behavior Checklist.
Results: The most common activity was participating in a formal or informal recreational activity (e.g., bowling, movies) and the least common was playing sports with others. Most youth spent some unstructured social time with classmates, co-workers, friends, or neighbors, but few did this regularly. For example, when in high school, 55% of youth spent some time with people from school/work outside of school/work hours, but only 15% did this once a week or more.
Youth in their last year of high school, on average, participated in 7.7 activities; this average decreased to 7.0 activities after exit, $t(32)=2.8$, $p<.01$. There were no differences in the amount of unstructured social activities or "other," primarily non-social activities, $ts(32)=.06$ and .24, respective, p=ns. There was a significant decline in structured social activities after high school – both in average amount of participation and in number of activities, $ts(32)=3.10$ and 2.97, respectively, $ps<.01$. The extent of decline in structured social activities was marginally related to internalizing problems when youth were out of high school, Spearman $rho=-.33$, $p=.07$. Youth who had a greater drop in structured social activities were more likely to have borderline or clinical-level internalizing symptoms.
Conclusions: In addition to difficulties obtaining vocational/educational activities, our findings suggest that many youth with ASD lose some structured social activities after high school. This loss of activities might be related to internalizing problems. Further analyses will continue to examine the relations between changes in social and recreational activities during the transition to adulthood and mental health.

14 **163.014** College Experiences for Students with Autism Spectrum Disorder (ASD): Identity, Disclosure, and Accommodations

B. E. Cox[1], *A. Anderson*[2], *J. Edelstein*[2] *and A. Wolz*[2], *(1)P.O. Box 3064452, Florida State University, Tallahassee, FL, (2)Florida State University, Tallahassee, FL*

Background:
College students with autism face daunting social, emotional, independent-living, self-advocacy, and communication challenges both inside and outside of the classroom (Adreon & Durocher, 2007; Gobbo & Shmulsky, 2013). However, critical holes in the empirical literature make it difficult to develop low cost, high yield, evidence-based interventions to improve student grades, persistence, graduation, and subsequent employment.
Objectives:
The current study begins to fill these knowledge gaps by (1) defining salient issues affecting college success for individuals with autism and (2) describing institutional initiatives with potential to promote college success for students with autism. The study's primary research question is: How do students with autism make sense of their experiences in higher education and respond to barriers potentially limiting postsecondary success?
Methods:
Data for the study are drawn from interviews, following the guidelines outlined by Fetterman (1998), with nine students with a formal diagnosis of ASD. Interviews centered upon student inputs, experiences, and outcomes in higher education (Astin, 1991). For example, participants were asked to describe their initial fears about going to college and their decisions about whether to disclose their diagnosis.
Analyses proceeded using a constant comparative approach (Straus & Corbin, 1998) with researchers coding data independently but meeting periodically to ensure convergence during two distinct rounds of coding. First, two of this paper's authors used Astin's (1991) framework as an *a-priori*descriptive coding structure. The second round of coding was led by a third researcher. To confirm appropriate interpretation, two of the participating students reviewed and approved this paper.
Results:
As expected, all of the interviewed students cited postsecondary enrollment as a major life event. Once in college, students took a pragmatic approach to disclosing their autism diagnosis, only revealing diagnoses if needed to acquire formal accommodations from the postsecondary institution or when asked directly by peers. One student explained, "I don't know when or how to say it so I was always wait for it to come up" while another said "that never really came up."
Student comments also revealed an internal tension regarding the manner in which autism fit into their own sense of identity. Decisions to disclose their diagnosis to peers or the institution or to seek formal accommodations, therefore, were the outward manifestations of the internal identity development process for each student. For example, one student boasted "So I'm very proud of the fact that I'm able to fake out as many people as I do, honestly" but, moments later, concluded "I mean I know that's not really a healthy way to relate to one with autism or Asperger's."
Conclusions:

The voices of college students with ASD have generally been drowned out by the overwhelming emphasis (in the general public and scholarly literature) on young children and early interventions. This study amplifies their voices and empowers individuals with ASD to self-advocate as they consider opportunities for continued educational advancement. Now professionals working in postsecondary education must listen to these voices and act on behalf of the growing number of college students with autism.

15 **163.015** College Students' Knowledge and Attitudes Towards Students on the Autism Spectrum: A Five Year Follow-up

***D. White**, A. Hillier, A. Frye and E. Makrez, Psychology, University of Massachusetts Lowell, Lowell, MA*

Background: Autism spectrum disorder (ASD) is characterized by social and communicative deficits, as well as patterns of rigid and repetitive behavior. However, with the appropriate supports in place, many individuals with ASD are capable of academic success, including success at the university level. In recent years, the importance of acceptance from peers and integration into the university has been increasingly recognized as contributing factors to success for university students with ASD.
Objectives: This study aimed to evaluate university students' knowledge and attitudes towards students on the autism spectrum, to identify underlying factors which contribute to such attitudes, and to examine whether attitudes changed over a five year period.
Methods: Participants were undergraduate students at a mid-sized university in the northeast. Data was collected for the first cohort in 2008 and included 111 participants. The second cohort was collected five years later in 2013 and included 103 participants. Participants in each cohort completed a questionnaire which asked about their knowledge of traits associated with ASD, whether they knew someone with ASD, and their attitudes towards students with ASD.
Results: As predicted the second cohort endorsed significantly more correct traits associated with ASD than those in the first cohort. They also demonstrated significantly more positive attitudes. In looking at the relationship between knowledge (measured by number of identified correct traits) and attitudes, no significant correlation was found. To investigate further the relationship between cohort, attitudes and knowledge, we examined associations between attitudes and nine subscales of traits including correct and incorrect traits. Positive traits were positively correlated with positive attitudes, and negative traits were negatively correlated with positive attitudes. In addition, students who identified a high number of incorrect traits were likely to have less positive attitudes toward their peers with ASD, regardless of the number of correct traits that were identified.
Conclusions:
While our findings indicate that student attitudes and knowledge improved over the course of five years, many students who were knowledgeable about ASD still reported negative attitudes toward participating in university and classroom based activities with students with ASD. These findings have implications for increasing knowledge and understanding of autism spectrum disorders on college campuses, and ultimately academic success and graduation rates for this population.

16 **163.016** Correlates of Academic Success in College Students with an Autism Spectrum Disorder: Do the Traditional Measures Apply?

***S. W. Eldred**[1], S. M. Ryan[2], L. K. Baker[1] and J. A. Rankin[1], (1)Psychology, The University of Alabama, Tuscaloosa, AL, (2)The University of Alabama, Tuscaloosa, AL*

Background:
Colleges use both the American College Testing college readiness assessment (ACT) and high school GPA as measures of students' previous educational achievements in order to help determine potential for success in college (ACT, 1997). Studies have found positive linear relationships between both ACT scores and college GPA, as well as previous GPA and college GPA, indicating that these are valid predictors of college success in neurotypical populations (Coyle, 2015; ACT, 2002). While cognitive ability is not traditionally used to predict success in college students, it is strongly correlated with ACT scores and may serve as an additional factor to help predict success in college (Coyle, 2015). The relationship between these factors and academic success in college have not been studied in college students with ASD.
Objectives:
The current study examines the relationship between students' GPA at the end of their first semester, and factors typically associated with success in college, (i.e., ACT scores, previous GPA, FSIQ).
Methods:
This study included 10 students enrolled in an ASD specific support program for degree-seeking undergraduate students with ASD at a major public university. Enrolled students meet 3 times per week with a mentor, participate in study hall, and attend group meetings. Three cohorts of students entering the University in 2012, 2013, and 2014 were included in the current analysis. Of these students, 7 entered as freshmen and 3 entered as transfer students. As part of their applications, each student provided past cognitive assessments, their high school GPA, and their ACT scores.
Results:
Correlations between ACT scores, previous GPA, FSIQ, and cumulative spring GPA were examined. These correlations revealed that, similar to studies with typically developing students, there was a strong positive correlation between ACT scores and IQ scores, ($r = .77$, $p = .01$). However, unlike neurotypical students, neither ACT scores nor IQ scores were significantly related to first-year GPA, ($r = .49$, $p = .15$; $r = -.05$, $p = .85$). Additionally, neither ACT scores, nor IQ scores were significantly related to previous GPA, ($r = .42$, $p = .20$; $r = .23$, $p = .40$). There was a significant positive correlation between high school GPA and first-year GPA ($r = .54$, $p = .04$). It should be noted that the limited sample size result in limited power to detect small to moderate effects. Six to seven additional students will be added from the most recent cohort prior to the IMFAR meeting in May.
Conclusions:
Overall, these results indicate that factors that are used as predictors of college success for typically developing students might not be as significant in students with ASD. For the current sample of college students with ASD, ACT and IQ scores did not significantly correlate with first-year GPA, suggesting a weaker association between these factors compared to typically developing students. The strongest relationship was found between previous GPA and first-year

17 **163.017** Correlates of Self-Reported Quality of Life in Verbally-Able Young Adults with Autism Spectrum Disorder

***K. M. Frost**[1], L. A. Pepa[2], K. Gotham[3] and C. Lord[4], (1)Center For Autism and the Developing Brain, White Plains, NY, (2)Rutgers University, Smithtown, NY, (3)Vanderbilt University, Nashville, TN, (4)Weill Cornell Medical College, White Plains, NY*

Background:
Although adults with autism spectrum disorder (ASD) demonstrate a range of abilities, many remain dependent on their families or other support services in adulthood (Howlin, Goode, Hutton, & Rutter, 2004; Taylor & Seltzer, 2011). Studies of ASD in adulthood often focus on symptom profiles and independence. Additionally, it is important to consider an individual's perceived quality of life. Quality of life is an aggregate of various factors, such as interpersonal relations, material and emotional well-being, social inclusion, and rights (Schalock, 2004). While previous research has examined this construct for caregivers, few studies to date have focused on quality of life for individuals with ASD (Renty & Roeyers, 2006; Kamio, Inada & Koyama, 2012).
Objectives:
This study aims to characterize factors related to self-reported quality of life in a transition-age sample of verbally-able young adults with ASD.
Methods:
Participants were drawn from a well-characterized sample of individuals who were suspected of having autism at age two, and have been followed into young adulthood (Lord, Risi, DiLavore, Schulman, Thurm & Pickles, 2006; Anderson, Liang, & Lord, 2014). The following data is derived from questionnaires and in-person assessments collected at approximately age 18. In addition to standardized measures of autism symptoms (Autism Diagnostic Observation Schedule; ADOS), cognitive ability, and adaptive functioning (Vineland Adaptive Behavior Scales; VABS), participants completed self-report measures, including the Quality of Life Questionnaire (QoLQ; Schalock & Keith, 1993), the Social Interests and Habits Questionnaire (SIH; Gotham, Bishop, Brunwasser, & Lord, 2014), and the Social Support Questionnaire (SSQ; Sarason, Sarason, Shearin, & Pierce, 1987). Parents completed the Family Support Scale (FSS; Dunst, Jenkins, & Trivette, 1984), as well as a questionnaire about the participant's service use. Participants were included in the present study if they were verbally fluent, and able to complete self-report questionnaires on their quality of life (n=23).
Results:
Scores on the QoLQ were significantly positively correlated to verbal IQ (r=0.55) and all domains of the VABS (r=0.45 to 0.63), and negatively related the ADOS Calibrated Severity Scores (CSS) in restricted and repetitive behaviors (RRB) (r=-0.60). Additionally, youth quality of life was positively related to amount of social activity on the SIH (r=0.65) and satisfaction with social support on the SSQ (r=0.70), and negatively related to service use (r=-0.43). No significant relationship was found between FSS and QoLQ (r=-0.07). When controlling for effects of verbal IQ, QoLQ scores remained significantly related to ADOS RRB severity scores and VABS communication scores, in addition to social activity (SIH) and satisfaction with social support (SSQ).
Conclusions:
Results suggest that a combination of factors, including fewer repetitive behaviors, higher verbal intelligence, stronger adaptive skills, and increased social activity are associated with greater self-reported quality of life in young adults with ASD. These findings underscore the importance of access to social activity and support as individuals enter adulthood. It also suggests that self-reported quality of life is an important outcome measure in this population, and one that may reflect an integration of autism symptom level, social and adaptive functioning.

Table. Correlates of the Quality of Life Questionnaire.

		ADOS Calibrated Severity Score				Vineland Standard Scores						
		Overall Total	Social Affect	Restricted/ Repetitive	Verbal IQ	Communi-cation	Daily Living Skills	Socializa-tion	SIH	SSQ Satisfaction total	Number of Services Accessed	Family Support Scale
Quality of Life Questionniare	Pearson *r*	-0.52*	-0.30	-0.60**	0.52*	0.65**	0.46*	0.47*	0.65**	0.67**	0.41*	-0.04
	Sig.	0.01	0.18	0.00	0.01	0.00	0.03	0.02	0.00	0.00	0.05	0.87
	N	22	22	22	23	23	23	23	21	16	23	22

*p<.05

**p<.01

18 **163.018** Depression and Anxiety in the Aging ASD Cohort: Relationships with Cognition and Social Networks

B. B. Braden[1], *C. J. Smith*[2], *T. Glaspy*[1], *A. M. Thompson*[1], *B. R. Deatherage*[1], *E. Wood*[1], *D. Vatsa*[1] *and L. Baxter*[1], *(1)Barrow Neurological Institute, Phoenix, AZ, (2)Southwest Autism Research & Resource Center, Phoenix, AZ*

Background: The population of adults with autism spectrum disorder (ASD) is rapidly growing, yet there are few studies investigating the effects of aging. ASD individuals have high comorbidity with other psychiatric disorders, especially depression and anxiety. In typically developing (TD) individuals, psychiatric symptoms increase with age which is hypothesized to be related to decreased social support. Many ASD individuals struggle with decreased social support at even younger ages. It is critical to understand mood symptom changes with age, since these factors negatively affect cognition, which can further impair functioning of ASD individuals.
Objectives: To evaluate the relationship between age and mood measures in ASD, we utilized self-report measures of depression, anxiety, and social networks and related findings to cognitive scores. We hypothesized that psychiatric symptoms are exacerbated in older cohorts of ASD, and that symptoms are related to level of social support and predict cognition.
Methods: Data were obtained for 16 high-functioning middle-age (40-65 years) ASD, 11 young-adult ASD (18-25 years), and age-matched TD (16 middle-age; 9 young-adult) male participants. Self-report measures were Beck Depression Inventory-II (BDI-II), State-Trait Anxiety Inventory (STAI), and Social Network Index. Mood measures were correlated with cognitive measures of executive functioning, memory, and visual detail processing.
Results: Participants did not significantly differ in IQ (p=0.18). For all mood and social network measures, there were main effects for diagnosis, such that ASD participants reported higher levels of depression and anxiety and lower levels of social networks, as compared to TD (all p<0.01). Based on clinical cutoffs, 88% of the middle-age ASD group reported significant levels of anxiety and 44% reported significant depression, as compared to 45% in the young-adult ASD group for both anxiety and depression. Social network measures did not significantly correlate with mood measures in either middle-age or young-adult ASD participants. In young-adult ASD participants, mood measures significantly predicted performance on several cognitive measures, most pronounced for memory. However, mood measures did not correlate with cognitive performance in the middle-age ASD group. IQ levels did not account for a significant amount of the variance in any dependent measure and effects did not change when values were added as covariates.
Conclusions: Findings suggest older adults with ASD experience greater levels of depression and anxiety and less social support than their TD counterparts. Further, rates of clinically significant anxiety in this sample of older adults with ASD are higher than ever reported in younger samples, including the young-adults in the present study. Interestingly, mood symptoms did not correlate with measures of social support or cognition in middle-age ASD participants. This dissociation between mood and cognition suggests cognitive deficits in older adults with ASD may be mediated by other effects of aging. Further, increased rates of psychiatric symptoms may not be a result of lack of social support in older adults with ASD. Understanding age-related changes and accurately detecting symptoms through measures uniquely designed for the ASD population is essential to providing appropriate care plans and effective treatment interventions for mental health in ASD.

19 **163.019** Determining Sex Differences in the Social Cognition of Adults with High-Functioning Autism Spectrum Disorder Using Advanced Mindreading Tasks

M. Kuroda[1,2] *and Y. Kawakubo*[3], *(1)Graduate School of Education, The University of Tokyo, Tokyo, Japan, (2)Child Mental Health-care Center, Fukushima University, Fukushima-shi, Japan, (3)University of Tokyo, Bunkyo-ku, Japan*

Background: At even three years of age, girls can understand another individual's emotions and thoughts better than boys of the same age; that is, girls exhibit more advanced social cognition than boys in childhood (Baron-Cohen, 2003). Additionally, individuals with autism spectrum disorder (ASD) display inherent deficits in mindreading abilities. The results of the study, using the Cambridge Mindreading Face-Voice Battery, revealed that females recognized emotions from facial expressions better than males did, regardless of the diagnosis of Asperger syndrome (AS) (Golan et al, 2006). However, few studies have examined the role of sex differences in social cognition.
Objectives: We aimed to examine sex differences in the social cognition of adults with high functioning ASD using advanced mindreading tasks, as well as the relationship between mindreading abilities, the symptoms of ASD, and IQ.
Methods: The 60 participants consisted of 41 male adults with ASD (mean age = 30.9±8.3 yrs, mean Full IQ (FIQ) =108.5±13.3, mean Verbal IQ(VIQ)=113.3±13.8) and 19 female adults with ASD (mean age =31.7±8.0 yrs, mean FIQ =105.7±11.0, mean VIQ=109.4±9.7). There was no significant difference in age, FIQ and VIQ scores between these two groups. The participants performed advanced mindreading tasks "The Motion Picture Mind-Reading Test"(Wakabayashi & Katsumata,2011) consisting of the evaluation of 41 video clips that were designed to assess mindreading ability. A word or a phrase that expressed a mental state was shown along with each video clip. The participants were asked to judge whether each word or phrase was appropriate for the paired scene. Autism Diagnostic Observation Schedule testing was also conducted with all participants to evaluate ASD symptoms.
Differences between the groups regarding accuracy rates for the advanced mindreading tasks were evaluated using an independent t-test. Additionally, we examined the correlation between the accuracy rates for the advanced mindreading tests and verbal IQ (VIQ), performance IQ (PIQ), FIQ, and ADOS scores.
Results: There was no significant difference in the accuracy rate for the advanced mindreading tasks between males (67.3±16.1) and females (69.7±2.7). The accuracy rate of advanced mindreading tasks and the ADOS social score showed a significant positive correlation in females (r=.648, p<.01), but not in males (r=.211, p=.185). Conversely, the correlation between the accuracy rate of advanced mindreading tasks and VIQ was significant for males (r=.323, p<.05) but not for females (r=.277, p=.251).
Conclusions: These results suggest that male adults with ASD perform the mindreading tasks by using their intelligence, specifically that measured by VIQ. This result was the same as that in Happé's study (1995) but that study did not consider sex differences. Our results also suggest that females with high functioning ASD may process the mindreading tasks through social cognition (ADOS social area). In the real world, males with high functioning ASD compensate for mindreading deficiencies by use of that portion of intelligence measured by the VIQ, whereas females perform the mindreading tasks through social cognition. The female's strategy for mindreading may be the same as in individuals with typical development.

20 **163.020** Do College Students with ASD Face Specific Challenges Navigating Job Interviews Relative to Students with Other Disabilities and Students without Disabilities?

D. Bublitz[1], *K. Fitzgerald*[1], *M. Alarcon*[2], *J. D'Onofrio*[3] *and K. Gillespie-Lynch*[1], *(1)City University of New York, College of Staten Island, Staten Island, NY, (2)City University of New York, Brooklyn College, Brooklyn, NY, (3)Center for Student Accessibility, City University of New York, College of Staten Island, Staten Island, NY*

Background:
Employment challenges faced by individuals with disabilities may be exacerbated for those with ASD (Newman et al., 2011). Difficulty navigating employment interviews may contribute to disparities between the abilities of individuals with ASD and employment outcomes (Hendricks & Wehman, 2009). Interventions have improved the interview skills of adults with ASD (Morgan et al., 2014; Smith et al., 2015). However, these interventions have not used comparison groups to identify challenges specific to people with ASD and have not focused on college students. Although increasing numbers of students with ASD are entering college, evidence-based supports to help college students with ASD remain scarce (Barnhill, 2014). Research is needed to identify both specific challenges that college students with ASD face during job interviews and challenges they share with other students, to develop interventions consistent with the principles of Universal Design.
Objectives:

1. Compare the interview skills of college students with ASD, students with other disabilities and students without disabilities.
2. Examine associations between interview performance and autistic symptoms, anxiety, self-esteem, and prior interview experience.

Methods:
Sixteen college students with ASD, fifteen students with other disabilities, and fourteen students without disabilities engaged in mock employment interviews and completed assessments including the SRS-2, STAI, and Rosenberg's SES. Verbal responses were coded using non-mutually exclusive codes by two coders who achieved research reliability. Responses were timed in milliseconds. Non-parametric analyses were employed.

Results:
Students with ASD reported higher autism symptoms than students with other disabilities (p = .023) or no disabilities (p = .003) and more state anxiety than students with other disabilities (p = .04). Group differences in self esteem and prior interview experience were not observed (ps > .12).
When asked what they look for in a workplace, students with ASD were less likely to mention desiring social interaction than either comparison group (ps < .008).
Most students with ASD (63%) and students with other disabilities (67%) fully disclosed disability status. However, students with ASD (13%) and those with other disabilities (7%) rarely framed disclosure by emphasizing positive aspects of their disabilities. Students with disabilities who reported higher self-esteem (irrespective of ASD classification) disclosed their disability prior to being asked (p = .039).
Students with ASD exhibited longer and more variable durations of responses than those without disabilities (ps = .020). Higher autistic symptoms were associated with longer duration of responses (p = .014).
Conclusions:
Responses to many questions in the mock interview did not differ between students with ASD and their peers. Therefore, college students with ASD may benefit from interview skills interventions that include diverse peers and are based on the principles of Universal Design.
Students with disabilities were ineffective in educating the interviewer about strengths associated with their disability. Interventions should include guidance concerning disclosure of disability status during job interviews.
Students with ASD exhibited challenges modulating the length of their responses and rarely expressed interest in social interaction in the workplace. Therefore, interventions should help students with ASD express their viewpoints succinctly while conveying social interest during the interview and/or seeking jobs requiring less interaction with others.

21 **163.021** Does Baseline Physiological Arousal Influence Inhibitory Control in Adults with Autism Spectrum Disorder?

M. Kuiper[1], *L. Verhoeven*[2] *and H. M. Geurts*[3], *(1)Research, Development & Innovation (RD&I); Brain & Cognition, Dr. Leo Kannerhuis; University of Amsterdam, Doorwerth, Netherlands, (2)Dr. Leo Kannerhuis, Doorwerth, Netherlands, (3)Dutch Autism & ADHD research center (d'Arc) Dept of Psychology, Brain and Cognition, University of Amsterdam; Dr. Leo Kannerhuis, Amsterdam, Netherlands*

Background:
Cardiac autonomic functioning (a.k.a. physiological arousal) is increasingly acknowledge to be related to problems that people with autism spectrum disorder (ASD) encounter in daily life. Baseline physiological arousal has been suggested to modulate inhibitory control in typically developing (TD) individuals: when confronted with a stressor, low baseline arousal would lead to more prepotent response inhibition difficulties than high baseline arousal. Recent meta-analysis showed that people with ASD have prepotent response inhibition difficulties (effect size: 0.55). However, a significant amount of heterogeneity between the studies was observed, suggesting there are unknown factors that influence inhibitory control in people with ASD. Baseline physiological arousal could be one of these factors.
Objectives:
We aim to examine the influence of baseline physiological arousal on prepotent response inhibition.
Methods:
Inhibitory control was measured with an emotional stop signal task (ESST) including neutral and negative pictures with stop signal reaction time (SSRT) as outcome measure. Participants were 32 male adults with ASD and 30 TD adults (age 18-45). Physiological arousal, at baseline and during the ESST, was indicated by heart rate variability (HRV). Data collection is expected to end in November 2015, with both groups containing 40 participants. Final results can be presented in May 2016.
Results:
Preliminary group comparisons revealed that the ASD group had significantly lower baseline HRV than the TD group. Both groups had similar SSRTs on the ESST. Using a median split on baseline HRV, both the ASD and TD group consisted of a significantly different low and high baseline HRV subgroup. The low ASD subgroup had significantly lower baseline HRV compared to the other three subgroups. The high ASD and high TD subgroup had similar baseline HRV. Mixed ANOVA analysis showed no interaction effect of baseline HRV on ESST, but indicated that all groups performed worse on the negative condition. Exploratory group comparisons revealed that the low ASD subgroup had significantly higher SSRTs compared to the high ASD subgroup.
Conclusions:
These preliminary findings suggest that adults with ASD are more aroused at baseline compared to TD adults but have similar prepotent response inhibition abilities. Both groups showed more prepotent response inhibition difficulties when confronted with a stressor. So far, results suggest no influence of baseline HRV on prepotent response inhibition. Exploratory analysis suggest a low baseline HRV subgroup within the ASD population that seem to have more prepotent response inhibition difficulties than adults with ASD with higher baseline HRV.

22 **163.022** Early Adult Outcomes of High-Functioning Children with Autism Spectrum Disorder (ASD) in Hong Kong

P. W. Leung *and R. Poon, Psychology, The Chinese University of Hong Kong, Hong Kong, China*

Background:
Autism spectrum disorder (ASD) is a neurodevelopmental disorder since childhood. Given the unavailability of a medical cure, it incurs considerable impairments to the psychosocial/educational/occupational development of the afflicted children. It is thus imperative to assess their adult outcomes for both academic and practical reasons.
Objectives:
This cross-sectional study in Hong Kong examines outcomes of high-functioning ASD children at their early adulthood (aged 18-28) in terms of persistence of ASD diagnosis/symptoms, psychosocial adjustment, and educational/occupational attainment. IQs assessed during childhood were investigated as predictors of adult outcomes.
Methods:
Sixty-four ASD adults were recruited from clinics and ASD groups in Hong Kong. They were Chinese with normal intelligence. All, except five, were males, aged between 18 to 28 years. A series of tests and interviews were administrated to them and/or their parents by clinicians in two half-day sessions.
Results:
Sixty-seven percent of the participants at early adulthood still retained an ASD diagnosis (by 3Di, a standardized diagnostic interview revalidated locally in Hong Kong, Kelly et al., *JADD*, 2015). For the remaining 33%, only one-third of them (or only 11% of the whole group) was completely symptom-free. The psychosocial adjustment of 58% of the ASD adults was rated “fair/poor”, in contrast to 42% “near normal/good”, on the basis of five areas, namely, work, friendship, independence, stereotyped/repetitive behaviors, and use of language. When compared to population age-peers, the ASD adults were also found to be under-achieved both in terms of educational/occupational attainment. IQs assessed at childhood, particularly Verbal IQ, were found to be good predictors of the adult outcomes, including persistence of ASD diagnosis/symptoms, psychosocial adjustment, and educational/occupational attainment, besides current IQs. Performance IQ remained essentially unchanged from childhood to adulthood, while Verbal IQ had made some significant improvement. The outcome variables were themselves all interrelated. Those ASD children starting with lower IQs at childhood would continue at early adulthood having lower IQs, persistence of ASD diagnosis/symptoms, poorer adjustment, and lower educational/occupational attainment or vice versa.
Conclusions:
Even amongst ASD individuals with normal intelligence, IQs remained potent predictors of their early adult outcomes. Our present outcome data indicated substantial developmental impairments/disadvantages with strong persistence of ASD diagnosis/symptoms. However, when compared to many previous studies, the early adult outcomes of our ASD individuals in Hong Kong were in fact at the favorable end. This could partly be explained by including only ASD adults with normal intelligence in our study. Or, this could also be partly due to facilitative environmental factors in Hong Kong such as an expanding economy with a labor market close to full employment, as well as to recent world-wide technological advances, including the mass availability of computers and web-based social networking platforms. Nonetheless, the overall chronicity and impairing nature of ASD identified here highlighted the needs for a wide range of services tailored to the adult problems of ASD in areas of education, vocational training, work, or independent living, besides those persistent autistic symptoms/traits.

23 **163.023** Effects of Internalizing Problems on Daily Living Skills Among High-Functioning Adults with Autism Spectrum Disorders in Japan

M. Tsujii[1], *Y. Murayama*[2] *and K. Suzuki*[3], *(1)Chukyo University, Toyota, Aichi, Japan, (2)Hamamatsu University School of Medicine, Nagoya-shi, Aichi, Japan, (3)Department of Psychiatry, Hamamatsu University School of Medicine, Hamamatsu, Japan*

Background: Adaptive functioning encompasses behaviors deemed critical to living independently, including daily living skills. Such adaptive behavior is often impaired to some degree in individuals with Autism Spectrum Disorders (ASDs) (Sparrow et al., 2005), with deficits appearing to be particularly pronounced in individuals with high-functioning ASDs in Japan. In addition to issues with adaptive behavior, though, individuals with ASDs are also likely to have mental health problems. Studies have shown that rates of depressive and anxiety disorders are higher in those with high-functioning ASDs. These internalizing problems may exacerbate deficits in daily living skills and most adaptive behaviors. And, few studies have investigated the relationship between daily living skills and severity of internalizing problems in adults with high-functioning ASDs.
Objectives: In our cross-sectional study, we examined the effects of internalizing problems on daily living skills in adults with high-functioning ASDs.
Methods:
Participants were 116 adults (90 men and 26 women) who had been diagnosed with a high-functioning ASD. Mean age was 28.10±6.54 years, with a range from 20 to 52 years.
Measures: *Daily Living Skills* Participants' daily living skills were evaluated using Daily Living Skill domain, the Vineland Adaptive Behavior Scale-II Japanese version (VABS-J; Tsujii et al., 2014; Sparrow et al., 2005).
Internalizing Problems Due to impairment of self-monitoring in individuals with ASD, levels of internalizing problems were assessed using both self- and other-rated methods. For self-rating severity of internalizing symptoms, the Kessler Psychological Distress Scale (K10; Kessler et al., 2002) Japanese version (Furukawa et al., 2002) was used. For other-rating severity of internalizing problems, parents of participants answered questions regarding Internalizing Problems in Maladaptive Behavior Index, VABS-J.

Results:
With regard to scores of Daily Living Skills domain, we performed a hierarchical regression analysis with gender and age as independent variables in the first step, main effects of scores on the self- and the other-rated scales in the second step, and the two way interaction of K10×Internalizing Problems in VABS-J in the final step. Finding from this analysis indicated the interaction was significant (β =-.292, p<.05). Simple slope analysis showed that, for adults with high K10 scores, other-rated severity of internalizing problems was negatively associated with daily living skills (t=-2.19, p<.05), whereas among those with low K10 scores, no association was noted between other-rated severity of internalizing problems and daily living skills (t=0.49, *n.s.)*. Further, with regard to Community subdomain scores, a significant effect of interaction was noted between K10 score and the other-rated score (β =-.360, p<.05). For adults with high K10 scores, other-rated severity of internalizing problems was negatively associated with Community scores (t=-2.42, p<.05), whereas among those with low K10 scores, no association was noted between other-rated severity of internalizing problems and Community scores (t=1.19, *n.s.)*.
Conclusions:
Results in the current study suggest that severity of internalizing problems negatively affects daily living skills in adults with ASD in Japan. Pharmacotherapy or psychological treatment (i.e. cognitive behavior therapy) may therefore improve degree of adaptive behavior in individuals with ASD.

24 **163.024** Emotional Suppression Moderates the Relationship Between Autistic Traits and Physiological and Cognitive Responses to Acute Social Stress in a Healthy Adult Sample

ABSTRACT WITHDRAWN

Background:
In the past decade, Autism has undergone a reconceptualization from a dichotomous, all-or-nothing clinical diagnosis to a dimensional classification including milder variants of the disorder, giving rise to interdisciplinary research on the broader autism phenotype (BAP). BAP examines subthreshold symptoms of ASD with the assumption that traits associated with the autistic spectrum are widely distributed and can be measured using self-administered instruments among adults with normal intelligence. Recently, we have demonstrated that the core features of AT, specifically social-communication deficits and restricted and repetitive behaviors, are associated with maladaptive emotion regulation strategies. Furthermore, it has been established that AT are related with dysfunctional stress coping; importantly, individuals with high levels of AT are more likely to have co-occurring stress-based disorders such as anxiety. To date, no studies have examined whether AT are associated with physiological responses to acute social stress and whether this link is moderated by emotion regulation.
Objectives:
The aim of this study is twofold: 1) To explore whether AT are associated with higher levels of the stress hormone cortisol, higher heart rate, and lower levels of cognitive performance in response to acute social stress in lab. 2) To determine whether the link between AT and physiological responses to acute stress are moderated by emotional suppression. We hypothesized that individuals with high AT will have higher physiological responses to stress, and this association will be more pronounced with individuals high in emotional suppression (ES).
Methods:
Data was acquired from a community sample of 39 male adults between 19 and 54 years old (M=27.79, SD=8.24). Participants were exposed to a standardized psychosocial laboratory stressor, the Trier Social Stress Test (5-minute simulated job interview, followed by 5-minute mental arithmetic task). Heart rate was continuously tracked throughout the TSST and salivary cortisol was collected at eight 10-minute intervals, during baseline, adaptation, stress, and recovery phases. Number of mistakes on the mental arithmetic task was recorded as an indicator of cognitive performance. AT was measured using Autism Spectrum Quotient and ES was measured by the Emotion Regulation Questionnaire.
Results:
AT was positively associated with cortisol and heart rate and negatively with the number of mistakes (rs > 0.37, ps < 0.03). Furthermore, emotional suppression significantly moderated the relationship between AT and salivary cortisol (β=1.72, t(35)=2.74, p<0.01) and the number of mistakes (β=1.44, t(35)=2.19, p=0.04). Simple slope analysis revealed that individuals high in AT and ES produced the highest levels of cortisol and made the most cognitive errors.
Conclusions:
The results of the current investigation extend the literature on AT by focusing on its physiological correlates for the first time. They also contribute to the growing volume of evidence that AT is associated with dysfunctional emotion regulation. Since dysfunctional emotion regulation and higher cortisol levels are linked to negative health outcomes, targeting maladaptive emotion regulation strategies of individuals high in AT through therapeutic interventions may be a way to preempt such outcomes.

25 **163.025** Employment for Adults with Autism Spectrum Disorders: A Retrospective Review of a Customized Employment Approach

***S. Carr**, Research, Rehabilitation and Training Center, Virginia Commonwealth University, Richmond, VA; Virginia Commonwealth University, Virginia Commonwealth University, Richmond, VA*

Background: Over the past few decades, there has been an increase in prevalence of children with autism spectrum disorders (ASD), and those children are now becoming young adults in need of competitive integrated employment (CIE). Customized employment (CE) is one pathway to employment that has been successful for other individuals with developmental disabilities (DD), though research has been very limited on the effectiveness with individuals with ASD.
Objectives: The purpose of this study was to explore the effect of supported employment and systematic fading of employment specialist support for individuals with ASD over a 5 year period in a variety of employment settings.
Methods: This is a retrospective review of 64 individuals with ASD who came to our program from 2009 to 2014 for supported employment services as referred by the state vocational rehabilitation services agency. Employment specialists engaged in situational assessment, discovery, job development, customized job descriptions, on-site training and support, positive behavioral supports, and job retention techniques. The employment specialists were responsible for tracking their actual time spent working directly with or for the jobseeker with Autism Spectrum Disorders (ASD).
Results: All vocational rehabilitation clients with ASD served during this time successfully secured CIE, and maintained their employment with ongoing supports, with intensity of support time decreasing over time. The majority (63/64, 98.4%) of individuals successfully secured CIE through the use of supported employment, in 72 unique employment positions. Of the majority of the individuals who secured employment, 77% (50) individuals indicated that they had never worked before and additional 18% (12) reported having short intermittent histories of employment.
Conclusions: Individuals with ASD present a broad array of individual support needs to obtain and maintain competitive employment. Some of the specific areas where the employment specialists concentrated their instructional and training activities included discovery and career development, career search, job interview preparation, disability disclosure, transportation planning and training, customizing jobs, job tasks, and workplace environments, instructional support, designing compensatory strategies, and coworker education. Despite this lack of employment experience, in all cases the jobseeker directed the job search and ultimately the job selection.

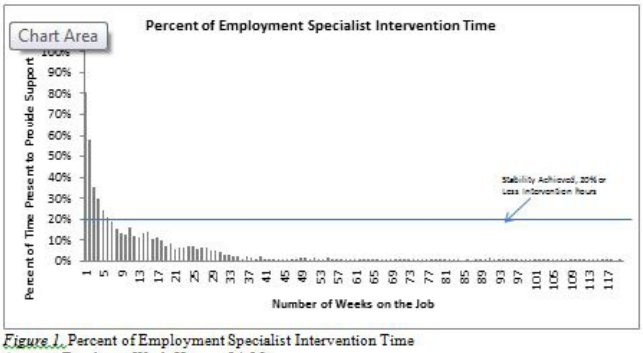


Figure 1. Percent of Employment Specialist Intervention Time
Average Employee Work Hours: 24:25

26 **163.026** Environmental Factors Impacting Work Satisfaction and Performance in Adults with Autism Spectrum Disorders

***B. A. Pfeiffer**, Rehabilitation Sciences, Temple University, Philadelphia, PA*

Background: The numbers of individuals with Autism Spectrum Disorders (ASD) transitioning into post-secondary roles such as employment has substantially increased in

parallel with escalating prevalence rates (CDC, 2014). Unfortunately, 90% of individuals with ASD over the age of 22 cannot find and maintain meaningful employment (Gal, Ben Meir, & Katz, 2013) and there are limited mechanisms to support needed transitional interventions. Many interventions focus on specific deficits in the person, such as communication and socialization difficulties, and its effects on work performance. There are fewer studies attempting to understand the environmental factors influencing the work experience from the perspective of the adult with ASD.
Objectives: The primary objective of this study was to explore the relationship between environment factors and work satisfaction/performance from the perspective of adults with ASD in order to better understand important outcomes and necessary components of interventions in the workplace.
Methods: A mixed methods design was used which involved collecting quantitative data through self-report questionnaires and qualitative data through recorded interviews with participants. Participants were individuals over the age of 21 years, diagnosed with ASD who worked at least 10 hours a week. All potential participants completed a demographics questionnaire and the Ritvo Autism Asperger Diagnostic Scale-Revised (RAADS-R). Participants needed to score 65 or higher on the RAADS-R for inclusion in the study. Individuals completed the Job Satisfaction Survey (JSS), Work Environment Scale (WES), and the Adolescent/Adult Sensory Profile (ASP) (n=50). Sixteen participants completed extensive qualitative interviews. Quantitative data was analyzed using t-tests and correlation coefficients to examine the relationships between work satisfaction and factors in the environment. Qualitative interviews were transcribed, crosschecked, and analyzed by multiple researchers using a constant comparison method until data saturation. Additionally, a reflective comparative analysis was completed between the quantitative and qualitative results.
Results: Quantitative results identified significant differences between participants that were satisfied and not satisfied with their work in how they perceived specific environmental factors including supervisor support (t = 34.26, p = .001) autonomy (t = 38.68, p = .02), task orientation (t = 33.3, p = .05), and physical comfort (t = 39.2, . p = .04). Additionally, adults who reported higher levels of sensory avoiding and/or sensory sensitivity reported significantly lower job satisfaction on the JSS. Qualitative results consistently identified that attitudinal, social and sensory environmental factors impacted on work satisfaction/performance for participants in the study. Specific themes were identified across data sources including the positive or negative impact of supervisory attitude and social demands on satisfaction/performance. The sensory environmental was identified as a barrier if adaptations were not incorporated into the work environment.
Conclusions: Results of the study identified the need for interventions targeting attitudinal, social, and sensory environmental factors to support individuals with ASD in the workplace. Future research is necessary to determine the effectiveness of these types of interventions.

27 **163.027** Exploring the Association Between Autistic Traits and Executive Function Among Typically Developing Adults

***N. Albein-Urios**, S. Kaur Girn, A. Beirne, C. Davies, M. Kirkovski and P. Enticott, Deakin University, Melbourne, VIC, Australia*

Background: The investigation of autistic traits in the “typically developing” population has shown that people with sub-threshold behavioural autistic traits perform poorer on some cognitive tasks. However, little is known about how these traits relate to executive functioning and self-regulation in an everyday environment.
Objectives: The present study examined whether young adults with higher autistic traits experience increased behavioral and cognitive difficulties associated with poorer executive function.
Methods: 57 young adults (18-25 years old) were administered the Autism Spectrum Quotient (AQ), and designated as high autistic traits (n=22) or low autistic traits (n=35). The Behavior Rating Inventory of Executive Function (BRIEF-A) was used to evaluate executive function. The BRIEF-A self-report was compared with the BRIEF-A informant-report to evaluate the construct of self-awareness. Cognitive flexibility skills were also measured using the Trail Making Test (TMT), Gender-Emotion Switch Task, and the Intra-dimensional/extra-dimensional (IDED) task.
Results: Individuals with higher autistic traits reported having more difficulties than the low autistic traits group in the BRIEF-A self-report in three scales: Shift (p<0.01), Emotional Control (p<0.01) and Behavioural Regulation Index (BRI; p<0.05). Four scales were found to be significant only in the high autistic traits group in the BRIEF-A informant-report: Inhibit (p<0.05), Emotional Control (p<0.01), Self-monitor (p<0.05) and BRI (p<0.01). Significant differences were found in the emotional control scale within the group of high autist traits when comparing the BRIEF-A self-report with the BRIEF-A informant-report (p<0.05). No significant differences were found in cognitive flexibility tasks between the two groups.
Conclusions: Individuals with higher autistic traits reported having more executive functioning difficulties, suggesting that difficulties with executive function might extend beyond those meeting clinical criteria for autism spectrum disorder. Parents and close friends of individuals with higher traits in autism also reported poorer executive function of their children/friends. Individuals with high autistic traits were found to have lower self-awareness associated with difficulties on the emotional control domain. These findings call for further research on the relationship between autistic trait and executive abilities, particularly with respect to underlying mechanisms that might mediate this association.

28 **163.028** Exploring the Prevalence and Predictors of Depression in Young Adults with Autism Spectrum Disorders

***V. Hallett**[1], T. Charman[2], J. Briskman[3], R. Kent[2], S. Lukito[3], F. Khalid[2] and E. Simonoff[2], (1)South London and the Maudsley NHS Foundation Trust, London, United Kingdom, (2)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (3)Child & Adolescent Psychiatry, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom*

Background: Although co-occurring psychiatric disorders are recognised to affect up to 70% of individuals with ASD, there have been few large-scale epidemiological investigations of adult comorbidity. With regard to symptoms of depression in ASD, previous studies have revealed widely varying prevalence estimates (from 0.9%-77%), and no studies to date have explored the longitudinal predictors of these difficulties.
Objectives: The current study aimed to explore the prevalence and predictors of depressive symptoms within a longitudinal, epidemiologically-derived cohort.
Methods: A subsample of 96 young adults (aged 21-24 years) from the population-derived Special Needs and Autism Project (SNAP) were assessed for depression using a standardised clinical interview (the Young Adult Psychiatric Assessment: YAPA) and the Beck Depression Inventory (BDI-II). Parent-report measures of young adult depression were also available for 104 families. Analyses assessed the prevalence of depression in the full sample and in those with IQ above and below 70. Predictors of depression were assessed cross-sectionally and longitudinally (at age 1, 16 and 23 years), including IQ, ASD severity, internalising symptoms, stressful life events and demographic / family characteristics. Associations between quality of life and depressive symptoms were also explored.
Results: 18.9% of young adults with ASD reached criteria for ‘any depressive disorder’, with significantly higher rates in those with IQ above compared to below 70. The prevalence of depression at age 23 years was significantly higher than the rates observed earlier in the study, at age 12 (1.4%) and age 16 (5.5%). Depression at age 23 was predicted significantly by self-reported ASD severity (OR: 1.06 CI 1.00-1.12; p<0.05) at the same age and the number of significant life-events experienced (OR: 1.54 CI 1.14-2.07; p<0.01). Young adult depression was also predicted, longitudinally, by the individual’s level of adaptive functioning at age 12 (OR: 1.07 CI 0.99-1.15, p=0.05). No family characteristics or demographic factors emerged as significant predictors of depression. Additional associations were observed between symptoms of depression, anxiety across development and reduced quality of life at age 23 years.
Conclusions: Rates of depression were higher in young adults with ASD compared to the general population, with an emergence of symptoms in late adolescence and early adulthood. Certain individuals, including those with higher IQ, higher perceived ASD severity and a history of emotional difficulties may be more susceptible to depressive symptoms. Co-occurring depressive symptoms constitute key targets for prevention and treatment in young adults with ASD.

29 **163.029** Factors Influencing Healthcare Satisfaction in Adults with Autism Spectrum Disorder

***A. H. Gerber**[1], C. McCormick[1,2], T. P. Levine[2], E. M. Morrow[1,3], T. F. Anders[1] and S. J. Sheinkopf[1,4], (1)Rhode Island Consortium for Autism Research and Treatment (RI-CART), Bradley Hospital, East Providence, RI, (2)Brown Center for the Study of Children at Risk, Women & Infants Hospital The Warren Alpert Medical School of Brown University, Providence, RI, (3)Department of Molecular Biology, Cell Biology and Biochemistry and Institute for Brain Science, Brown University, Providence, RI, (4)Brown Center for the Study of Children at Risk, Women & Infants Hospital, Providence, RI*

Background: Adults with autism spectrum disorder (ASD) have medical needs that require higher healthcare service utilization than typically developing adults (Croen et al., 2015). Prior research also has indicated that adults with ASD are less satisfied with their healthcare than typically developing adults. (Nicolaidis et al., 2013).
Objectives: The current study examined healthcare satisfaction and factors contributing to satisfaction in adults with ASD.
Methods: The sample consisted of 92 adults with ASD, ranging in age from 18 to 64 years (M=31.1 years, SD=12.6). Participants were divided into young adults (< 26 years of age; 46%), and adults (≥ 26 years of age). This cut point was selected because in the US a number of significant health care transitions take place by age 26. 76 participants completed an Autism Diagnostic Observation Schedule, second edition (ADOS-2). All participants, recruited from community service agencies and clinicians, entered the study with a diagnosis of ASD and/or met criteria for ASD on the ADOS-2. 62 participants had a parent or guardian available to complete a Vineland-II questionnaire. Participants or their caregiver completed a survey about their experiences with their primary care physician, dentist, vision care practitioner, and mental health clinician. Each practitioner was rated on a 1-5 scale (1=extremely dissatisfied, 5=extremely satisfied). A total healthcare satisfaction score was computed by averaging the four satisfaction subscales. All participants completed this questionnaire.
Results: In contrast to previous reports, study participants were highly satisfied with their healthcare (M=4.39, SD=0.88). The mean adaptive skills score of study participants (M=52.3, SD=19.7) was two standard deviations below average, indicating significant impairment. The majority of participants in the study were living in their family home (68%). 97% of the sample had public and/or private health insurance. While 60% were their own guardians, only 30% completed the satisfaction questionnaire on their own, and only 29% were involved in their own healthcare decisions. A series of correlation analyses revealed age to be the only significant predictor of satisfaction, $r(90) = .24$, $p < .05$. Specifically, participants below 26 ($M = 4.62$) were more satisfied with their healthcare than participants 26 and older ($M = 4.19$). Further analysis demonstrated that participants under 26 were significantly more likely to live at home, $\chi^2 (1) = 31.24$, $p < .001$, have private health insurance, $\chi^2 (1) = 18.03$, $p < .001$, have someone else complete the questionnaire, $\chi^2 (1) = 11.34$, $p < .01$, and have others make their healthcare decisions, $\chi^2 (1) = 10.62$, $p < .01$, than participants 26 and above. Additionally,

participants below 26 (M = 67.76, SE = 3.64) had significantly greater communication skills than participants 26 and older (M = 47.21, SE = 4.78), $t(57.72) = 2.59$, $p < .05$. *Conclusions:* Healthcare satisfaction, in a significantly impaired adult ASD population, can be high in a community that emphasizes family care, adequate health insurance and supportive services. Future studies need to define the context as well as correlated factors associated with satisfaction.

Table 1. Participant characteristics

Variable	%
Participant Age	
< 26	46
≥ 26	54
Participant Living situation	
Family Home	68
Other residence	32
Participant Insurance status	
Private Insurance	61
Public Insurance/Uninsured	39
Individual completing healthcare survey	
Self	30
Other	70
Participant Guardianship Status	
Self	60
Other guardian	40
Healthcare decision maker	
Self	29
Other	71

Table 2. Adaptive Functioning and Health Complexity of Study Participants

Variable	< 26 years	≥ 26 years
Vineland-II		
Communication Standard Score, Mean (SD)*	62.8 (19.6)	47.2 (27.4)
Daily Living Skills Standard Score, Mean (SD)	64.6 (19.6)	60.5 (24.1)
Social Skills Standard Score, Mean (SD)	52.6 (19.6)	43.5 (22.4)
Adaptive Behavior Composite Standard Score, Mean (SD)	57.5 (17.5)	47.9 (20.5)
Health Complexity		
Number of Medical Health conditions, Mean (SD)	4.0 (3.0)	4.3 (3.1)
Number of Mental Health Conditions, Mean (SD)	2.1 (1.7)	1.6 (1.4)

* p < .05

30 **163.030** Feasibility of a Systematic Outcomes Assessment Protocol for Adults with ASD Participating in Community-Based Programs

A. C. Jozkowski[1], *K. P. Wilson*[2], *G. Chasson*[3], *K. Hoer*[1], *A. Focazio*[1], *B. Finklestein*[1] *and A. Grant*[1], *(1)Occupational Therapy & Occupational Science, Towson University, Towson, MD, (2)Department of Audiology, Speech-Language Pathology, and Deaf Studies, Towson University, Towson, MD, (3)Department of Psychology, Towson University, Towson, MD*

Background: There is a lack of research regarding the services beneficial to transition-aged youth and young adults with Autism Spectrum Disorder (ASD) as they transition out of the school system and enter a more autonomous life stage. This population is at an increased risk for an array of lifestyle challenges and health problems. Fortunately, a variety of adaptive skills including self-advocacy and problem-solving are believed to contribute to improved quality of life and more positive outcomes. However, uncertainty on how to promote these skills remains. In 2007 a community-based center was established at a regional university in an effort to facilitate meaningful social experiences that support the development of the adaptive skills of self-advocacy, self-expression, self-regulation, problem solving, and teamwork among transition-aged

youth and young adults with ASD. However to date, program effectiveness has not been comprehensively assessed.
Objectives: The aim of the current pilot study is to determine the feasibility of a protocol developed to standardize the method for assessing the effectiveness of programs offered at a community-based center. This center aims to enhance the adaptive skills of transition-aged youth and young adults on the Autism spectrum. The data collected will be used to refine the assessment process we intend to use during a larger program evaluation/outcome study planned for Spring 2016.
Methods: During the Fall 2015 pilot study, quantitative and qualitative data have been collected at a single time point from ten program participants and/or their legal guardians. Demographic and social impairment data were collected using the *IAN Adult on the Autism Spectrum* measure, the *Social Responsiveness Scale, 2nd Edition,* and the *Hospital Anxiety and Depression Scale* or the *Anxiety, Depression, and Mood Scale.* The dependent variables of self-advocacy, self-expression, self-regulation, problem solving, and teamwork were assessed with the *American Institutes for Research Self-Determination Scale*, the *Adaptive Behavior Assessment System-II,* the *Emotion Regulation Questionnaire* or the *Emotion Regulation Checklist*, the *Behavior Rating Inventory of Executive Function*, and the *Youth Outcomes Battery-Teamwork Scale.* Following quantitative data collection, participants were invited to participate in a semi-structured interview to provide qualitative feedback that will be useful for recommending tool modifications/adaptations in preparation for the forthcoming repeated-measures outcomes study.
Results: The research team is presently completing data collection and analysis, and will have conclusive results to report by January 2016. Because both quantitative and qualitative data is being collected and the questionnaires being used have proven to be reliable and valid in this population, we hypothesize that the pilot study will yield rich data regarding the effectiveness of the proposed assessment procedure.
Conclusions: Through this study, the research team aims to support the establishment of a systematic and rigorous method for assessing the effectiveness of a community-based program in developing adaptive living skills among transition-aged youth with ASD. We seek to do so in order to refine future programs that will better serve this population. The data collected during this pilot study will lay the foundation for future research that has more global implications for individuals with ASD and their families in the community.

31 **163.031** Gender Differences in Adult Outcomes for Individuals Diagnosed with ASD in Childhood

W. T. Brooks[1], *L. G. Klinger*[1], *E. M. Lamarche*[2], *J. L. Mussey*[3] *and M. R. Klinger*[4], *(1)Psychiatry, University of North Carolina TEACCH Autism Program, Chapel Hill, NC, (2)UNC TEACCH Autism Program, Chapel Hill, NC, (3)TEACCH Autism Program, University of North Carolina at Chapel Hill, Greensboro, NC, (4)University of North Carolina at Chapel Hill, Chapel Hill, NC*

Background: Research in autism spectrum disorders (ASD) has historically focused on males, as they are diagnosed 4-to-5 times more often with the condition than females. However, interest in females with ASD has been on the rise, with recent studies suggesting gender differences in the presentation of symptoms and associated behavioral features. Research suggests that parents of girls with disabilities may provide their daughters with fewer opportunities to practice activities that encourage independent daily living skills, which may affect adult outcomes (Hogansen et al., 2008); however, few studies have examined how childhood daily living skills and other characteristics impact life outcomes of women with ASD.
Objectives: The aim of this study was to examine gender differences in a variety of measures associated with well-being (e.g., employment status, daily living skills, quality of life) in adults with ASD, including how their childhood characteristics affected adult outcomes.
Methods: This project is part of a larger study examining adult outcomes of children diagnosed with ASD during childhood between 1970 and 1999. Measures of ASD symptoms (CARS; Schopler et al., 1986), adaptive behavior skills (Vineland ABS; Sparrow & Cichetti, 1984), and IQ were assessed during childhood, and caregivers completed surveys assessing a variety of outcomes in their adult children, including independent daily living skills, quality of life (QoL), current ASD symptom severity, and employment status. Participants included caregivers of 189 adults with ASD including 38 women and 151 men. Women and men with autism did not differ on age, ethnicity, parent education level, or communication ability.
Results: In childhood, there were no gender differences in IQ scores or ASD symptom severity; however, girls with ASD scored lower on childhood Vineland standard scores than boys ($t(186)=-2.99$, $p=.004$). In adulthood, women with ASD scored lower on the Waisman Activities of Daily Living Scale (Maenner et al., 2013) ($t(187)=-2.9$, $p=.004$) and on the QoL-Questionnaire (Shalock & Keith, 1993) ($t(186)=-2.1$, $p=.04$) than men. Women (41.9%) were less likely to have been employed in the past two years ($\chi^2=6.13$, $p=.05$) than men (56.6%), and they exhibited higher scores on current ASD symptom severity (SRS-2; Constantino & Gruber, 2012) ($t(182)=-2.8$, $p=.006$). When adult outcomes were examined while controlling for childhood Vineland scores, gender was no longer significantly related to the outcome measures, with childhood Vineland mediating all of the effects of gender on adult outcomes.
Conclusions: Despite exhibiting similar childhood ASD symptom severity and intellectual functioning to males, females with ASD exhibited lower childhood adaptive behavior skills. Poorer outcomes for females in adulthood were accounted for by differences in childhood adaptive functioning skills, suggesting that early gender differences in adaptive behavior may be at the heart of why women with ASD show more significant difficulties in adulthood than men. It is unclear if these outcomes reflect fundamental gender differences in early adaptive skills or if they are due to gender differences in childhood experiences, parental expectations, and learning opportunities. Future research in this area is needed to examine whether early intervention targeting adaptive skills may improve outcomes for females with ASD.

32 **163.032** Gender Variance in Men and Women with Autism

M. C. Lai[1,2,3], *A. N. Ruigrok*[4], *A. S. Baron*[5], *M. V. Lombardo*[1,6], *B. Chakrabarti*[4,7], *S. H. Ameis*[3], *P. Szatmari*[3], *K. J. Zucker*[8] *and S. Baron-Cohen*[1,9], *(1)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (2)Department of Psychiatry, National Taiwan University Hospital and College of Medicine, Taipei, Taiwan, (3)Centre for Addiction and Mental Health, The Hospital for Sick Children, and Department of Psychiatry, University of Toronto, Toronto, ON, Canada, (4)Department of Psychiatry, Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (5)Department of Psychology, University of British Columbia, Vancouver, BC, Canada, (6)Department of Psychology and Center for Applied Neuroscience, University of Cyprus, Nikosia, Cyprus, (7)School of Psychology & Clinical Language Sciences, University of Reading, Reading, United Kingdom, (8)Centre for Addiction and Mental Health, Toronto, ON, Canada, (9)Cambridgeshire and Peterborough NHS Foundation Trust, Cambridge, United Kingdom*

Background: Autism reflects one form of human variation of neurotypical norms. Binary gender is prevalent in neurotypical individuals, but one study (Bejerot & Eriksson, 2014) has shown increased gender variance in women with autism and decreased stereotypical masculine (but not feminine) gender role characteristics in both men and women with autism, using self-report measures. Increased rates of autism diagnosis or level of autistic traits in children, teenagers and adults with gender dysphoria have also been reported. The phenotypic and underlying developmental relationships between autism and gender variance have yet to be clarified.
Objectives: To investigate variations in gender identity and gender role characteristics in men and women with autism using both self-report and implicit measures.
Methods: A total of 167 adults participated, including 34 biological males and 48 females with autism, and 46 neurotypical (control) males and 39 females. Self-reported gender variance was measured using the Gender Identity/Gender Dysphoria Questionnaire for Adolescents and Adults (GIDYQ-AA), and Lippa's gender-stereotyped occupational (10-item) and hobby (18-item) preference questionnaires. Implicit association between self and gender (tested using self-related versus gendered terms) were measured using an Implicit Association Test (IAT). Group differences were tested using nonparametric (when involving GIDYQ-AA) and parametric methods.
Results: Men with autism self-reported more variant gender identity (against natal sex) than control men (Mann-Whitney $U=261.5$, $p<0.001$), as did women with autism compared with control women ($U=493$, $p<0.001$); no sex differences were noted within either the control or autism group. Across diagnosis, men consistently showed stronger preferences for gender-stereotyped masculine hobbies/occupations than women (hobbies: $F(1,158)=60.2$, $p<0.001$; occupations: $F(1,158)=32.4$, $p<0.001$). After sex-stratification, women with autism reported significantly stronger preferences for gender-stereotyped masculine hobbies/occupations than control women (hobbies: $T(82)=5.0$, $p<0.001$; occupations: $T(82)=4.3$, $p<0.001$). These effects were in the same direction but less strong (occupations: $T(72)=2.6$, $p=0.01$) or non-significant (hobbies: $T(72)=0.4$, $p=0.72$) in men with autism compared with control men. IAT showed a strong implicit association between self and gendered terms of one's natal sex in both sexes, irrespective of diagnosis. After sex-stratification, there was no difference in gender-identity IAT effects (the association strength between self and male-gender) between men with and without autism ($T(76)=0.2$, $p=0.82$), whereas women with autism, on average, showed weaker gender-identity IAT effects (between self and female-gender) than did control women ($T(83)=2.5$, $p=0.01$). Correlations between IAT effect and self-report variant gender identity (GIDYQ-AA) were significant in women with autism (Spearman's $rho=0.28$, $p=0.03$) but minimal in other groups.
Conclusions: We found increased rates of men and women with autism self-reporting variant gender identity that did not fit the neurotypical gender-binary norm, compared with control men and women. Women with autism compared with control women, particularly, further reported stronger preference for gender-stereotyped masculine hobbies/occupations, weaker implicit association between self and female-gender, and stronger implicit-explicit correlation in gender identity. These effects were not evident in men with autism compared with control men. Gender variance is more prominent in adults, especially women, with autism. This may reflect phenotypic overlap between the autistic and gender spectra, and common biological underpinnings and/or gender socialization experiences during development.

33 **163.033** How Do You Feel about Driving? Development of the Scale for Apprehensive Driving to Measure Driving-Related Attitudes in Novice Drivers

V. Ross[1], *D. J. Cox*[2], *R. E. Reeve*[3], *T. Brown*[4], *M. Moncrief*[2], *R. A. Schmitt*[5] *and G. Gaffney*[4], *(1)Hasselt University, Diepenbeek, Limburg, Belgium, (2)University of Virginia, Charlottesville, VA, (3)University of Virginia, Earlysville, VA, (4)University of Iowa, Iowa City, IA, (5)National Advanced Driving Simulator, University of Iowa, Iowa City, IA*

Background: Impairments related to autism spectrum disorders (ASDs) can pose limits on daily living skills. One example relates to driving, which allows autonomy and permits maintenance of social- and work-related contacts. Research regarding ASD and driving has been steadily increasing in the past years. Most studies however focus on difficulties they might experience with the execution of the driving task. Meanwhile, research suggest that there are additional barriers related to driving. For instance, a previous study investigating viewpoints of individuals with ASD reported anxiety as an important barrier (Chee et al., 2014). Although several driving anxiety measures exist, none specifically focus on novice drivers. Furthermore, driving apprehension might not only be present during the drive itself but also in phases preceding driving (e.g.,

getting ready to drive). Finally, it is possible that novice drivers are reluctant to report their feelings, making parents important sources of information as they usually play a large role in the process of learning how to drive.
Objectives: The aim of the present study was to develop a parent questionnaire measuring their child's attitudes towards driving, allowing to compare whether novice drivers with ASD are more apprehensive towards driving than a control group.
Methods: The 18-item (1-4 answering category) Scale for Apprehensive Driving (SAD), to be filled in by parents, was developed to measure positive and negative attitudes towards driving during three phases: 'thinking about driving', 'preparing to drive', and 'while driving'. Considering that emotions can be expressed cognitively, behaviorally and physically, questions were developed to tap each dimension. The questionnaire was completed by a group of parents of novice drivers (age range= 15-24), who earned their learners permit, without (n= 98) and with ASD (n= 66). Reliability analyses were executed per group, after which a 2x2 ANOVA (Valence: total positive, total negative; Group: control, ASD) was conducted to determine whether the ASD group reported more negative attitudes compared to the control group.
Results: Correlations between positive and negative items showed the expected direction for both the control (r= -.39, p= .00) and the ASD (r= -.65, p= .00) group. Furthermore, the Cronbach's alpha coefficient was also high for both the control (α= .85) and the ASD (α= .90) group. A significant interaction effect of Valence*Group (F= 92.58, p= .00, η^2p= .20) indicated a difference in the reported attitudes between the control and ASD group. Further analyses, indicated that the control group reported more positive attitudes (F= 203.16, p= .00, η^2p= .68, μPos= 18.67, μNeg= 7.00), while the ASD group reported more negative attitudes (F=3.71, p= .00, η^2p= .058, μPos= 10.73, μNeg=13.30).
Conclusions: The results showed that the ASD group was less positive towards driving when compared to a control group. As driving apprehension could pose an important barrier for driving independently, future research should take this factor into account.

34 **163.034** Identifying and Addressing the Concerns of College Students with Autism

J. Edelstein[1], *B. E. Cox*[2], *A. Wolz*[1] *and A. Anderson*[1], *(1)Florida State University, Tallahassee, FL, (2)P.O. Box 3064452, Florida State University, Tallahassee, FL*

Background:
With roughly 16,000 ASD students entering postsecondary institutions each year (Wei et. al, 2015) colleges and universities must understand the needs of this population and provide support to best enable success. While transitioning into college, students with ASD are likely to experience considerable stress and anxiety as they face social, academic, and personal challenges they have not encountered before. Yet there is remarkably little research regarding the experiences of ASD individuals in higher education.
Objectives:
The objectives of this study are threefold:

1. Identify concerns which are unique to those with ASD, as well as those which are heightened (i.e. exacerbated in those with ASD relative to non-ASD peers).
2. Analyze the effects of identified concerns.
3. Explore methods of alleviating the concerns of these students in an impactful manner.

Methods:
Student testimonials related to postsecondary education were gathered from the website WrongPlanet.net, an online resource for individuals with ASD that provides support through articles, forums, and discussions. Data were collected from discussions within the "School and College Life" forum. The statements were then coded using Astin's (1991) Inputs-Experiences-Outputs model. The second round of coding followed specific themes that were established by the first round of coding. Students' concerns were identified by the use of words expressing feelings (i.e., fear, afraid, concern).
Results:
Students expressed fourteen unique concerns which the researchers clustered into two types: ASD-specific concerns (e.g. bullying, loss of prior supports) and ASD-heightened concerns (e.g. change in routine, hurting others). Within each type, student concerns were further categorized as either social concerns (e.g. "I haven't succeeded in getting anyone's phone number or becoming close ") or transitional concerns (e.g. "I feel trapped with having so much responsibility so fast.")
Students commonly noted low levels of self-confidence and mental health issues (e.g. "So, how can I even begin to tell my parents in a week that I have failed… It is difficult for me not to constantly think of suicide because of this situation"). Few students indicated resolutions to their issues. Those who did resolve their concerns noted the importance of socialization (e.g. "Spend as much time developing social skills and… The school WILL NOT try to help you do this") and access to information as routes for overcoming their concerns successfully.
Conclusions:
Students with ASD often do not feel supported by their colleges and universities, suggesting they may not have the same perception of higher education as their neurotypical peers. However, by addressing the specific concerns expressed by these students, higher education professionals can help these individuals assimilate into postsecondary environments and maximize their academic and developmental potential.

35 **163.035** Implicit Vs Explicit Attitudes Towards Individuals with Autism

J. Zeman[1], *C. Dickter*[2], *J. Burk*[2] *and J. A. Kittel*[1], *(1)College of William and Mary, Williamsburg, VA, (2)College of William & Mary, Williamsburg, VA*

Background: Given the strengths and challenges associated with ASD, it is not surprising that some studies demonstrate that individuals with ASD are perceived negatively, whereas other research suggests positive perceptions (Swaim & Morgan, 2001). Most research has relied on self-report which is effective at evaluating explicit attitudes but is susceptible to social desirability biases. To better characterize the attitudes towards members of social groups, it is important to study both self-report and implicit measures because each method predicts different types of behavior. Due to the difficulties that may pose disproportionately greater challenges for students with ASD as they enter higher education (e.g., increased opportunity for social interactions, changes in daily routines; Lai et al., 2014), we focused on college students.
Objectives: The goal of this study was to address gaps in the literature by assessing college students' implicit and explicit attitudes towards people with ASD. We evaluated: (a) implicit and explicit attitudes toward individuals with ASD, (b) the relation between the two variables, and (c) whether attitudes would vary depending on the degree to which students self-reported autistic behaviors.
Methods: Participants were 178 college students (65 male; *M* = 19.15 years, 50.0% White). A modified version of the Implicit Attitudes Test (IAT, Nosek et al., 2002) was developed to assess attitudes towards autistic and neurotypical individuals. The Societal Attitudes towards Autism Scale (SATA, Flood et al., 2013) was administered that assessed explicit Societal Attitudes, Knowledge, and Personal Distance. The Autism Quotient questionnaire (AQ; Baron-Cohen et al., 2001) measured self-reported autistic traits with five subscales.
Results: There was an overall implicit bias against individuals with autism (*d* = -0.83, *SD* = 0.41), *t*(177) = -27.09, *p* < .001, suggesting that participants had more positive implicit associations with neurotypical compared to autistic individuals. For explicit attitudes, the means for the Knowledge subscale (*M* = 15.16, *SD* = 2.20) and Personal Distance subscale (*M* = 17.25, *SD* = 2.70) were similar to other college samples (Flood et al., 2012). Regarding the relations between implicit and explicit attitudes, there were significant positive correlations between the IAT and the Knowledge subscale, marginally positive significant relations with the Total SATA score and the Personal Distance subscale, and no significant association with the Social Attitudes Scale (see Table 1). The IAT was significantly positively correlated with the total AQ score, the AQ Social Skills subscale, and the AQ Communications subscale. Students scoring in the top third of the total AQ demonstrated less implicit bias than those in the bottom third. This pattern was replicated for the Social Skills and Attention Switching subscales (see Table 2). Thus, students reporting more autistic behaviors held less implicit bias towards those with autism.
Conclusions: We created the first IAT to measure students' implicit associations with neurotypical and neurodiverse individuals. Our sample appeared to be somewhat knowledgeable and hold relatively positive explicit attitudes towards individuals with ASD compared to the sample norms, but generally held an implicit bias against individuals with autism, except by those reporting autistic traits themselves.

Table 1

Correlations between IAT d scores and the Autism Quotient subscales, the Societal Attitudes towards Autism subscales

	IAT d score
AQ total	.18**
AQ Social Skill	.24***
AQ Attention Switching	.17*
AQ Attention to Detail	-.05
AQ Communication	.13+
AQ Imagination	.01
SATA Total	.13+
SATA Societal Attitudes	.08
AQ Knowledge	.16*
AQ Personal Distance	.13+

Note. AQ = the Autism Quotient (Baron-Cohen et al., 2001). SATA = the Societal Attitudes towards Autism Scale (Flood et al., 2013). $+p < .10$,* $p < .05$., **$p < .01$, *** $p < .001$

Table 2

Mean IAT differences and standard deviations in parentheses between participants in the bottom and top thirds of the Autism Quotient and its subscales

	Bottom Third	*Top Third*	*t-value*
Total AQ score	-.95 (.35)	-.78 (.43)	-2.43*
Social Skills	-.95 (.35)	-.72 (.43)	-4.04***
Communication	-.89 (.37)	-.80 (.45)	0.15
Attention Switching	-.93 (.37)	-.79 (.39)	-2.12*
Attention to Detail	-.80 (.41)	-.86 (.45)	0.86
Imagination	-.83 (.42)	-.83 (.39)	0.07

Note. *$p < .05$,** $p < .01$,*** $p < .001$.

36 **163.036** In Their Own Words: The Experiences of Young Adults with High-Functioning Autism/Asperger's Syndrome Attending College or University

R. Nirmal, *Psychology, BC Children's Hospital, Vancouver, BC, Canada*

Background: According to the Centre for Disease Control and Prevention (2014), the prevalence of ASD in children has increased to 1 in 68, with more children being identified without significant cognitive impairment (i.e., high-functioning autism [HFA]). With the increasing prevalence of HFA, more students with HFA are beginning to transition to college or university, as they are generally capable of meeting the academic demands of postsecondary education (e.g., VanBergeeijk, Klin, & Volkmar, 2008). Unfortunately, studies have demonstrated poor postsecondary educational outcomes for students with HFA (e.g., Shattuck et al., 2012). Despite having the neurocognitive and academic ability to attend college or university, there are many students with HFA who do not enroll in postsecondary education or drop out soon after entry (Shattuck et al., 2012). There is a critical need to better understand the experiences of students with HFA currently attending college or university to help foster better postsecondary outcomes for this population (Gelbar, Smith, & Reichow, 2014).
Objectives: Understanding the experiences of students with HFA through their own voice can provide valuable insight into their successes and challenges in postsecondary education (Gelbar et al., 2014). Too often, the voices of students with disabilities are overlooked, minimized, or misunderstood (Scuitto, Richwine, Mentrikoski, & Niedzwiecki, 2012). To that end, the objective of this study was to understand the meaning of the lived experiences of attending college or university for students with HFA, the phenomenon in question, and to discover common aspects of their experiences.
Methods: Postsecondary students (n = 12; 9 males, 3 females) with either HFA or Asperger's disorder were recruited from 4 postsecondary institutions. Interpretive Phenomenological Analysis was the method of inquiry, which examines the meaning of personal and social experiences of individuals in a detailed way (Smith, Flowers, & Larkin, 2009). Each participant engaged in two semi-structured, in-depth interviews with the researcher. Data analysis was an iterative and interpretive process, including a case-by-case thematic analysis. Validity strategies were used to ensure scientific rigour and credibility of the research findings (Creswell, 2009).
Results: Eight broad themes and corresponding subthemes emerged from the data analysis depicting the phenomenon of attending college or university for students with HFA. The broad themes are 1) *Managing Academic Expectations*; 2) *Experiencing Support*; 3) *Managing Autism Spectrum Disorder and Related Symptoms*; 4) *Reference to or Influence of Past Experiences*; 5) *Having a Sense of Appreciation*; 6) *Understanding Autism Spectrum Disorder by Others and Self*; 7) *Managing the Transition*; and 8) *Entering a New Social World*.

Conclusions: The results of this study contribute greatly to our understanding of the lived experiences of students with HFA in college or university, including the successes and challenges experienced. The results also highlight how the needs of individuals with HFA persist into adulthood. It is hoped that the findings will help to inform the provision of services and supports for college or university students with HFA in order to foster both the transition to and success in postsecondary education.

37 **163.037** Life-Skills Coaching Reduces Anxiety Around Goals and Improves Functional Skills Among Adults on the Autism Spectrum

A. Hillier[1], *N. Poto*[2], *A. Frye*[1] *and M. Santangelo*[1], *(1)Psychology, University of Massachusetts Lowell, Lowell, MA, (2)Autism/Aspergers Network (AANE), Watertown, MA*

Background: The lack of services for adults on the autism spectrum is of considerable and growing concern. Given the complicated profile of ASD, individualized approaches can be particularly effective. Specifically, one-on-one mentoring is an intervention model which holds promise for this population.
Objectives: This study examined the life goals adults with ASD had set for themselves such as employment related goals, independent living, social skills etc., and evaluated the efficacy of a life skills coaching / mentoring program in reducing anxiety and increasing confidence surrounding these goals, as well as improving functional skills.
Methods: Participants were 322 young adults on the autism spectrum enrolled in a life skills coaching program run by a non-profit organization (Asperger/Autism Network (AANE) in Massachusetts). Participants' goals were coded by two independent raters in to one of eight categories: employment, social skills, academic, executive functioning, independent living, health/fitness/wellbeing, self-insight, and self-advocacy. To examine change in anxiety and confidence towards goals across time, we selected data from a subset of participants who had completed measures for at least three consecutive time points (measures were taken every 8 weeks). We also examined whether coaching led to an increase in functional skills over time in five different areas: social / communication skills, executive functioning / daily living skills, self-awareness, employment, and college.
Results: Our results showed the majority of participants had employment related goals, followed by independent living, executive functioning and social skills related goals. Participants demonstrated significant increases in goal related confidence over time, and significant decreases in anxiety. Regarding functional skills, participants rated themselves as significantly improving over time in all five areas measured.
Conclusions: Adults on the autism spectrum set themselves a broad range of life goals. Increased confidence and decreased anxiety around these goals can be fostered in a relatively short period of time using a one-on-one coaching model. These results support the efficacy of life-skills coaching / mentoring programs for adults with autism spectrum disorders for whom individualized intervention approaches might be key to successful outcomes in adulthood.

38 **163.038** Longitudinal Age-Related Impairments in Processing Speed, Anxiety, and Adaptive Functioning from Childhood to Adulthood in Individuals with Autism

J. E. Lainhart[1], ***K. L. Kane***[2], *M. D. Prigge*[3], *D. P. Samsin*[1], *B. G. Travers*[4], *A. Freeman*[1], *N. Lange*[5], *E. D. Bigler*[6] *and A. L. Alexander*[1], *(1)Waisman Center, University of Wisconsin-Madison, Madison, WI, (2)ISLA, Waisman Center, UW-Madison, Madison, WI, (3)Pediatrics, University of Utah, Salt Lake City, UT, (4)Occupational Therapy Program in Kinesiology, University of Wisconsin Madison, Madison, WI, (5)McLean Hospital, Cambridge, MA, (6)Psychology/Neuroscience Center, Brigham Young University, Provo, UT*

Background: Despite special education services and other standard interventions (e.g., speech, language, and social skills therapy) received during childhood, the majority of indivduals with autism remain significantly impaired in everyday functioning into adulthood.
Objectives: To compare the trajectories of longitudinal age-related changes from childhood to adulthood in severity of core features of autism, IQ, processing speed, expressive and receptive language, anxiety, and adaptive functioning in individuals with autism compared to typically developing individuals.
Methods: Data were collected from 98 males with autism (age range 4-36 years at first assessment, nonverbal IQ ≥ 70) and 61 typically developing males (age range 4-39 years at assessment). Each participant was assessed 1-3 times, on average every 2.5 years (total of 350 datasets per instrument). At each point, IQ and processing speed (Wechsler Scales), language (EVT, PPVT, CELF-3, CTOPP Non-Word Repetition), quantitative composite of core features of autism (Social Responsiveness Scale), anxiety (SCARED), and everday adaptive functioning (Vineland Adaptive Behavior Scales) were assessed. Mixed effects models were used to describe longitudinal trajectories in the autism group in comparison to the typically developing control group (TDC).
Results: The autism group demonstrated age-related improvements in verbal and performance IQ, as well as expressive and receptive language. Autistic symptoms improved during childhood and adolescence; yet, began to worsen again in the early 20's. In contrast to these longitudinal trajectories showing improvement during childhood and adolescence, adaptive functioning was significantly impaired in the autism group and the degree of impairment remained fixed across development relative to that of the TDC group (age x group interaction, ns). Similarly, processing speed was lower and level of anxiety was higher in the autism group and the degree of severity, relative to the TDC group, remained fixed across development.
Conclusions: The results of this study provide insight as to why everyday functioning remains significantly impaired in the majority of indivduals with autism despite overall improvements in autistic symptoms, cognitive functioning, and language. Specifically, findings suggest that both processing speed and anxiety, which are not usually targeted directly by standard interventions in childhood, may contribute to sustained impairment in adaptive functioning from childhood into adulthood in autism. Future study will test these relationships longitudinally at the level of affected individuals.

39 **163.039** Medical Care Utilization and Costs Among Transition-Age Young Adult Medicare Beneficiaries with Autism Spectrum Disorder

T. W. Benevides[1], *H. J. Carretta*[2] *and K. Graves*[3], *(1)Thomas Jefferson University, Philadelphia, PA, (2)Florida State University College of Medicine, Tallahassee, FL, (3)College of Medicine, Florida State University, Tallahassee, FL*

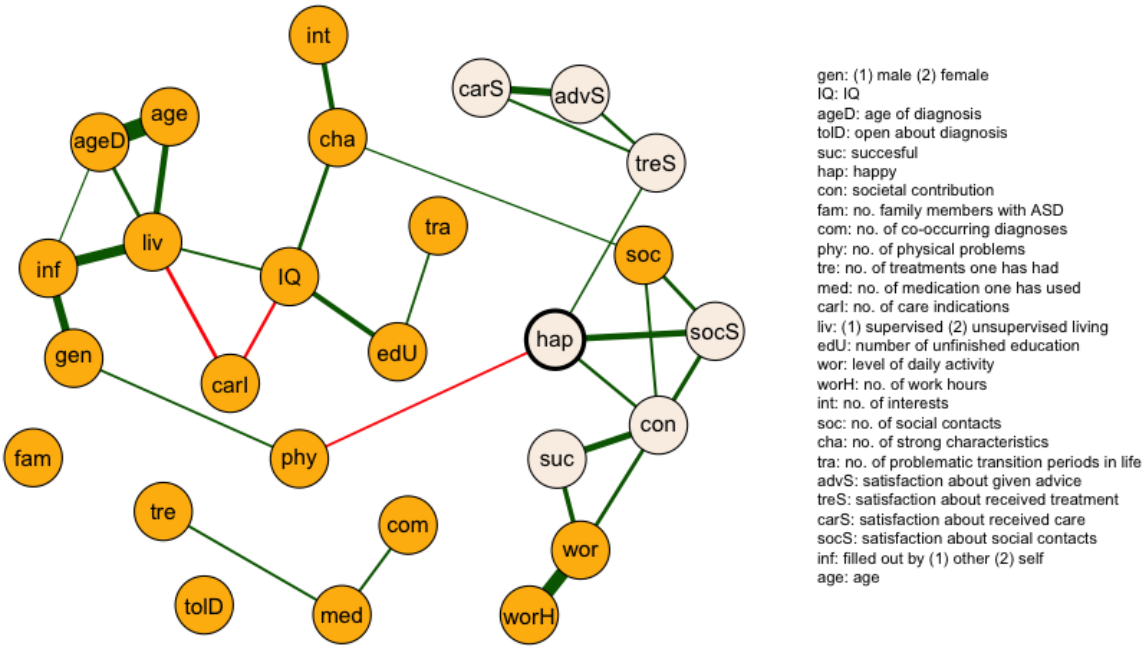
Background: Autism spectrum disorder (ASD) is a lifelong condition which globally impacts functioning (APA, 2013). Emerging research suggests increases in restrictive medical care for adolescents with ASD (e.g. Cidav et al., 2013) corresponding studies finding higher rates of psychiatric illness among adults with ASD compared to non-ASD adults (e.g. Croen et al., 2015). Additionally, comorbid intellectual disability (ID) contributes to greater healthcare needs. It is imperative to identify healthcare needs of young adults with ASD.
Objectives: We aimed to 1) describe utilization and cost of services (hospital-based services, ambulatory services, therapy services) among young adults in Medicare fee-for-service claims data (years 2008-2010), and 2) examine differences in utilization and costs between young adults with ASD without intellectual disability (ASD-ID) and with ID (ASD+ID).
Methods: We used CMS national Limited Data Files to identify persons with ASD and ID aged 18-25 years in the 5% physician visit (Carrier) claims files for 2008, 2009 and 2010. Individuals were included if they had a minimum of 1 claim of ASD (299.xx) in at least 1 file type; individuals with ID alone were identified as having a minimum of 1 claim of either 317.xx, 318.xx or 319.xx in 1 or more file types. Those with ASD+ID were identified as having a minimum of one claim with both an ASD and ID diagnosis code types in any claim file. Carrier claims records were linked to the other five claims types: inpatient hospitalization, home health, hospice, outpatient facility, and skilled nursing facility to create a dataset of identified claims based on diagnosis type. Weighted frequency counts of overall utilization and for each service type (hospitalizations, ambulatory services, therapy service), and bivariate comparisons were used to identify differences in utilization and costs between individuals with ASD+ID, ASD-ID, and ID only (no ASD). A total of 1,537 unique individuals with ASD+ID were available for analysis in 2008, 1,911 in 2009 and 2,090 in 2010. For individuals with ASD-ID, 2,073 unique individuals were available for analysis in 2008, 2,838 in 2009, and 3,603 in 2010.
Results: The number of unique individuals with an ASD-related claim increased in Medicare files 2008-2010, consistent with observed prevalence increases. Total payment costs almost doubled (44.87%) for all individuals with ASD with a Medicare claim from 2008 compared with 2010 claim year. We found that overall utilization and costs were higher among those with ASD+ ID compared with ASD-ID. Young adults with ASD+ID had significantly greater overall utilization (mean number of annual claims= 8.48) compared to those with ASD-ID (mean number of annual claims= 6.06). Average claim payment was higher among those with ASD+ID ($717.38) compared with those with ASD-ID ($547.99). Additional findings on specific healthcare services will be presented, as well as comparisons with an ID-only comparison group.
Conclusions: Similar to pediatric literature, individuals with ASD+ID utilize more healthcare and therefore costs are higher among this population. Across the three claim years, adjusted utilization and costs increased for both groups. Implications for care providers, policymakers, and researchers will be discussed.

40 **163.040** Multicausal Systems Ask for Multicausal Approaches: A Network Perspective on Subjective Well-Being in Individuals with ASD

M. K. Deserno[1], *D. Borsboom*[2], *S. Begeer*[3] *and H. M. Geurts*[1], *(1)Dutch Autism & ADHD research center (d'Arc) Dept of Psychology, Brain and Cognition, University of Amsterdam; Dr. Leo Kannerhuis, Amsterdam, Netherlands, (2)Department of Psychology, University of Amsterdam, Amsterdam, Netherlands, (3)VU University Amsterdam, Amsterdam, Netherlands*

Background: Recent literature has highlighted the need to accommodate the multifactorial nature of antecedents of subjective well-being in Autism Spectrum Disorder (ASD) populations, as it is unlikely that there could be a single element of ASD that predicts well-being in all cases. Despite a large body of research identifying specific predictors of positive outcome, the predictive utility of such measures still differs in unanticipated ways and the *mechanisms* by which these factors may influence outcome for individuals with ASD remain poorly understood. These results suggest that we need further understanding of the multivariate framework in which variations in the combination of risk and protective factors contribute to individual differences in later outcome. Above all, given the vast heterogeneity within the ASD population, an important limitation of ASD research is that outcome measures are statistically modeled as separate dependent variables.
Objectives: The current study aims to lift this limitation, by providing the first assessment of a network structure risk and success factors relevant to subjective well-being in individuals with ASD.
Methods: We used network analyses to explicate the multivariate association pattern of potential risk and success factors taken from 27 life domains in 2341 individuals with ASD (aged 2 to 90). We assessed the centrality of specific life domains as well as their importance for well-being. Centrality is a metric that indicates the overall connectivity of

a variable in the network.
Results: We identified *social satisfaction* and *societal contribution* to be the strongest direct paths to subjective well-being (i.e., *happiness*), while *treatment satisfaction* also shows strong enhancing relations with feeling happy. *Physical complaints* were an important inhibiting factor for feeling happy. Factors most important in determining the network's structure include *IQ*, *living situation*, *level of daily activity*, and *happiness*. On the other hand, we found that *number of family members with ASD* and *openness about one's diagnosis* are least important of all factors, implying that they do not play a role in the multivariate pattern of risk and success factors for subjective well-being.
Conclusions: This study is the first to represent and analyze the multivariate network structure of factors involved in well-being in ASD. These results provide a potential roadmap for interventions and research directed at improving the well-being of individuals with ASD.



41 **163.041** Narratives of College Life from the Perspectives of Students with ASD and ADHD

Y. Bolourian[1], *S. M. Zeedyk*[2] *and J. Blacher*[1], *(1)University of California - Riverside, Riverside, CA, (2)Child and Adolescent Services Research Center, University of California, San Diego, San Diego, CA*

Background:
Youth with autism spectrum disorder (ASD) present with an array of deficits in social interactions, as well as with manifestations of problem behaviors. Despite the significant challenges that these diagnostic features can create for an individual's personal and academic development, many youth with high-functioning ASD are testing their independence by entering college. Additionally, there has been an increase in the number of high school students with attention deficit hyperactivity disorder (ADHD) pursuing higher education. Given the high comorbidity between ASD and ADHD, these youth are hypothesized to have similar, yet unique, experiences.
Objectives:
The purpose of this study is to investigate the narratives of students with ASD and ADHD on college life and to identify the commonalities and dissimilarities among these accounts.
Methods:
Undergraduate and graduate students with ASD (*N*=12 and ADHD (*N*=18) participated in semi-structured interviews, consisting of both open- and closed-ended questions. Audiotapes of these interviews were transcribed and qualitatively analyzed to identify themes that characterize the experiences of college students with disabilities.
Results:
Through the iterative coding process, seven main themes in the ASD sample were revealed: (1) *disclosure of diagnosis* (e.g., most students felt that disclosing their diagnosis was a privacy issue and waited to receive accommodations through the university disability services center, "until it becomes an issue"); (2) *self-awareness* (e.g., one student spoke of his experiences as a student on the spectrum by comparing himself to his typically developing peers. He revealed, "I think I really truly understood how different I was when I started college, and I saw the big gap between me and my peers"); (3) *comorbid conditions* (e.g., all students expressed that college was anxiety-inducing, mainly impacting their autism symptoms; for instance, finding and switching lab partners caused one student who ended up switching majors great angst); (4) *peer interactions* (e.g., many students described themselves as having few or no friends. One individual reported having only one friend in college with whom he speaks to occasionally on Skype); (5) *housing arrangements* (e.g., majority of students reported living at home, which can be "stressful and lonely"); *(6) academic expectations* (e.g., one student described college as a "zero sum game where [students with disabilities] can't ever catch up"); and (5) *anticipation of the future* (e.g., several participating students identified concerns regarding post-graduation, either in graduate school or on the job market. One student worried primarily about her social skills. During her preemptive job search she commented, "If you weren't very good at social skills, you wouldn't get a job"). Analyses of themes from the sample of students with ADHD are ongoing.
Conclusions:
In view of these self-reported challenges, youth with ASD and ADHD seem to be at risk for poor academic and social functioning in college settings. The number of college students with ASD and ADHD is expected to continue rising, and thus, it is imperative that we seek to gain a better understanding of the shared and distinct experiences of students with ASD and ADHD.

42 **163.042** National Autism Indicators Report 2016: Vocational Rehabilitation Services and Outcomes

A. Roux[1], *J. Rast*[2], *P. Shattuck*[3] *and K. A. Anderson*[4], *(1)3020 Market St., Ste 560, A.J. Drexel Autism Institute, Philadelphia, PA, (2)A.J. Drexel Autism Institute, Philadelphia, PA, (3)A.J. Drexel Autism Institute, Drexel University, Philadelphia, PA, (4)AJ Drexel Autism Institute, Philadelphia, PA*

Background: Approximately four in every 10 young adults with autism never work for pay outside the home between high school and their early 20s. Of these, 28% never receive services to assist them in attaining these outcomes. The U.S. Vocational Rehabilitation (VR) system is the largest provider of employment services for individuals with disabilities. Recent revisions to federal legislation aim to increase participation in integrated workplaces with sustainable wages for people with developmental disabilities who receive support services. Yet, we understand little about the role and effectiveness of VR services for those with autism.
Objectives: We characterize VR service users with autism, the services they receive, services outcomes, and how their experiences compare with other disability groups.
Methods: Data came from the federal Rehabilitation Services Administration (RSA) database which contains records for cases closed by state VR agencies. We

analyzed data for 10,534 clients with autism who received services and had a case that closed in FY2013. We compared outcomes of the autism group to those with intellectual disability (ID) and mental illness (MI) including anxiety, depression and other mood disorders.
Results: VR service users with autism were primarily male (83%), White (85%), and non-Hispanic (95%) with a mean age of 21.6 years. The majority (75%) had an IEP during high school, and 10% had a job at the time of application to VR. Average duration of services was 743 days - roughly comparable to those with ID and MI. The most frequent service types for those with autism were assessment (64%), VR counseling (60%) and job placement (47%). Over half (56%) of individuals with autism exited VR with employment - a rate slightly higher than those with ID (50%) and MI (46%). One-third of those with autism were in supportive employment (37%) and almost all had competitive employment (97%) - earning at least minimum wage in an integrated workplace and not paid less than a non-disabled person in the same position. Individuals with autism who were employed earned an average of $220 weekly, averaging 23 hours of work per week. Individuals with MI averaged higher pay ($336/week) and hours (30/week). Common occupations for those with autism were office and administrative support (22%), food preparation (17%), grounds cleaning/maintenance (12%). Fewer with ID worked in office and administrative support (12%), and more worked in food preparation (22%) and grounds cleaning/maintenance (23%). The array of job types the MI group experienced was much more varied.
Conclusions: Over half of individuals with autism who received VR services attained employment - a rate slightly higher than those with ID or MI. Approximately one-third were in supportive employment and nearly all had an outcome of competitive employment. They typically remained in the program for 2 years with services focusing on assessment, VR counseling, job placement and supports. Foundational information about VR services, experiences, and outcomes for those with autism may help inform transition planning and improve outcomes for those who receive VR services.

43 **163.043** Parent-Child Sexuality Communication for Adolescent Girls with ASD

L. Graham Holmes[1], *M. B. Himle*[2], *D. S. Strassberg*[2] *and A. Gillespie*[2], *(1)University of Utah, Salt Lake City, UT, (2)Department of Psychology, University of Utah, Salt Lake City, UT*

Background:
Adult sexual relationships are associated with physical and mental health benefits and risks. Despite the recent focus on transition issues and adult outcomes, and the interest most individuals with ASD have in sexual relationships, research on supporting health relationships remains limited. Furthermore, research on sexuality and ASD has primarily focused on males. This study addresses the need for research with females. Parents of youth with ASD have reported uncertainty about what to expect and how to support healthy sexual development. Most parents of males with ASD report covering basic topics (e.g., sexual abuse prevention, privacy, hygiene), but not other important topics such as sexual decision-making, contraception, and romantic relationships. If parents delay or omit covering such topics, youth may learn from less credible sources and have lower sexual knowledge, a known risk for victimization.
Objectives:
There is ample reason to believe that biological and cultural differences cause parents to engage in PCSC differently with male and female children. In this follow-up study, we determine whether previous research with males generalizes to females regarding the relationships between parent and child characteristics (e.g., ASD symptom severity, intellectual functioning), parental romantic expectations, parental sexuality concerns, and parent-child sexuality communication (PCSC).
Methods:
We surveyed 93 parents of 12 – 17 year-old females with ASD. Of these, 62 youth had average or above IQ and 31 had below average IQ. Data from parents of girls with below average IQ is not presented here due to small N; data collection is ongoing.
Simple and multiple regression was used to replicate results from previous research. Parents completed the Social Responsiveness Scale, 2nd edition (SRS-2), the Parent Sex Education Inventory indicating number of sexuality topics covered (range = 0 – 38), the Parent Romantic Expectations Inventory (range = 5 – 30, higher numbers indicate greater expectations) and the Parent Sexuality-Related Concerns Inventory (range = 25 – 125, higher numbers indicate more serious concerns).
Results:
Descriptive data will be presented on gender differences in specific topics and other variables. Results for parents of adolescent females were very similar to those for parents of males (see tables). Parental romantic expectations appear more important than concerns in parent engagement in PCSC, and mediate the relationship between SRS-2 and PSEI for the complete sample but not the subsample. Parents' feeling of preparedness to manage sexual development and ratings of self-efficacy for engaging in PCSC are the best predictors of number of topics covered.
Conclusions:
Healthcare providers and other personnel can encourage parents to discuss a variety of topics in order to increase sexual knowledge and decrease risks. Providers might also engage in discussion with parents and individuals with ASD about their romantic/sexual expectations and concerns, and provide resources to parents to help increase their feeling of self-efficacy and preparedness. Researchers should (a) consider cognitive functioning as an important factor in sex and relationships research and (b) continue to replicate studies with female samples to ensure efficacy of recommendations.

Combined Sample (N = 93)	*F test*	*B (SE)*	R^2
SRS-2 predicting PSEI**	$F(1, 92) = .559$, $p = .457$	$B = -.078$ (.098)	$R^2 = .006$
SRS-2 predicting Romantic Expectations**	$F(1, 91) = 10.001$, $p = .002$	$B = -.315$ (.062)	$R^2 = .099$
SRS-2 predicting Sexuality Concerns**	$F(1, 91) = 15.243$, $p = .000$	$B = .379$ (.134)	$R^2 = .143$
Romantic Expectations predicting PSEI**	$F(1, 91) = 40.413$, $p = .000$	$B = .555$ (.133)	$R^2 = .308$
Sexuality Concerns predicting PSEI**	$F(1, 91) = .093$, $p = .761$	$B = .032$ (.071)	$R^2 = .001$
Preparedness & Self-Efficacy predicting PSEI**	$F(2, 91) = 24.981$, $p = .000$	$B = .116(.966); .507$ (.922)	$R^2 = .354$
ASD+Average or Above IQ (N = 61)			
SRS-2 predicting PSEI**	$F(1, 60) = 1.018$, $p = .317$	$B = .129$ (.102)	$R^2 = .017$
SRS-2 predicting Romantic Expectations**	$F(1, 59) = 2.724$, $p = .104$	$B = -.210$ (.059)	$R^2 = .044$
SRS-2 predicting Sexuality Concerns**	$F(1, 60) = 23.878$, $p = .000$	$B = .534$ (.135)	$R^2 = .285$
Romantic Expectations predicting PSEI**	$F(1, 59) = 4.034$, $p = .049$	$B = .253$ (.218)	$R^2 = .064$
Sexuality Concerns predicting PSEI**	$F(1, 60) = .004$, $p = .949$	$B = -.008$ (.084)	$R^2 = .000$
Preparedness & Self-Efficacy predicting PSEI**	$F(2,59) = 6.949$, $p = .002$	$B = .314$ (1.379); .147 (1.4)	$R^2 = .191$

**** Indicates replication of findings with parents of male adolescents with ASD**

44 **163.044** Pay Attention during the Important Part: Adults with ASD Increase Their Gaze to Faces When Watching Richer Social Scenes

A. Pallathra[1], *L. Perez*[1], *A. Lee*[1], *R. T. Schultz*[2], *E. S. Brodkin*[1] *and J. Parish-Morris*[3], *(1)University of Pennsylvania, Philadelphia, PA, (2)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (3)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA*

Background: Reduced attention to social information is a defining characteristic of autism spectrum disorder (ASD; (APA, 2013)), and can be directly measured using eye tracking technology (Klin et al., 2002). Despite overall reductions in attention to social information, however, some older individuals with ASD appear to utilize compensatory mechanisms to "hack the social code", particularly when cognitive reasoning skills are intact (Frith, 2004). In this study, we test whether adults with ASD show evidence of

contextually modulated attention to social information (faces) using an established paradigm that distinguishes children with ASD from typically developing counterparts (Chevallier et al., 2015). We hypothesized that adults with ASD would look relatively more at people's faces in the context of nonverbal communication (two children playing together) than in the absence of communication (two children playing in parallel).

Objectives: Assess contextual modulation of visual attention to social stimuli in adults with ASD.

Methods: Twenty-eight adult participants with ASD (4 female; see Table) watched a ~6-minute video comprised of 22 sequential 15.5-second scenes of children playing together (Joint condition) or separately (Parallel condition). A Tobii X120 infrared eye tracker measured participants' gaze direction and duration. Areas of interest (AOI) were drawn around faces (social stimuli) and background objects (nonsocial stimuli). To control for individual differences in overall attention, we calculated the proportion of looking time toward each AOI relative to total looking time at the full screen. Preliminary analyses revealed no significant correlations between gaze variables and age or IQ, so we did not include these as covariates.

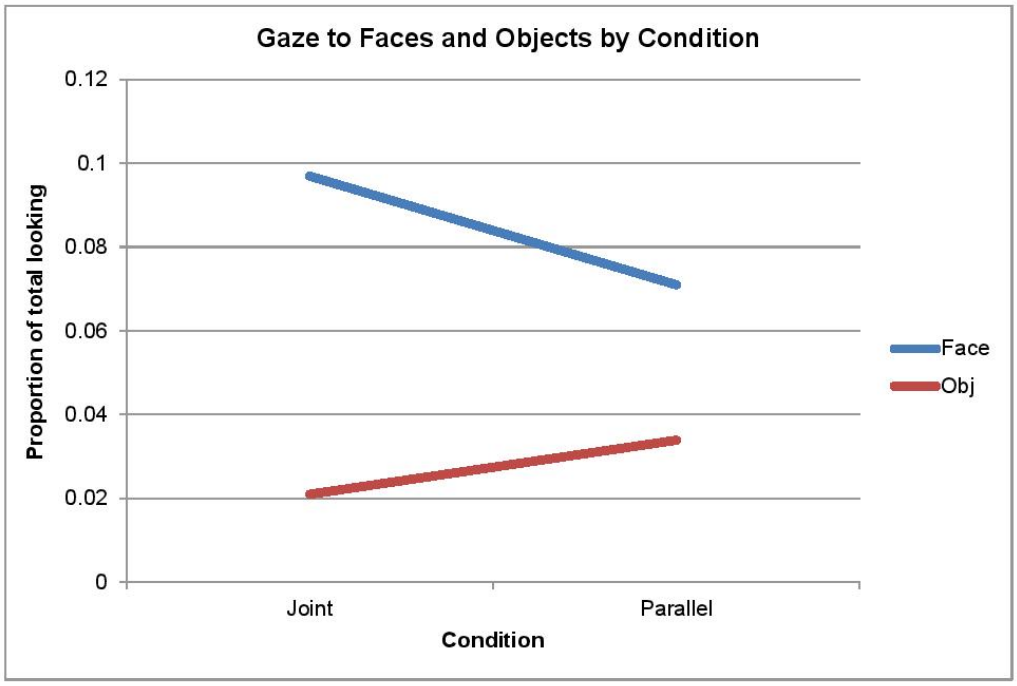
Results: A 2x2 repeated measures ANOVA revealed a significant interaction between condition (Joint, Parallel) and gaze duration to each stimulus type (Face, Background Objects), $F(1,27)=53.59$, $p<.001$, $\eta_p^2=.67$ (see Figure). Planned paired t-tests showed that participants looked more to faces in the Joint condition than the Parallel condition. To assess the nature of this effect, we calculated a Social Prioritization metric for each condition. Social Prioritization was defined as the total duration of looking at faces minus the total duration of looking at background objects. A paired samples t-test comparing average Social Prioritization in the Joint vs. Parallel condition showed that participants looked twice as long at faces relative to objects in the context of joint play between actors (mean=.08) than in the context of parallel play (mean=.04).

Conclusions: Contextual modulation of visual attention to social stimuli is an important skill that may be relatively preserved in adults with ASD. Despite clinically significant social impairments, participants looked more at children's faces in the context of interactive play than parallel play. This suggests that typical patterns of attention distribution may exist in older individuals with ASD, with the ability to tune into social context by modulating their gaze to capture communicative information from the face when it is present. Planned future analyses will explore whether this effect is also found in typically developing adults (data collection underway), will compare the magnitude of the modulation by diagnosis, and will assess whether contextual modulation can serve as a metric of treatment response.

Table. Participant demographic and phenotypic data. One participant is missing ADOS severity scores, 6 participants are missing IQ.

	Mean	SD	Min	Max
Age	25.96	7.34	20	48
SCQ	16.6	7.0	3	28
SRS-II	65.9	10.1	51	88
SRS-Self Report	63.8	8.6	47	80
WASI				
Verbal	110	21.8	71	160
Perceptual	100	26.4	57	160
FSIQ-4	106	21.7	72	140
ADOS severity	7.04	2.19	2	10

Figure. Significant interaction between condition (Joint vs. Parallel) and gaze to faces versus background objects (BG).



45 **163.045** Perception of Life As Stressful, Not Biological Response to Stress, Predicts Greater Social Disability in Adults with Autism Spectrum Disorder

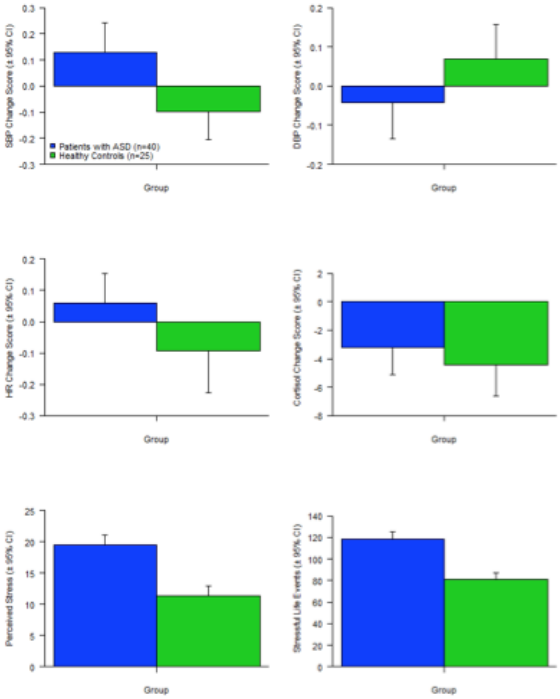
L. Bishop-Fitzpatrick[1], *C. A. Mazefsky*[2], *N. J. Minshew*[2] *and S. M. Eack*[3], *(1)Waisman Center, University of Wisconsin - Madison, Madison, WI, (2)Department of Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA, (3)School of Social Work, University of Pittsburgh, Pittsburgh, PA*

Background: Poor social functioning is a central feature of autism spectrum disorder (ASD) and has far-reaching effects on multiple domains of life. Yet, we know little about modifiable factors that predict social functioning in this population. Preliminary work suggests that there may be differences in the underlying mechanisms that drive stress management in individuals with ASD and that these differences may be associated with adult outcomes.
Objectives: This study aimed to (1) identify differences in stress response among adults with ASD and healthy volunteers; and (2) examine the relationship between stress response and social functioning adults with ASD. We hypothesized that adults with ASD would experience greater biological stress, perceived stress, and stressful life events than healthy volunteers and that there would be a significant relationship between stress and social functioning in adults with ASD.
Methods: Cross-sectional data were collected from 40 adults with ASD and 25 healthy volunteers. Participants with ASD were ages 18-44 (M=24.2), had intelligence quotient (IQ) scores from 80-132 (M=106.3), and 90.0% male. Healthy volunteers were ages 18-32 (M=25.1), had IQ scores from 82-138 (M=110.6), and 84.0% male. Repeated measures of systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) were taken during a social stress challenge task, while salivary cortisol was collected before and after the task. Measures also assessed perceived stress (Perceived Stress Scale), stressful life events (Stress Survey Schedule), social disability (Social Adjustment Scale-II), daily living skills (Waisman Activities of Daily Living), and social impairment (Social Responsiveness Scale). Analyses examined group differences between adults with ASD and healthy volunteers on biological stress response variables (SBP, DBP, and HR growth coefficients and salivary cortisol change scores) and

self-reported stress variables (perceived stress and stressful life events). The relationship between biological stress response and psychosocial stress variables and social functioning variables (global functioning, social impairment, social disability, and daily living skills) was analyzed using hierarchical multiple regression procedures.
Results: Results indicated that adults with ASD experienced significantly more perceived stress, *F(1, 63)=23.13, p<.001*, and stressful life events, *F(1, 63)=25.90, p<.001*, and greater SBP reactivity, *F(1,63)=4.95, p<.05* but did not differ from healthy volunteers in terms of DBP reactivity, HR reactivity, or cortisol reactivity. Results of regression analyses indicated that perceived stress, *β=0.07, t(35)=3.16, p<.05*, and stressful life events, *β=0.02, t(35)=3.20, p<.05*, significantly predicted social disability, when controlling for age, IQ, and treatment exposure. However, none of the biological stress response variables significantly predicted any social functioning variables, and perceived stress and stressful life events did not predict social impairment or daily living skills.
Conclusions: These results suggest that, while adults with ASD experience both greater systolic blood pressure reactivity and greater perceived stress and stressful life events than healthy volunteers, the perception of life as stressful is associated with social disability in this population while measured biological response to stress is not. Future research should examine both the directionality of the association between perceived stress and social functioning and interventions designed to help adults with ASD experience and respond to stress differently.

Figure 1

Group Differences on Stress Measures



46 **163.046** Prevalence and Predictors of Anxiety Disorders in Adolescent and Adult Males with Autism Spectrum Disorder and Fragile X Syndrome

J. Ezell[1], *S. McGrath*[1], *S. O'Connor*[1], *L. Abbeduto*[2] *and J. Roberts*[3], *(1)University of South Carolina, Columbia, SC, (2)MIND Institute, UC Davis, Sacramento, CA, (3)Psychology, University of South Carolina, Columbia, SC*

Background: Fragile X syndrome (FXS) is a monogenetic disorder characterized by abnormal social behavior and intellectual disability. FXS is also the most frequent inherited cause of autism spectrum disorder (ASD), which makes it an ideal model for studying ASD. Additionally, high rates of anxiety symptomatology have been reported in FXS (~90%) and ASD (~40%). Despite the high association of anxiety, few studies have examined predictive indicators of anxiety in FXS to those in ASD, or the trajectory of symptoms over time.
Objectives: Since nearly 70% of males with FXS meet criteria for ASD with considerable overlap with ASD and anxiety features, disentangling the trajectory of these features in FXS is critical to direct targeted treatments and can contribute to the latent heterogeneity in ASD. The purpose of this study is to advance our understanding of the nature of anxiety disorders in adolescent males with FXS compared to those with ASD by examining the prevalence and predictors of anxiety disorders using multiple measures over time.
Methods: Participants included males with FXS (n=30) or ASD (n=7) from 16 to 24 years of age from an ongoing longitudinal study (with 10 more ASD by IMFAR). Screening indices of anxiety preceded diagnostic determination a year later. Screening measures included the ADAMS and the CBCL anxiety subscales. The Children's Interview for Psychiatric Symptoms-Parent Version (P-ChIPS), a semi-structured interview with mothers, measured diagnosis of anxiety disorders including Specific and Social Phobias and Generalized Anxiety Disorder (GAD). The ADOS-2 documented autism severity and the Leiter-R measured nonverbal IQ.
Results: In preliminary analyses, no group differences were evident for chronological age or autism severity (p >.05). The FXS group did have a lower nonverbal IQ ($t(18)$=-4.43), p<.01); but, it was unrelated to anxiety diagnostic categorization for both groups. Findings indicate that 63% of the FXS adolescents met criteria for at least one anxiety disorder compared with 29% in ASD. Across the FXS and ASD groups respectively, 31% versus 14% met for Specific Phobia, 17% versus 14% met for Social Phobia and 33% versus 14% met for GAD. Anxiety problems from the CBCL were significantly greater in males with ASD than those with FXS ($t(8)$=-2.56), p<.05). In logistic regression models, group (B=2.13-2.25, p<0.05) predicted presence of an anxiety disorder while taking previous anxiety problems into effect as captured by the CBCL or ADAMS.
Conclusions: This study is somewhat consistent with previous work indicating high prevalence of anxiety disorders in FXS and ASD; however, our data indicate generally lower rates for both the presence and specific anxiety diagnoses across both groups. Our primary finding is greater anxiety behaviors in FXS than idiopathic ASD across general (any anxiety) and specific categories (Specific Phobia, GAD). We also report that early symptoms of anxiety on screening measures predicted the presence of an anxiety disorder a year later in ASD. This study is the first to document a tentative difference between anxiety symptoms and later diagnoses in ASD and FXS adolescent males, allowing for more targeted assessment and treatment of anxiety in these populations.

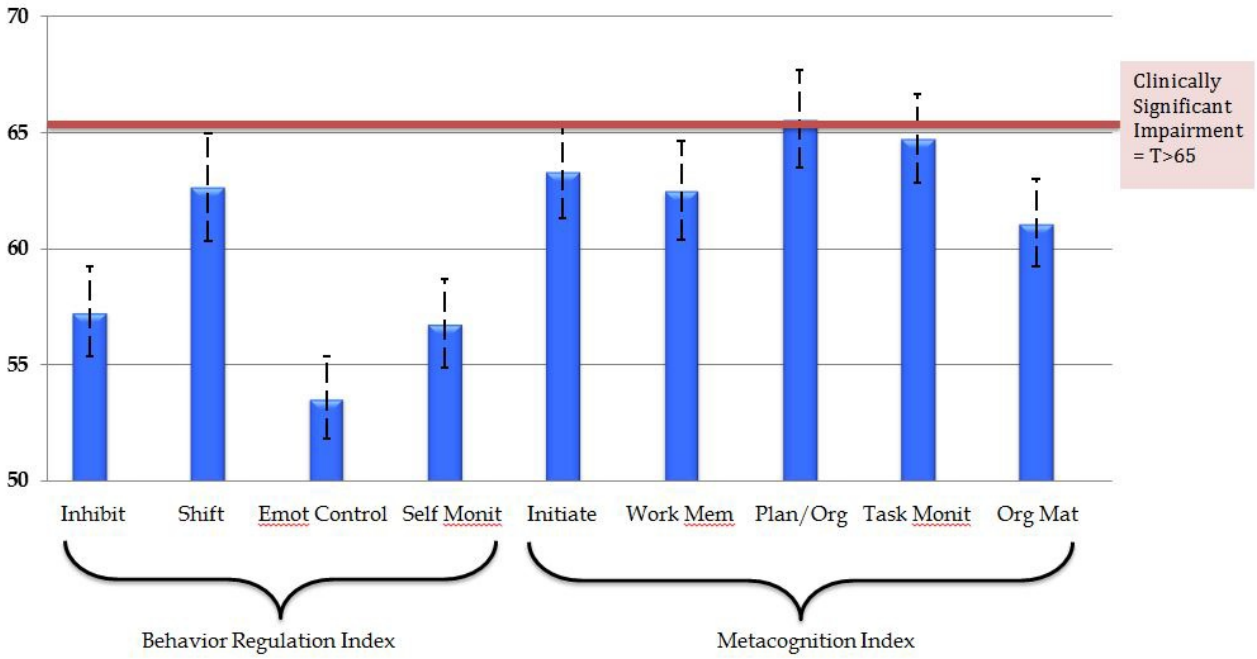
47 **163.047** Real-World Executive Functions in Adults with Autism Spectrum Disorder: Profiles of Impairment and Associations with Adaptive Functioning and Co-Morbid Anxiety and Depression

L. Kenworthy[1], *C. E. Pugliese*[2], *H. S. Popal*[3], *E. I. White*[3], *J. F. Strang*[4], *A. Martin*[3] *and G. Wallace*[5], *(1)Children's Research Institute, Children's National Medical Center, Rockville, MD, (2)Children's National Medical Center, Rockville, MD, (3)NIMH, Bethesda, MD, (4)Children's National Medical Center, Silver Spring, MD, (5)The George Washington University, Washington, DC*

Background:
Although executive functioning (EF) difficulties are well documented among children and adolescents with autism spectrum disorder (ASD), little is known about real-world measures of EF among adults with ASD. In spite of recent estimates indicating that nearly 70% of individuals with ASD do not have an intellectual disability, adult outcome in ASD remains poor. Two key components of outcome are psychiatric co-morbidities and adaptive behavior, both of which are related to EF in children and adolescents with ASD.
Objectives:
To examine real-world EF profiles as reported on the informant version of the Behavior Rating Inventory of Executive Function-Adult; and to investigate the links between real-world EF problems and both adaptive functioning and internalizing psychopathology (i.e., anxiety and depression symptoms).
Methods:
We examined parent-reported EF problems among 35 adults with ASD without intellectual disability (31 males; 18-40 years [M=21.55, SD=4.12]; Full Scale IQ 88-133 [M=112.47, SD=11.21]). We defined the profile of specific EF domain deficits in adults with ASD and investigated how EF was related to adaptive functioning and co-morbid

anxiety and depression symptomatology through regression analyses. Research reliable autism diagnosis using ADI and ADOS was confirmed by expert clinical opinion. Parent report was gathered on measures of: EF (Behavior Rating Inventory of Executive Functioning-Adult version [BRIEF-A]), adaptive behavior (Adaptive Behavior Assessment System-Second Edition) and internalizing psychopathology (Adult Behavior CheckList).
Results:
One-sample t-tests indicated that adults with ASD were impaired on all nine domains measured by the BRIEF-A relative to the normative mean (p's<.05). A repeated measures ANOVA demonstrated a variable EF profile in ASD (F=10.20, p<.001) with the most prominent deficits occurring in flexibility (i.e. the BRIEF-A Shift scale) and metacognition (i.e. the BRIEF-A Metacognition Index and the Plan/Organize scale). Hierarchical multiple regressions revealed that even after accounting for the influences of age, IQ, and ADHD symptoms, flexibility problems were associated with anxiety-related symptoms (F=8.56, p=.002; ΔR^2 =.38), while metacognition, and specifically problems on the Plan/Organize scale were associated with depression symptoms (F=4.62, p=.02, ΔR^2 =.17). Although neither age nor IQ scores were significant predictors of adaptive behavior, metacognition scores were. Adding ADHD problems to the regression model as a nuisance variable resulted in metacognition problems no longer significantly predicting adaptive functioning impairments however.
Conclusions:
Real-world EF problems persist into adulthood, with a profile of impairment that emphasizes problems with flexibility and metacognition, consistent with previous reports in children and adolescents. The relationship between EF problems and adaptive behavior may be mediated by ADHD symptomatology in this adult sample. Even after accounting for ADHD symptoms, EF problems are strongly associated with co-morbid anxiety and depression symptoms, making EF an important treatment target among adults with ASD.

Figure 1. Profile of informant ratings of real-world executive functioning among 35 adults with autism spectrum disorder by subscale of the Behavior Rating Inventory of Executive Function-Adult (T-scores; *M*=50, *SD*=10).



48 **163.048** Results of an Autism Screening Study Among Adults Receiving Community Mental Health Services

D. S. Mandell[1], *J. Miller*[2], *E. S. Brodkin*[3], *M. E. Calkins*[3], *K. Shea*[3], *K. T. Mullan*[3], *B. B. Maddox*[2], *S. 2. Marcus*[3] *and T. M. Moore*[4], *(1)University of Pennsylvania School of Medicine, Philadelphia, PA, (2)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (3)University of Pennsylvania, Philadelphia, PA, (4)Psychiatry, University of Pennsylvania, Philadelphia, PA*

Background: Adults with ASD may be misdiagnosed, or their psychiatric comorbidities may be recognized without recognizing the ASD. Studies report that 10% of psychiatrically hospitalized adults in US and 6% in the UK have undiagnosed ASD. Studies from the UK, Sweden and Taiwan find 0.6 - 4% of adult patients with ASD in outpatient settings. The prevalence of ASD in adult US outpatient psychiatric settings is unknown. Accurately diagnosing ASD is challenging for community clinicians. ASD diagnostic tools are lengthy, most are validated only in children, and they require considerable training to administer correctly. Therefore they are not feasible for use with adults in community mental health settings.
Objectives: 1) Estimate the prevalence of undiagnosed ASD in community outpatient settings; 2) compare clinical characteristics, treatment and assigned diagnoses of adults with ASD with those of adults with other psychiatric disorders; and 3) develop and test a brief tool for community mental health practice to screen for ASD in adults.
Methods: Staff from three community mental health centers completed the Social Responsiveness Scale, Adult Version (SRS-A) and the Autism Spectrum Disorders in Adults Screening Questionnaire for their adult clients. Our research team conducted chart reviews to extract information found to discriminate adults with ASD from adults with other psychiatric disorders in prior studies. A subset of these clients, enriched for those with SRS-A scores >60, completed in-person evaluations. This evaluation included Module 4 of the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2), a brief clinical interview about ASD-related characteristics not assessed by the ADOS-2, and the Overview and Psychosis modules of the Structured Clinical Interview for DSM-IV-TR Axis I Disorders (SCID). Clinical case conferences were conducted for all participants to make a final determination of ASD. Item response theory was used to reduce the number of items on the SRS. Logistic regression and recursive partitioning were used to identify the most parsimonious set of elements needed to accurately screen for and diagnose ASD.
Results: 1134 adults were screened, 813 of whom were not receiving developmental services, and therefore counted towards our denominator. To date, 296 charts were reviewed and >58 clinical interviews were conducted (35 more expected, enriched for autism). Seventeen individuals were already diagnosed with ASD and an additional 21 had a mention of ASD in their charts. Two met research criteria for ASD, although 22 had scores on the ADOS indicative of ASD. 18 items on the SRS, selected through item response theory, had a .95 correlation with the SRS total score. Analyses examining the combined accuracy of the SRS plus additional items pulled from charts will be completed by the time of submission.
Conclusions: Study results suggest that the prevalence of ASD among adults receiving outpatient psychiatric care is approximately .5%, although challenges in interviewing more severely impaired participants suggest that this is a lower-bound estimate. Traditional screening tools can be substantially shortened with no reduction of accuracy in this population, especially when combined with other data elements easily extracted from clinical charts.

49 **163.049** Seeking Safe Spaces: Autistic Students Finding Places to be Themselves on College Campuses

A. Wolz[1], *B. E. Cox*[2], *A. Anderson*[1] *and J. Edelstein*[1], *(1)Florida State University, Tallahassee, FL, (2)P.O. Box 3064452, Florida State University, Tallahassee, FL*

Background:
The traditional college setting is being challenged as students on the autism spectrum enter postsecondary education. This presents trials for students with ASD, as “failure

by universities to provide social supports would substantially impair the student's ability" to reach the goals of developing social skills and forming relationships (VanBergeijk, Klin,& Volkmar, 2008). One method of providing resources is the provision of formal and informal 'safe spaces' on campus to accommodate students with ASD, where they can self-regulate and feel prepared to accomplish the aforementioned objectives. Such spaces help students overcome potential barriers to academic and social engagement, thereby facilitating students' growth and success.
Objectives:
The purpose of this paper is to examine the need for safe spaces on college campuses as sustainable resources for students with ASD, from the perspectives of students with ASD who have postsecondary education experience. Safe spaces offer a place free from an otherwise overwhelming environment.
Methods:
Data were collected from a virtual platform for individuals with ASD, wrongplanet.net. Discussion threads were collected from the "School and College Life" board. Using Astin's Inputs-Environments-Outputs (IEO) framework, four researchers coded data in three separate rounds, with inter-coder reliability established by joint coding during the first round. Both procedural and thematic memos were taken throughout the coding process.
Results:
Students with ASD reported the college environment can be overwhelming and potentially hostile. These students expressed experiencing anxiety about certain college experiences, difficulties with social interactions, and feeling overwhelmed by new environments. Said one student, "I ended up having a serious meltdown due to over stimulation. It took me two months to recover."
Safe spaces in the college environment provide a place for these students to escape stressors. Despite the disruptive nature of the college settings, students with ASD reported safe spaces helped them to alleviate anxiety and propel success. One student found alternatives to spaces where he felt overwhelmed, saying "Sometimes I was so overwhelmed with nerves/fear that I would avoid going to the cafeteria for dinner and just eat something like popcorn in my room." Another student had strategies of active avoidance. "You need to secure some solitary hangout spots in and around campus. A hidden nook of the library, a café off-campus that's open late, etc.. Make it so you don't need to come back until your roomie(s) are asleep."
Conclusions:
College students with ASD need places into which they can retreat when feeling overloaded. Safe spaces provide the opportunity to process information in a secure setting. Safe spaces should enable separation from social environments, provide security, and vary to meet individual students' needs. These spaces may be pre-existing physical spaces, but may also include virtual systems. Moreover, institutional policies can enable temporal safe spaces by providing students adequate time to process all the necessary information before making a decision.
It is essential that the growing population of postsecondary students with ASD view institutional environments as conducive to their well-being. The creation of safe spaces is one promising means of doing so.

50 **163.050** Skilled Jobs for People with ASC Successful Dual Vocational Training and Job Placement in Germany

***M. Dalferth**, OTH Regensburg, University of Applied Sciences, Regensburg, Germany*

Background: Improvement of framework conditions and creating instruments for successful training qualifications and job placement

Objectives: Continuous evaluation of adolescents with autism spectrum in twelve vocational training centres; outcomes of vocational training and job placement; experiences with support measures, job coaching and mentoring.
Methods: Mail questionnaires (centres), Structured interviews with experts (staff), graduates (with autism) and entrepreneurs (companies)
Results: Special training programmes in twelve dual vocational training centres have led to a jump in numbers of participants with ASC from 348 (2010) to 649 (2013). 228 have successfully finished their training (2.5 – 3.5 years) and left the centres. 131 have provided information about their kind of employment: 40.5% have found work on the labour market, most of them in their trained jobs. 12.2 % have started further training or studies. 4.6 % work in a sheltered workshop. 2.3 % are not available for the labour market. 40.4 % are still looking for a job. Graduates supported by job coaches were more successful to find a demanding job on the labour market
Conclusions: People with ASC (especially with Asperger's Syndrome and High Functioning Autism) are able to successfully undergo vocational training and work in different kinds of qualified jobs where they can unfold their potentials and do skilled work for the companies. Nevertheless there is a discrepancy between successful graduation and job placement. Therefore, some prerequisites should be taken into account for the second step:
Graduates with autism should be especially trained for job interviews or accompanied by a coach. But most of them are living with their families. They need support to find an individual accommodation, to manage everyday life skills, and to establish social contacts. An ongoing social skill training helps them to develop flexibility and social competence. Job coaching tailored to their special needs highly increases the chances to get and maintain a job.
Companies need useful information about people with ASC and their capabilities, about how to adequately communicate with them and deal with their special characteristics. They benefit from external job coaches and colleagues who volunteer as mentors.

51 **163.051** Student-Professor Relationships and Needs Among University Students with ASD or ADHD: Student and Professor Perspectives

***S. M. Zeedyk**[1], Y. Bolourian[2] and J. Blacher[2], (1)Psychiatry, University of California, San Diego, San Diego, CA, (2)University of California - Riverside, Riverside, CA*

Background:
Increasingly, young adults with ASD are attending 4-year universities (Shattuck et al., 2012). At the postsecondary level, most supports offered during the K-12 years are no longer available (VanBergeijk et al., 2008), and accommodations at many campuses present challenges for students with ASD. Therefore, it is imperative to consider the role of university professors. Further, there is a high level of comorbid ADHD symptoms among individuals with ASD (van der Meer et al., 2012). Thus, students with ASD may share similar experiences in college as their peers with ADHD.
Objectives:
The present study aimed to evaluate the needs of college students with ASD or ADHD, including the similarities and differences identified between the groups. Additionally, we sought to identify the knowledge (or lack thereof) that faculty members possessed about working with these students.
Methods:
Participants included 18 professors, 13 students with ASD, and 18 students with ADHD, all from 4-year universities. Students and professors participated in individual semi-structured interviews, which were transcribed and analyzed through an iterative coding process to identify common themes.
Results:
Preliminary analyses of the interviews with professors and students with ASD revealed six main themes: (1) *Autism is an invisible disability* (e.g., One professor discussing a colleague's attitude disclosed, "He didn't think he needed to provide accommodations to students who appeared *normal*."); (2) *Available services* (e.g., academic accommodations were described as "a perfunctory/one size fits all" approach); (3) *Things professors need to know* (e.g., One student indicated that he switched majors because he was required to change lab partners almost daily; he explained that the new major was "more consistent," and he didn't have to constantly meet new people.); (4) *Interactions between students and professors* (e.g., One professor described a student who did not understand college classroom etiquette, "It took a little bit of management because one of the characteristics of his specific position on the spectrum is he's not shy at all about talking. So it was a matter of helping him learn when not to talk… It was a great learning experience for me as a teacher." Themes unique to the faculty interviews included, (5) *Interest in autism* (i.e., professors' personal and professional interests in ASD); and (6) *Education/training in autism* (e.g., One professor explained, "I would like to know what needs – what special needs they have? What can I expect in terms of their behavior or their frustration or their anxiety.") Analyses of the interviews with students with ADHD are ongoing. Comparison of the overlap and discrepancies between the two student groups will be identified.
Conclusions:
University professors have limited knowledge about working with students with ASD or ADHD. Unfortunately, available services are primarily geared toward students with learning disabilities. Changes in the administration of campus disability services and better faculty training may be useful in aiding these students to be more successful in college. Understanding the challenges faced by these students through in-depth accounts is valuable in uncovering the areas of need in assisting them at the postsecondary level.

52 **163.052** Support Systems for Students with Autism Spectrum Disorder during Their Transition to Higher Education: A Qualitative Analysis of Online Discussions

***A. Anderson**[1], B. E. Cox[2], A. Wolz[1] and J. Edelstein[1], (1)Florida State University, Tallahassee, FL, (2)P.O. Box 3064452, Florida State University, Tallahassee, FL*

Background:
Individuals with high functioning autism spectrum disorder (ASD), formerly diagnosed as Asperger syndrome, are graduating from high school and entering institutions of higher education (IHE) in greater numbers than ever before. Transitioning from high school to college can be challenging for all students, and can be particularly difficult for students with ASD, who often face adversity during periods of transition. Although a growing number of colleges and universities have begun developing programs to support these students, more efforts are necessary to better understand how to best serve this population. Further, much of the relevant literature relies on secondhand reporting from parents, faculty, and administration rather than the student with ASD him or herself.
Objectives:
This study is an exploration into how college students with high functioning autism spectrum disorder describe their support systems during the transition to higher education.

In particular, this study explores how these students describe their experiences within an online environment among their peers.
Methods:
The study used unobtrusive qualitative methods to collect and analyze online forum discussion posts from college students with autism spectrum disorder. Data was collected from the Wrong Planet "School and College Life" forum, which is a publicly viewable discussion forum. Source forum replies were coded into qualitative data analysis software NVivo in the first round of analysis as guided by (Astin's) I-E-O framework. Following this, a second round of coding occurred in which specific themes were established, from which this study draws data.
Results:
Support services do not work in isolation. Many students described multiple support systems (e.g. Housing, Counseling, and Advising) working in conjunction with one another during their successful transition to higher education. One student noted that "There are many support programs as well that can assist with the executive functioning issues, extra tutoring, and all the other things that come up like handling relationships, advocating, budgeting (a huge one), etc.". Students find their support systems through both formal and informal means. Many use services provided by their Office of Disability Services (ODS), but many students lack the awareness or documentation needed to obtain services. One student describes how he found his group of "interesting people" in a student association: "I prefer to meet people in a group that is interest-focused and where there is enough room to accommodate to slow processing speed and sensory processing differences."
Conclusions:
Institutions of higher education offer a variety of support services for students with ASD. Though services offered through ODS typically require documentation of a formal diagnosis, others are available without diagnosis or disclosure. Because some students do not have a formal diagnosis and many others choose not to disclose, colleges and universities must train faculty and staff throughout the institution to provide the support these students deserve.

53 **163.053** Supported Employment, Comprehensive Cognitive Enhancement and Social Skills (SUCCESS) Program for Adults with ASD: Who, What, Where, When and How Plus Outcomes

M. J. Baker-Ericzen[1], *M. Fitch*[2], *M. Kinnear*[3] *and M. M. Jenkins*[1], *(1)Child and Adolescent Services Research Center, Rady Children's Hospital San Diego, San Diego, CA, (2)Child & Adolescent Services Research Center, Rady Children's Hospital, San Diego, San Diego, CA, (3)Rady Children's Hospital San Diego, San Diego, CA*

Background:
The increasing population of adults with ASD is considered a pressing, challenging public health issue (Bailey, 2012). Longitudinal studies of intellectually able adults with autism have shown consistent and persistent deficits across cognitive, social, and vocational domains, indicating a significant need for effective treatments for these functional disabilities (Howlin, 2000). The cognitive and social skill deficits that are core features of ASD have been identified as major challenges to employment success for these adults (Hillier et al, 2007).
Objectives:
This study developed a novel, integrated community-based intervention, **Su**pported employment, **C**omprehensive **C**ognitive **E**nhancement & **S**ocial **S**kills (SUCCESS) treatment that augments existing community supported employment practice with a newly developed a manualized "soft skills" curriculum. A pilot study was conducted to obtain estimates of effects of outcomes which include cognitive skills and social skills for young adults with ASD.
Methods:
A total of 18 young adults participated in an open trial pilot study of the SUCCESS program to date with another 15-25 estimated to have participated by April 2016. SUCCESS was delivered weekly for 90minutes via active group participation during a simulated work meeting within a larger vocational training program in community services. The program involves 24 sessions over 5 months with first half of the curriculum teaching executive functioning skills as attention, learning, memory, prospective memory, cognitive flexibility, problem solving, goal oriented thinking and contextual awareness. The second half teaching social communication skills including social conversation (giving and receiving compliments, feedback and help), social relationships, initiations and social networking (including do's & don'ts of social media). Pre and post assessments include a full battery of assessments with the Behavior Rating Inventory of Executive Function- Adult Version (BRIEF-A) and Social Responsiveness Scale-2 (SRS-2) adult form presented. Participants and caregiver informants completed each measure. The majority of participants were male (84%), white race/ethnicity (84%) and all graduated with a high school diploma. Some were involved with various social services: 42% disability services, 26% department of rehabilitation, 11% social security income.
Results:
Analyses consisted of calculating effect sizes using Cohen's d to measure the magnitude of the effect of the SUCCESS intervention pre and post training program on executive functioning (8 clinical subscales; 2 indexes and 1 Total score: Global Executive Composite) and social skills (6 subscales and 1 Total score) by informants (self and caregiver). Preliminary findings reveal small to large negative effects per participant and caregiver report on the BRIEF. This may be a reflection of increased awareness of issues. Small to large positive effects were found on the SRS-2 subscales per parent report and minimal effects for participants (Refer to Tables).
Conclusions: This study demonstrates that it is feasible to develop the "soft skills", a cluster of cognitive abilities and social graces that make someone a good employee and compatible to work with, within a community supported employment environment for adults with ASD. Specifically, the SUCCESS program has potential to improve social skills and it can be offered within vocational preparedness programs. Additional measures should be analyzed to examine effectiveness.

Table 1. Social Skill Outcomes

Social Responsiveness Scale-2	Participant			Parent		
T Scores	pre-mean	post-mean	effect size	pre mean	post-mean	effect size
Social awareness	57.00	56.71	0.04	67.29	60.29	0.97
Social cognition	57.29	56.14	0.23	64.00	63.14	0.12
Social communication	62.14	62.29	0.03	66.86	64.14	0.45
Social motivation	64.00	64.86	-0.20	72.29	70.57	0.27
Restricted interests and repetitive behavior Domain Total	64.00	65.00	-0.13	67.43	66.86	0.07
Social communication and interaction Domain Total	62.00	61.57	0.27	69.29	65.71	0.60
SRS-2 Total	62.71	62.57	0.07	69.14	66.57	0.47

Table 2. Executive Functioning Skill Outcomes

BRIEF-A	Participant n=7			Parent n=8		
T-Scores	pre-mean	post-mean	effect size	pre mean	post-mean	effect size
Inhibit	53.71	59.00	-0.66	56.71	57.57	-0.13
Shift	60.57	59.43	0.12	69.71	67.57	0.37
Emotional control	46.71	49.29	-0.44	53.86	55.29	-0.21
Self-monitor	52.43	55.29	-0.44	57.29	58.86	-0.38
Initiate	63.71	68.57	-0.48	68.86	67.86	0.12
Working memory	61.71	63.57	-0.37	60.86	65.29	-0.89
Plan/organize	61.57	62.43	-0.21	66.00	68.71	-0.40
Task monitor	53.57	58.00	-0.68	62.71	65.57	-0.54
Organization of materials	64.00	61.57	0.19	55.86	57.71	-0.26
Behavioral Regulation Index	52.71	55.57	-0.4	58.43	59.29	-0.16
Metacognition Index	63.57	65.14	-0.24	64.43	66.57	-0.56
Global Executive Composite	59.43	62	-0.39	62.57	64.14	-0.4

54 **163.054** The ADOS-2 in Adult Community Mental Health Settings

J. Miller[1], *E. S. Brodkin*[2], *M. E. Calkins*[2], *B. B. Maddox*[1], *K. T. Mullan*[2], *K. Shea*[2] *and D. S. Mandell*[3], *(1)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (2)University of Pennsylvania, Philadelphia, PA, (3)University of Pennsylvania School of Medicine, Philadelphia, PA*

Background:
For adults with possible ASD, the ADOS-2 is likely to be the instrument of choice to gather observations about social communication and restricted interests and behaviors. While insufficient on its own for a diagnosis, it might be the most standardized and objective information available about ASD related characteristics, especially when early developmental history is unavailable. Because evidence suggests many adults with ASD have unmet psychiatric care needs, it is thus particularly critical to know how to identify adults with ASD and ensure they are receiving needed services. To that end, it is critical to know how the ADOS-2 performs in different care settings, include CMH

centers.
Objectives: To examine the utility of the ADOS-2 to distinguish individuals with ASD from individuals with other diagnoses receiving CMH services.
Methods: Consumers of services at three large CMH centers in Philadelphia (n = 1134) were screened for social communication impairments with the Social Responsiveness Scale, Adult version (SRS-A) and the Autism Spectrum Disorders in Adults Screening Questionnaire (ASDASQ). Of these, a sample stratified to heavily recruit participants with SRS-A scores >60 was recruited to participate in a clinical evaluation that included an ADOS-2, brief clinical interview about ASD related characteristics not assessed by the ADOS-2, social history questions from the KIDDIE-SADS-Present and Lifetime Version (K-SADS-PL), and the Overview and Psychosis modules of the Structured Clinical Interview for DSM-IV-TR Axis I Disorders (SCID). The clinical evaluation team remained blind to results from the SRS-A and ASDASQ. The ADOS-2 was always administered first, and scored independently of subsequent information gathered. After the full evaluation, clinical case conferences were conducted for all participants to make a final determination of ASD.
Results: To date, 58 in-person evaluations have been conducted. An additional 35 evaluations are expected by May 2016. Results from clinical case conferences suggested that 2 of the 58 had an ASD (3.45%); 43 had some form of psychosis (74.14%). However, 22 participants obtained ADOS-2 scores above the cutoffs suggestive of ASD; 2 were the individuals with ASD, 16 were individuals with psychosis, and the remaining 4 had existing mood disorder diagnoses and suspected personality disorders. From clinical observation, it was often the negative symptoms of psychosis that resulted in elevated ADOS-2 scores.
Conclusions: Social communication impairments are not specific to ASD, and of course the ADOS-2 is not intended to be used as the sole source of data in a diagnostic evaluation. However, our data suggest that ADOS-2 scores may yield a very high rate of false positives in adults with complex mental health issues. Across these CMH settings, 20/56 (35.7%) of our sample obtained elevated ADOS-2 scores, although clinical case conference judgment determined the client did not have ASD. The high rate of false positives on the ADOS-2 among adults with complex psychiatric issues suggests the ADOS-2 may not be a helpful tool for discriminating ASD in this population, or at least must be considered in the context of other developmental and clinical information.

55 **163.055** The Economic Cost of Adults with Autism Spectrum Disorder on Households

*J. Shannon, **A. Arrieta**, B. C. Amick and T. Page, Health Policy and Management, Florida International University, Miami, FL*

Background: In 2010, 1 in 68 children had been diagnosed with an Autism Spectrum Disorder (ASD), an increase of 120 percent in prevalence since 2000. As larger cohorts age and transition to adulthood, ASD will impose a greater economic burden on households. Few studies in the field have assessed the cost of ASD in adults, and even fewer have focused on the cost from a household perspective.
Objectives: The objective of this study was to produce preliminary estimates of the direct and indirect cost of ASD in adults from a household perspective.
Methods: We developed a survey instrument to gather data from households on the economic cost of caring for adults with ASD. We recruited 31 households in the South Florida area to participate in the study, and asked the household primary caregiver to complete the survey. The survey instrument was designed to match the Medical Expenditures Panel Survey (MEPS) database. Each adult with ASD from our study was matched to one or more adults without ASD from MEPS using the nearest neighbor matching method. The direct medical cost of ASD, defined as the additional cost of caring for adults with ASD compared to similar adults without ASD, was estimated with a generalized linear model to account for skewness in the MEPS cost data. Other direct costs (accommodations and other non-medical services) as well as indirect costs (productivity loss of the primary caregiver and the adult with ASD) were obtained from the survey.
Results: The average total economic cost of ASD in adults for households in our study was estimated at $42,684 annually (in 2015 dollars). Income loss from the primary caregiver ($11,665) and adult with ASD ($25,308) accounted for the majority of the cost. Direct medical costs for outpatient, emergency room, hospital stays, and dentist services were $554 annually. Direct non-medical costs for accommodation, paid helper, special needs school, speech therapy, occupational therapy, and vocational rehabilitation for the adult with ASD were $8,485 annually. Adults with ASD had 4.4 more outpatient visits and 1.0 more hospital visit per year than adults without ASD.
Conclusions: This is, to our knowledge, the first study to estimate the cost of ASD in adults in the U.S. We estimated the cost of ASD in adults for an average household in South Florida at $42,684. This translates to a total economic cost to households in Florida of $663 million per year and $21 billion nationwide.

56 **163.056** The Effect of Diaphragmatic Breathing on Stress Caused By a Socially Stressful Paradigm on Young Adult Males with Autism Spectrum Disorder

***T. Kozikowski**[1], R. M. Mizrahi[2], A. Herndon[1], S. Neumann[3], K. Hartmann[1] and M. Urbano[1], (1)Eastern Virginia Medical School, Norfolk, VA, (2)Psychological and Brain Sciences, University of Massachusetts, Amherst, MA, (3)Psychiatry, Eastern Virginia Medical School, Norfolk, VA*

Background:
One of the hallmarks of Autism Spectrum Disorder (ASD) is difficulty with social interactions and forming appropriate social relationships. ASD is often comorbid with social anxiety and those with ASD report higher levels of stress in social situations. Therefore, one predominate theory is that the social deficit seen in individuals with ASD is due to an increased anxiety associated with social interactions. Anxiety in those diagnosed with ASD is of considerable concern because frequent elevated levels of cortisol associated with stress and anxiety can negatively affect brain development and general health.
Diaphragmatic breathing (DB) techniques have consistently been shown to improve self-reported anxiety and associated autonomic cardiac responses. Furthermore, research has shown that these techniques have successfully lowered the stress response in other populations diagnosed with mental health disorders
Objectives:
The goal of this study was to investigate whether DB techniques would be useful in decreasing stress in young adult males with ASD following a socially stressful paradigm.
Methods:
Participants for this study were 26 males (M_{age} = 21.1) including participants with an ASD diagnosis (n_{ASD} = 16) and participants without an ASD diagnosis ($n_{non\text{-}ASD}$ = 10). Heart rate variability (HRV) for all participants was measured during baseline, a socially stressful activity, and recovery periods as a biomarker of autonomic nervous system response linked with emotional stress. The baseline period consisted of participants sitting quietly. The activity period consisted of participants taking part in The Talking, Feeling, and Doing Game® with two confederates. In order to induce a socially stressful paradigm, confederates were instructed prior to the session not to provide the participant any social feedback while playing the game. During the recovery period, participants were randomly selected into one of two conditions (DB or control conditions). Participants in the DB condition were coached through a DB exercise paced at 6-10 breaths per minute. Participants in the control condition were instructed to sit quietly. The associated stress response was evaluated through statistical analyses of the HRV parameters measured at the three data points.
Results:
Period (baseline, activity, recovery) x condition (DB, control) repeated measures ANOVAs were conducted analyzing high frequency: low frequency (HF:LF) HRV for the ASD and non-ASD groups separately. There was a significant main effect of condition ($F(1,14) = 6.84$, $p<.02$) on HRV for the ASD group.
Independent samples t-tests for the ASD participants indicated that HF:LF HRV did not differ between the DB and control conditions during baseline or activity periods (all $p>.43$). However, the DB group had a significantly lower HF:LF HRV (M_{DB} = -0.04, SD_{DB} = 0.02) than the control group ($M_{control}$ = 0.92, $SD_{control}$ = 0.39; $t(16) = -0.74$, $p<.001$) during the recovery period.
Conclusions:
Results reveal that DB successfully decreased stress as measured by HRV in a socially stressful paradigm in young adult males with ASD compared to controls (non-DB). These results indicate that DB may be a beneficial technique to decrease stress related to social anxiety for those with ASD.

57 **163.057** The Effects of Employment on Mental Health and Executive Functions in Adults with Autism Spectrum Disorder (ASD)

***L. Dockery**[1] and E. L. Hill[2], (1)Lewisham Way, New Cross, Goldsmiths, University of London, London, United Kingdom, (2)Goldsmiths, University of London, London, United Kingdom*

Background: Little is known about life for adults with Autism Spectrum Disorder (Howlin, 2013). This is worrying because research suggests adults with ASD experience poorer mental health than those without ASD (Joshi et al., 2013) with depression commonly reported (Moss et al., 2015). Some research also indicates executive functions (higher-order cognitive processes including planning, flexibility and inhibition) are also associated with difficulty in ASD (Hill, 2004). Few adults with ASD are in employment despite many being able and willing to work. However, employment can be seen as one route to independence and social inclusion. The effects of employment on mental health in adults with ASD are unknown. However, one study has suggested improved executive functioning performance following participation in a supported employment scheme in adults with ASD (Garcia-Villamisar & Hughes, 2007).
Objectives: This study will focus on mental health and executive functioning with the hypothesis that mental health and executive functioning will improve after a period of employment in adults with ASD.
Methods: 20 adults (age 18+) with ASD and 20 individuals without ASD (matched on IQ, age and gender) will take part. Those with intellectual disability, DCD, ADHD or dyslexia are excluded. Participants will be assessed at two time points: pre-employment and post-employment. Each session will involve a series of mental health questionnaires and executive functioning tasks. All participants will be unemployed at the pre-employment stage and employed, or have just completed a period of employment, at the post-employment stage.
Results: To date, eleven adults with ASD have taken part. Most participants are males (91%) aged 20-36 (M = 25.6, SD = 4.3). Pre-employment, participants reported mild symptoms of depression (M = 6.2, SD = 5.4), few or no symptoms of anxiety (M = 4.0, SD = 3.5), slightly below average levels of life satisfaction (M = 17.3, SD = 8.3) and slightly lower than average levels of well-being (M = 43.6, SD = 8.3). Initial data from the present study suggest an improvement in well-being ($t(6) = -2.19$, $p = .036$), verbal fluency ($t(6) = -2.14$, $p = .039$), cognitive flexibility($t(6) = 2.49$, $p = .024$) and response inhibition ($t(6) = 3.57$, $p = .006$) after a period of employment.

Conclusions: Whilst this is extremely tentative, as data collection and analysis are ongoing, the preliminary findings support the hypothesis that an improvement in mental health and executive functioning is observed in adults with ASD after a period of employment. This supports clinical guidelines recommending individual supported employment as a psychosocial intervention for adults with ASD (NICE, 2012) and links to funding opportunities for specialist adult ASD employment services. Few of these services exist and an improvement in well-being and some aspects of cognition means many adults with ASD would benefit from specialist supported employment services. Finally, the present study supports recent statutory guidance in the United Kingdom recommending employment be included in needs assessments for adults with ASD.

58 **163.058** The Impact of Postsecondary Education on Employment for Young Adults with Autism Spectrum Disorders

B. Freedman[1]*, S. Pi*[2] *and J. C. Lee*[1]*, (1)Center for Disabilities Studies, University of Delaware, Newark, DE, (2)Department of Counseling, Educational Psychology and Special Education, Michigan State University, East Lansing, MI*

Background: There has been a recent increase in the number of young adults with autism spectrum disorders (ASD) who are seeking postsecondary education (Gardiner & Iarocci, 2013). Specialized supports appear to foster greater academic success for young adults with ASD (Gelbar et al., 2014). However, little is known about whether participation in college promotes improved employment outcomes, which may deter support teams from encouraging postsecondary education. Limited previous research suggests that postsecondary education is a strong predictor of employment for young adults with ASD (Migliore et al., 2012) although the contribution of functional limitations has not yet been explored. Additionally, little is known about the types of occupations young adults who have postsecondary education successfully attain and whether these are different than positions held by those who do not have postsecondary education.
Objectives:

1. Examine the impact of participation in postsecondary education on employment status for young adults with ASD.
2. Explore the association between participation in postsecondary education and types of occupation among young adults with ASD.

Methods: The study population was individuals ages 14-24 with ASD who received services from the Vocational Rehabilitation (VR) agency in a Midwestern state and whose cases were closed during FY 2011-2013 (n=1,001). Rehabilitation Services Administration Case Service Report (RSA-911) dataset was used as the primary data source, and functional limitation data was extracted from the agency's case management system. Four logistic regression models were sequentially performed with "employment status at closure" as the outcome. Model 1 included only participation in postsecondary education. Individual characteristics, VR services, and functional limitations were sequentially entered in subsequent models. Chi-squared tests were performed to explore the association of participation in postsecondary education with different types of occupations for youth with ASD.
Results: Young adults with ASD who participated in postsecondary education were more likely to achieve employment compared to those who did not participate in postsecondary education (Adjusted Odds Ratio [AOR]=2.08; 95% CI = 1.5, 2.9), after controlling for individual characteristics, VR services received, and types of functional limitation. Functional limitation in self-care (AOR=0.6; 95% CI = 0.4, 0.9) or work-tolerance (AOR=0.7; 95% CI = 0.5, 0.9) was found as risks for not achieving employment. Chi-squared tests indicated a significant association between participation in postsecondary education and employment in sales; office and administrative support; and transportation and material moving. A higher proportion of those without postsecondary education obtained jobs in building and grounds cleaning and maintenance; and installation, maintenance, and repair.
Conclusions: Participation in postsecondary education is an effective vehicle for achieving employment for young adults with ASD, particularly when combined with specific VR services. A greater focus on self-care and work-tolerance during postsecondary education may improve the likelihood of employment. Participation in postsecondary education may lead to employment in a variety of fields beyond those, like grounds cleaning, which are traditionally associated with people with ASD. This study only focused on one particular geographic area and therefore requires replication in other states/regions.

59 **163.059** The Relationship Between ASD Symptoms and Adjustment to College

S. M. Ryan[1]*, L. K. Baker*[2]*, S. W. Eldred*[2] *and J. A. Rankin*[3]*, (1)The University of Alabama, Tuscaloosa, AL, (2)Psychology, The University of Alabama, Tuscaloosa, AL, (3)Stony Book University, Stony Brook, NY*

Background:
Estimates suggest that 46% of individuals with an ASD diagnosis have average or better cognitive functioning (CDC, 2014). According to the National Longitudinal Transition Study-2 (NLTS-2), 32% of students with an ASD diagnosis attend college (Wei, et al., 2012) with fewer than 20% of those enrolling in a 4-year university completing a degree (Shattuck, et al., 2012). In order to increase successful completion of college degrees it is important to examine how ASD symptoms effect students' adjustment to college. Trevisan et al., (2015) found that Broader Autism Phenotype symptoms in neurotypical students significantly predicted adjustment to college as measured by the Student Adaptation to College Questionnaire; however, this study did not examine symptoms in individuals with an ASD diagnosis.
Objectives:
The purpose of the current study is to examine the relationship between ASD symptoms as measured by the SRS-2 and adjustment to college as measured by the Student Adaptation to College Questionnaire and the students' GPA at the end of the first academic year.
Methods:
The current study included 10 degree-seeking college students who were admitted to an ASD Specific support program at a major public university. The sample included students across 3 cohorts (9 males/1 female; 7 freshmen/3 transfer students). Students were paired with a therapist-mentor who met with them 3 times per week to address academic organization, self-advocacy, social skill development, career building skills, and coping with anxiety and/or depression. Students were administered a battery of measures at summer orientation prior to beginning college and then each subsequent semester. The current study examined the correlation among ASD symptoms as reported by parents on the Social Responsiveness scale, Second Edition (SRS-2), the Student Adaptation to College Questionnaire completed at the end of the first academic year, and the cumulative GPA at the end of the first academic year.
Results:
Three subscales of the SRS-2 were significantly correlated with overall adjustment to college as measured by the SACQ. Specifically, there was a significant negative correlation between the SRS-2 Communication scale and the SACQ (r=-.660, p=.038), the SRS-2 Social Motivation and the SACQ (r=-827, p=.003), and SRS-2 Restricted Interests and Repetitive Behaviors and the SACQ (r=-.689, p=.028). High levels of symptoms were associated with poorer adjustment to college. It should be noted that all but one student in the sample had self-reported adjustment scores in the average range. GPA at the end of the first academic year did not correlate with any subscales of the SRS-2. Six additional data points from the 4th cohort will be added prior to presentation of this study in May 2016.
Conclusions:
Students with an ASD face unique challenges related to their ASD symptoms which can affect adjustment to the college setting and possibly retention in college as studies suggest that adjustment to college is one predictor of retention in college (Gerdes, et al 1994). Future studies with a larger sample size will be needed to confirm these findings and to further examine more specific aspects of college adjustment (i.e., academic, social, emotional).

60 **163.060** The Relationship Between Habitual Emotion Regulation, Anxiety, and Depression in Adolescents and Young Adults on the Autism Spectrum

R. Y. Cai[1,2]*, M. Uljarevic*[1,3] *and A. L. Richdale*[1,2]*, (1)Cooperative Research Centre for Living with Autism (Autism CRC), Brisbane, Australia, (2)Olga Tennison Autism Research Centre, Melbourne, Australia, (3)Olga Tennison Autism Research Centre, La Trobe University, Bundoora, Australia*

Background: Anxiety and depression are among the most common and disabling comorbid psychiatric conditions in individuals on the autism spectrum. However, factors that may account for high rates of anxiety and depression in autism are currently not well understood. Although some studies suggest that age, gender and severity of autism traits might influence the presence of these internalising problems, it has been argued that non-autism specific traits, which vary across individuals, might be more important; one such trait is emotion regulation. Emotion regulation strategies such as suppression have been found to be associated with poorer mental health in the general population. It has been proposed that emotion regulation impairments are a risk factor for anxiety in autism as individuals on the spectrum tend to use suppression strategies more than typically developing individuals. Thus, while it might be expected that greater use of suppression strategies is associated with anxiety and depression in individuals on the autism spectrum, relationships between emotion regulation strategies and anxiety and depression have not been formally tested.
Objectives: To investigate whether or not the use of habitual emotion regulation strategies, specifically reappraisal and suppression, are related to anxiety and depression symptoms in individuals on the spectrum over and above age, gender and autism traits.
Methods: This study forms part of the Australian Autism CRC longitudinal study of school leavers; recruitment is ongoing. Participants aged 15 to 25 years were recruited Australia-wide via various channels. As part of the longitudinal study, participants completed the Emotion Regulation Questionnaire (ERQ), the Adult Autism Spectrum Quotient (AQ), the DSM-5 Cross-cutting Dimensional Anxiety Scale (Cross-D), and the Patient Health Questionnaire-9 (PHQ-9), which measures depression. To date, 37 individuals on the spectrum (25 males and 12 females; M_{age}= 18.59 years, SD_{age}= 2.37) have completed the questionnaires. Preliminary data are presented here; for our presentation, data will be re-analysed with the inclusion of all new participants.
Results: Pearson's correlation analyses were conducted to assess the relationships between age, gender, AQ, Cross-D, and PHQ-9 total scores, and suppression and reappraisal scores from the ERQ. PHQ-9 and Cross-D scores were significantly correlated with both reappraisal and AQ scores, but not with age, gender, or suppression score. Partial correlation was then used to explore the relationship between reappraisal, and anxiety and depression scores, while controlling for scores on AQ. There were significant moderate, negative correlations between reappraisal and anxiety, r = -.42, p = .02, and between reappraisal and depression, r = -.45, p = .01.

Conclusions: This is the first study to assess the relationships between emotion regulation strategies and anxiety and depression in individuals on the spectrum. Although it has been shown that individuals on the autism spectrum use suppression more frequently, the findings suggest reduced use of cognitive reappraisal is associated with increased levels of anxiety and depression symptoms over and above the influence of age, gender and autism traits. These findings have potential clinical implications and future work should replicate these results with a larger sample.

61 **163.061** The Transition to the Adult Health Care System Among Adolescents with Autism Spectrum Disorder

R. A. Nathenson[1] *and B. Zablotsky*[2]*, (1)University of Pennslyvania, Philadelphia, PA, (2)National Center for Health Statistics, Hyattsville, MD*

Background: The transition from the pediatric to the adult healthcare system is a noted challenge for all individuals, but particularly for those adolescents with special health needs (Stewart, 2009). A population of adolescents who may experience additional difficulties are those with autism spectrum disorders (ASD) because they are commonly diagnosed with co-occurring developmental, psychiatric, neurological, and other medical conditions (Levy et al., 2010) that may persist into adulthood and require frequent and intensive service and treatments (Liptak, Stuart, & Auinger, 2006).
These difficulties may be further compounded by the fact that many adolescents with ASD receive everyday services in the school setting (Kang-Yi et al., 2015) and may find themselves exiting both the educational system and the pediatric healthcare system simultaneously. The current study examines the use of medical services in a national population of privately insured adolescents/young adults (aged 16-22) diagnosed with ASD.
Objectives: 1) Calculate the percentage of adolescents/young adults with ASD receiving home, office/outpatient hospital, inpatient hospital and emergency department services annually by age; 2) Calculate the annual average number of services received at each place of service.
Methods: Data come from the Optum database, a clinically rich database that includes the health care claims of all individuals insured by Optum's parent company from May 2000 to June 2013. The sample includes individuals diagnosed with ASD (n=16,029).
Estimates were calculated using Stata 13.0 SE. Cross-sectional multivariate linear regressions were used to determine if an association exists between age and service usage after controlling for child characteristics, household characteristics, and insurance plan structure.
Results: Fewer individuals with ASD received services in an office/outpatient hospital department ($p<.01$) or inpatient hospital department ($p<.01$) as they aged, which was accompanied by a reduction in the annual number of visits each year. There was not a reduction seen in the percentage of individuals with ASD receiving services in either the home or emergency department as they aged.
Females with ASD were more likely to use services in all locations than males, with two-and-a-half visits more per year than males in the outpatient/office setting and two more visits a year in the home. Black children were less likely to use inpatient, emergency room, and office/outpatient services than white children with two fewer visits per year on average in the office/outpatient setting and one fewer visit to the emergency department. Children living in households with lower net worth had fewer annual office/outpatient setting visits than children living in households with higher net worth.
Conclusions: As adolescents with ASD age out of the pediatric health care system, there is a notable decline in both the percentage of adolescents that receive services and the number of annual services received across multiple settings. This decline, which potentially co-occurs with a "service cliff" upon graduating from high school (Roux et al., 2015), could lead to unmet service needs.

62 **163.062** Underlying Mechanisms of Deficient Social Problem-Solving Abilities in Adults with High-Functioning Autism: Exploring the Roles of Alexithymia, Emotion Dysregulation, and Executive Dysfunction

S. L. Jackson[1]*, B. Dritschel*[2] *and F. R. Volkmar*[3]*, (1)School of Psychology & Neuroscience, University of St Andrews, St. Andrews, United Kingdom, (2)School of Psychology & Neuroscience, University of St Andrews, St Andrews, United Kingdom, (3)Yale Child Study Center, Yale University School of Medicine, New Haven, CT*

Background:
Adults with HFASD are reported to be a particularly susceptible population to episodes of depression. A recent study found deficits in social problem-solving (SPS) to account for a significant proportion of the association between ASD-related social impairments and depressive symptomology. This finding would suggest that psychosocial interventions designed to develop SPS skills may prove a valuable resource for treatment of depressed mood in adults with HFASD. A number of areas of impairment associated with ASD may play important underlying roles in the SPS deficits found in this population. Knowledge of these roles could provide instrumental insight for interventions designed to develop this area of social functioning.
Objectives:
The current study aims to better understand the underlying mechanisms resulting in SPS deficits for adults with HFASD by exploring the specific impacts of alexithymia, emotion dysregulation, and executive dysfunction on the different components of the SPS process.
Methods:
The study sample consists of 54 HFASD adults (39 female, 15 male) with an age range of 19-65 (M=32.61, SD=10.50). Participants were assessed on SPS ability (SPSI-R), alexithymia (TAS-20), emotion dysregulation (DERS), and executive dysfunction (BRIEF). Age, gender, educational attainment, ASD-related social deficits (SRS-2), and depressive/anxious symptomology (DASS) were assessed as potential confounds.
Results:
Both SRS-2 and the DASS-Depression scale were found to be potential confounds, and were thus controlled for in all analyses. Hierarchical regression analyses were performed with the SPS process components as the DV, DASS-Dep. and SRS-2 scores entered as IVs during the first step (enter-method), and TAS-20, DERS, and BRIEF entered as IVs during the second step of the analyses (stepwise-method). Results suggest difficulties with emotion dysregulation to be a significant predictor of increased utilizations of a Negative Problem Orientation ($\beta=0.34$); increases in alexithymic traits to be a significant predictor of increased use of Avoidance ($\beta=0.38$) and Impulsive/Careless ($\beta=0.48$) SPS styles, decreased use of a Ration Problem-Solving process in general ($\beta=-0.46$), and greater difficulties with the Generation of Alternative Solutions ($\beta=-0.38$) and Decision Making ($\beta=-0.34$) aspects of that process; and greater levels of executive dysfunction to be a significant predictor of increased use of an Impulsive/Careless Style ($\beta=0.33$), and greater difficulties with the Problem Development and Formulation ($\beta=-0.47$), Decision Making ($\beta=-0.35$), and Solution Implementation and Verification ($\beta=-0.37$) aspects of a rational problem-solving process. The inclusion of these variables to the models resulted in significant improvements in the predictive strength of all models ($\Delta R^2=0.07-0.36$, $p<0.05$).
Conclusions:
This study provides insight into the underlying mechanisms resulting in difficulties with different aspects of the SPS process for adults with HFASD. Problem-Solving Therapy (PST) has a history of proven utility in the treatment of depression for other populations, and a recent pilot study showed that PST can be effectively used with adults with HFASD. The current study can help improve the efficacy of future attempts to use PST for this population as it provides a more detailed understanding of why difficulties in certain aspects of SPS may be present, and thus, more insight into how to better design the intervention to work on these areas of need.

63 **163.063** Untended Wounds: The Unexplored Problem of Non-Suicidal Self-Injury in Adults with ASD

B. B. Maddox[1]*, A. Trubanova*[2] *and S. W. White*[2]*, (1)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (2)Virginia Polytechnic Institute and State University, Blacksburg, VA*

Background: Non-suicidal self-injury (NSSI) involves deliberate injury to body tissue that is inflicted without suicidal intent and for purposes that are not socially sanctioned. Recent studies have examined the characteristics and predictors of NSSI in community and clinical samples, but there is no published research on NSSI in individuals with autism spectrum disorder (ASD). This is somewhat surprising given that many of the most salient predictors of NSSI, including depression and emotion dysregulation, have been widely reported among people with ASD. Given the focus on self-injury as a form of restricted, repetitive behavior in individuals with ASD, NSSI in the context of ASD may be overlooked by both researchers and clinicians.
Objectives: The purpose of this study was to examine NSSI methods, frequency, severity, functions, and initial motivations in adults with ASD. Our secondary aim was to compare NSSI characteristics across adults with ASD and history of NSSI and adults without ASD but with history of NSSI. In addition, we explored the degree to which depression symptoms and emotion regulation difficulties are associated with NSSI in adults with ASD.
Methods: This study involved a two-group, cross-sectional survey, with one survey for adults in the community with ASD ($n = 42$) and one survey for university students without ASD ($n = 1252$). The anonymous online survey included the Non-Suicidal Self-Injury Assessment Tool (NSSI-AT), the Severity Measure for Depression-Adult, and the Difficulties in Emotion Regulation Scale (DERS).
Results: In the ASD sample, 21 participants (50%) reported engaging in NSSI behavior. A gender-matched subsample of participants who endorsed NSSI was drawn from our university-based survey ($n = 21$) in order to compare individuals with and without ASD on NSSI characteristics. Of the 18 women with ASD, 13 (72.2%) reported NSSI, compared to only 8 of the 24 men with ASD (33.3%), $\chi^2(1) = 6.22$, $p = .013$. There were no statistically significant differences between the ASD and non-ASD groups on any of the NSSI-AT items. Within the ASD group, point-biserial correlations revealed that a history of NSSI was not significantly related to current depression ($r = -.013$, $p = .936$) or emotion dysregulation ($r = .054$, $p = .734$). Within the subset of individuals with ASD who endorsed a history of NSSI, more difficulty with emotion regulation was significantly related to Sensation Seeking functions of NSSI ($r = .512$, $p = .018$).
Conclusions: This descriptive study is one of the first investigations of NSSI in adults with ASD. Our preliminary findings suggest that NSSI is (1) phenomenologically distinct from core ASD symptoms and similar to NSSI as it is conceptualized in the non-ASD literature, (2) a common problem among adults with ASD, and (3) overlooked in the extant research, and likely overshadowed or misconstrued (e.g., as SIB, or core ASD symptoms) in clinical practice.

64 **163.064** Well-Being on the Autism Spectrum: Relationships Between Identity, Stigma, Self-Esteem, and Quality of Life

***T. A. M. McDonald**, University of Wisconsin- Madison, Atlanta, GA*

Background: Adults on the autism spectrum experience stigma, and stereotype threat research on other populations suggests stigma exerts direct and indirect detrimental impacts on wellbeing. Since there are multiple studies reporting undesirable objective and subjective quality of life (QoL) outcomes for adults on the autism spectrum, such as higher unemployment and poorer psychological health, possibly, experiences of stigma have a detrimental impact on wellbeing for adults on the autism spectrum. Moreover, this impact may be mediated by other factors, such as variation in identification with the autism spectrum and stereotype threat intersectionality.
Objectives: This study examined how perceptions of stigma, self-esteem, and QoL, both subjective and objective, interrelate and, also, relate to postsecondary outcomes for adults on the autism spectrum. This study, also, examined whether, and how, variation in identity, as measured by the Autism Spectrum Identity Scale (ASIS), gender, and identification with different diagnostic categories, relates to factors of subjective wellbeing.
Methods: Over 1000 adults who had a diagnosis of, or identified with, an autism spectrum disorder participated in a national online survey containing the Autism Spectrum Identity Scale (ASIS; McDonald, 2015a) along with other measures of well-being such as stigma, self-esteem, and objective and subjective QoL. The survey also gathered demographic data, including gender, diagnoses, diagnoses identification preference, age, and postsecondary student and employment statuses.
Results: Greater stigma consistently related to poorer outcomes and higher self-esteem related to better outcomes in well-being and postsecondary outcomes of education and employment. Without exception, higher scores in Changeability related to better outcomes across all of the other factors. The Positive Difference factor demonstrated a similar pattern; it related to all of the other measures except self-care. Both women and those who identified with autism reported higher stigma and poorer QoL, but no differences in self-esteem, than men or those who identified with Asperger's Syndrome, respectively.
Conclusions: These relationships may indicate stereotype threat acts as a mechanism to reduce performance and well-being for adults on the autism spectrum. Although, the DSM-5 has recently collapsed these two diagnoses into a single category, many adults in this study were diagnosed within the DSM – IV criteria. One rationale for the DSM-5 change was the inability to reliably distinguish differences between these two groups (Hazen, McDougle, & Volkmar, 2013). Based on that decision, it is surprising to find the consistent differences between these two groups in attitudes of autism identity, stigma, and subjective and objective QoL in this study. Since adults on the autism spectrum have lower rates of employment and education attainment than the mainstream population, the intersection of being a woman on the autism spectrum is particularly concerning. On a more optimistic note, higher self-concepts of Positive Difference and Changeability may represent important identity strategies to cope with stigma and preserve self-esteem. Possibly, attitudes which characterize the autism spectrum as a Positive Difference and as Changeable provides some resilience against experiences of frustrations, failures, and discrimination. Future research should examine causal relationships between these factors.

Poster Session
164 - Communication and Language
5:30 PM - 7:00 PM - Hall A

65 **164.065** Acoustic Predictors of Trained and Naive Rater Impressions of Speech Qualities in ASD

***I. M. Eigsti**, J. Mayo and E. Schoen Simmons, Psychological Sciences, University of Connecticut, Storrs, CT*

Background: Clinicians and teachers frequently report an intuition that they are able to diagnose autism spectrum disorder (ASD), after hearing a brief speech sample from an affected individual. Such differences in speech qualities have the potential to significantly disrupt social and work success. Few studies have been able to detect what specific qualities in speech differ in ASD; likely this reflects the broader challenge of speech invariance – that a single acoustic cue segment carries information about multiple phonemic segments (Liberman et al 1967).
Objectives: Our aim was to combine human perception with acoustic analyses of a single set of speech productions, to reveal which acoustic cues seem to guide listener perceptions of atypicality.
Methods: Participants included 15 adolescents with high-functioning ASD and 15 with typical development (TD). Groups did not differ in age, full-scale IQ (scores>80), or gender, *p*'s>.50; standardized language (CELF) scores were all in the typical range, but with a trend for higher scores in the TD group. We elicited a set of eight spoken sentences, all with similar sentence structures and vocabulary items, by giving participants a card with the printed sentence, asking them to learn it by heart, and then to speak it aloud using their normal voice. Stimuli were recorded for subsequent analyses using Praat. Acoustic analyses to date included measures of minimum, maximum, and median pitch; pitch range, excusion, and standard deviation (SD); and mean pitch divided by SD.
In addition, the speech samples were presented to 15 undergraduates and 10 clinicians with ASD expertise, all of whom were naïve to study hypotheses. Raters were asked to determine whether a given sample sounded "atypical or unusual" (in the undergraduate group) or "ASD-like" (in the clinician group), versus "typical," on a 1-3 scale (with "2" anchored as "somewhat unusual").
Results: Both groups of raters gave significantly higher "atypicality" scores to the ASD group (p's<.01, with CELF score as a covariate). Grouping the slightly (2) or very (3) atypical ratings into a single category, sensitivity for naïve raters was .80, specificity of .73; for expert clinicians, sensitivity was .86, specificity of .86. Interestingly, again holding CELF scores constant, there were *no* mean group differences in acoustic variables. Thus, both naïve and expert raters were highly accurate in sorting the groups on the basis of speech samples, although acoustic analyses failed to distinguish between groups. In a regression analysis of the acoustic variables that predicted atypicality ratings, the best predictors were not IQ, age, nor symptom severity, but rather, slow speech rate and high median pitch.
Conclusions: Both trained and naive listeners appear to be able to detect ASD based only on speech. The trained clinicians showed significant sensitivity and specificity, misclassifying 4/30 participants (2 per group). Naïve undergraduates were slightly less accurate, misclassifying 7/30. Speech rate and median pitch appeared to drive these perceptions. Future work should compare findings from children with other speech and language delays or developmental concerns. These findings suggest that speech rate and fundamental frequency may provide useful targets for acoustic analysis and for intervention.

66 **164.066** Analyzing Discourse Patterns of Young Adults with ASD

*C. O. Alm[1], E. T. Prud'hommeaux[2] and **B. Meyers**[1], (1)Rochester Institute of Technology, Rochester, NY, (2)OHSU, Beaverton, OR*

Background: Most previous work in analyzing speech transcripts from individuals with Autism Spectrum Disorder (ASD) has focused primarily on quantitative syntactic and lexical metrics and qualitative measures of pragmatics, which are usually applied in the restricted context of a narrative retelling or picture description task. Less research has been devoted to systematically examining higher-level discourse structures in less constrained conversational interactions, particularly among young adults on the spectrum.
Objectives: The objectives of this research are: (1) to confirm previous findings about low-level lexical and syntactic characteristics of language in high-functioning young adults with ASD; and (2) to detect differences in the high-level discourse patterns of college-aged males with and without ASD.
Methods: All participants in the study were male university students. Typically-developing (TD) participants were recruited to match the ASD participants according to age, college major, and GPA. Transcripts were produced for 6 male subjects (ASD n=3, TD n=3) from recordings of three tasks designed to elicit conversation with a TD confederate in (1) a usability task for a web application, (2) a collaborative game, and (3) an interactive math and computing tutoring task. Standard measures of syntactic complexity, vocabulary diversity, and disfluency frequency were automatically extracted from the transcripts. In addition, an existing discourse-based annotation scheme was used to manually code the discourse units ("dialog acts") in the transcripts in order to characterize the way that individuals with ASD acknowledge their interlocutors, seek actions, and ask for information.
Results: As previously reported in the literature, few between-group differences were found in the lower-level syntactic, pragmatic, and lexical features. Several differences in discourse features, however, were observed. In the cooperative game task, individuals with ASD were less likely to acknowledge (oh alright) their interlocutor's comments and were far more likely to suggest (I'd say start out by moving past and jumping over...) -- and considerably less likely to request (ok push the block on to the ramp) -- that their interlocutors perform an action than their TD counterparts. When compared to their TD counterparts across all tasks, individuals with ASD were considerably more likely to (1) answer questions with "no", (2) apologize for something they had said or done, (3) request clarification, and (4) thank their interlocutor.
Conclusions: Many of the lower-level features typically used to characterize language in children with ASD seem to lose their discriminative power when applied to young adults, underscoring the need for the development of more complex and nuanced methods of language analysis. The study suggests that discourse analysis, particularly when applied to conversations produced in a collaborative and relatively unconstrained context, can provided insight into the linguistic differences that persist into adulthood. As results for lower-level features align with previous literature, future work will focus primarily on discourse-based comparisons between groups.

67 **164.067** Are There Phonological Consequences of Auditory Processing Differences in Autism Spectrum Disorder? Evidence from Phonological Categorization Tasks

***B. Castelluccio**[1], A. Canfield[2], J. Green[2], A. Hogstrom[2], E. Kapnoula[3], B. McMurray[4], J. Edwards[5] and I. M. Eigsti[1], (1)Psychology, University of Connecticut, Storrs, CT, (2)Psychological Sciences, University of Connecticut, Storrs, CT, (3)Psychological and Brain Sciences, University of Iowa, Iowa City, IA, (4)Psychology, University of Iowa, Iowa City, IA, (5)Communication Sciences and Disorders, University of Wisconsin, Madison, WI*

Background: Speech comprehension requires rapid and accurate phonological categorization of temporal and spectral features of the acoustic signal. One well-studied example of phonological categorization is the contrast between voiced and voiceless stop consonants (e.g. /b/ vs. /p/) using *voice onset time* (VOT), the length of time

between stop release and onset of vocal fold vibration. While VOT is continuous, perception of these consonants seems to be categorical. Stop consonants produced along a range of VOTs are perceived as /b/, but with a VOT increase of just a few milliseconds, listeners perceive that sound as /p/. However, underneath this seemingly discrete behavior, the underlying cognitive representations for most listeners are highly gradient and continuous, which can be measured in tasks that accommodate a gradient response format. There appear to be reliable individual differences in the degree of gradiency or categoricalness; one study showed individual differences relate to the degree to which typically developing (TD) listeners integrate multiple cues, such as the primary temporal cue (VOT) and a secondary spectral cue (fundamental frequency [f0]). Although individuals with autism spectrum disorder (ASD) have largely been thought to possess intact phonological abilities, phonological impairments have been reported. Studies of low-level auditory processing, likely relevant for phonological development, have reported *impaired* temporal processing in ASD and *heightened* spectral processing. Additionally, individuals with ASD show more veridical perception, with less influence of top-down information, across perceptual domains.
Objectives: The current study examines whether auditory processing differences in ASD result in differences in phonological categorization or in cue weighting of temporal and spectral cues to the voicing contrast. We hypothesized that heightened spectral processing might be associated with greater use of f0.
Methods: Participants with and without ASD completed a classic two-alternative forced choice (2AFC) task and a visual analog scale (VAS) task. Adolescents with ASD (*n*=12) and TD (*n*=12) categorized bilabial (/b/, /p/) and alveolar (/d/, /t/) stop consonants with VOTs of 1- 45 ms and f0 of 90 or 125 Hz as either bull/pull or den/ten.
Results: Analyses indicated no group differences in boundary placement or categorization, and no group differences in use of f0 as a cue on the 2AFC task (Figure 1a). Additionally, there were no group differences in how continuously the voicing contrast was perceived using a VAS task (Figures 1b-d). Both groups showed high fidelity to VOT in the VAS task.
Conclusions: These data suggest that, in the absence of informative top-down lexical information, individuals with ASD surprisingly show no disadvantage in perceiving temporal information relevant for phonological categorization. Also surprising is the lack of difference in use of a spectral cue (f0) in individuals with ASD. While previous research has found that individuals with ASD show poor auditory discrimination of temporal differences and heightened spectral processing, these auditory processing differences appear not to affect phonological processing, at least in adolescence.

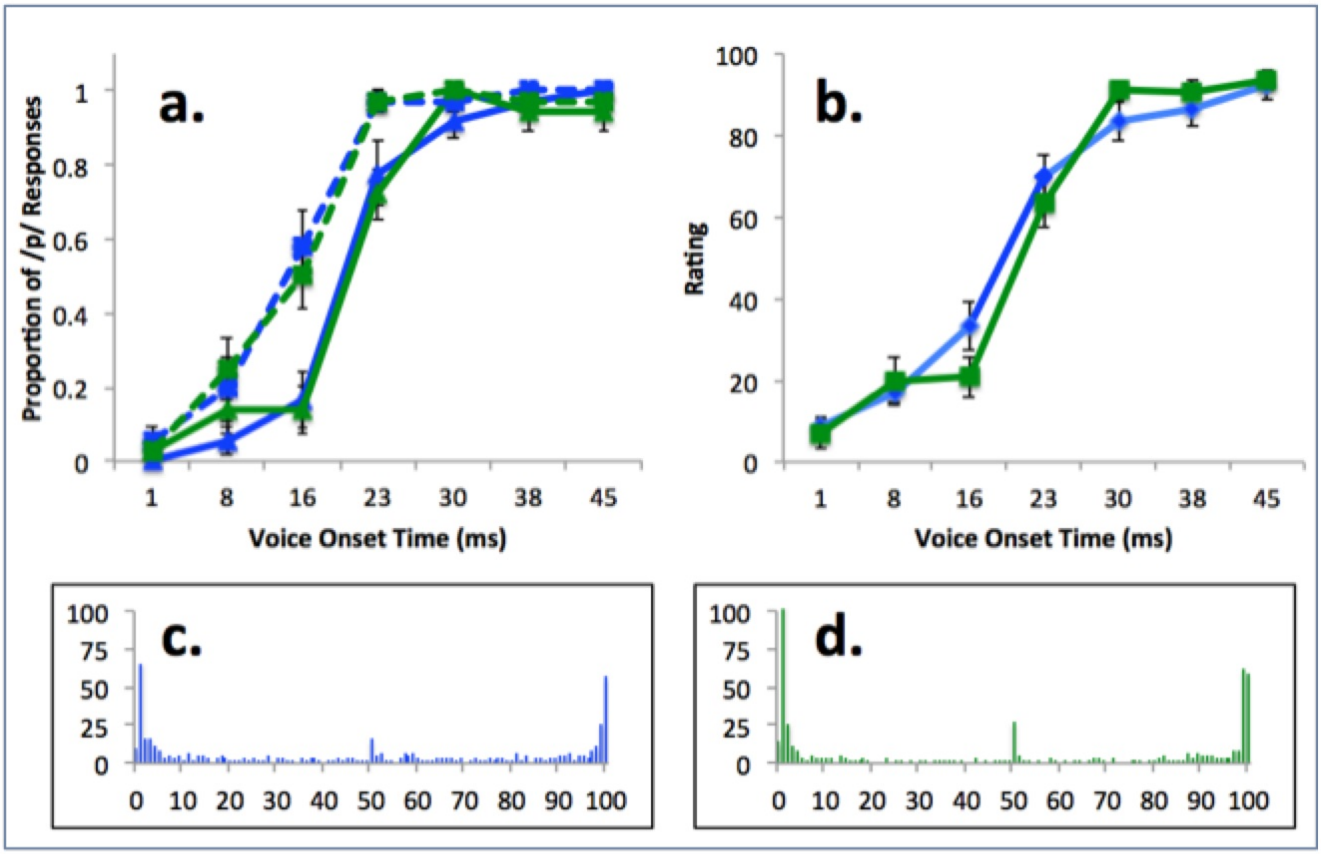


Figure 1. (a) Proportion of /p/ responses in the 2AFC task; blue = TD, green = ASD. Solid lines indicate a fundamental frequency of 90 Hz, and dashed lines indicate a fundamental frequency of 125 Hz. (b) Ratings on the VAS task, with more /p/-like judgments toward 100. Histograms of VAS ratings for the TD (c) and ASD (d) groups, showing the similar distributions of judgments.

68 **164.068** Assessing the Relationship Between Verbal Ability and Problem Behavior Among Children with Autism Spectrum Disorder

K. A. Smith[1,2], *A. Stedman*[1] *and M. Siegel*[3], *(1)Maine Medical Center Research Institute, Portland, ME, (2)Tufts University School of Medicine, Boston, MA, (3)Maine Medical Center Research Institute - Tufts School of Medicine - Spring Harbor Hospital, Westbrook, ME*

Background:
The verbal ability of children with Autism Spectrum Disorder (ASD) is an important criterion for clinicians in selecting treatment strategies for problem behaviors. Available research literature has, to date, offered conflicting evidence on the relationship of verbal ability and problem behaviors in children with ASD, with varying results by age and ASD severity. There is also preliminary evidence that self-injury and aggression/tantrums, which are typically lumped together in treatment trial measurement, may have differential responses.
Objectives:
To analyze the relationship between verbal ability and the type, severity and frequency of problem behaviors, and to explore for potential variation of this relationship within models using the Aberrant Behavior Checklist – Irritability subscale (ABC-I) Self-Injurious Behavior (SIB) and Tantrum Behavior (TB) subdomains.
Methods:
Seventy-eight children and adolescents with ASD admitted to a specialized inpatient psychiatry unit were prospectively enrolled and a consistent parent was administered the ABC-I at admission, discharge, and 2-month follow-up. The subject's verbal ability was coded as non-verbal, limited verbal, or fluent verbal by a speech-language pathologist based upon caregiver information and extensive direct observation. Type and frequency of problem behaviors (i.e., aggression, self-injury, and tantrums) were recorded every 15 minutes by direct care staff. Model testing was conducted using multi-level models repeated measure analyses to examine differences in problem behaviors by verbal ability groups. Covariates included in the model were age, sex, intellectual disability, length of stay, number of behaviors of clinical concern, and number of medications.
Results:
A majority of the subjects were Caucasian (91%) males (81%) averaging 12.4 years old (*SD*=3.42, range=6-20) with fluent verbal ability (55.1%), limited verbal ability (26.9%) or non-verbal (17.9%) status. Forty-five percent of subjects had Intellectual Disability (ID) and the average length of inpatient stay was 52.27 days (*SD*=29.41, range=8-174). A significantly lower proportion of subjects with fluent verbal ability had intellectual disability (p=0.049), had a shorter length of stay (p=0.002), presented with fewer behavioral problems (p=0.027) and engaged in fewer self-injurious behaviors (SIB) (p=0.001) and pica (ingesting non-food objects) (p=0.001) than non-verbal and

limited verbal groups. Parents reported a significant decrease in their child's overall problem behavior between admission, discharge and 2-month follow-up, (see Table 1 for complete model results), though this difference did not significantly vary between verbal ability groups, (see Figure 1). Examination of the ABC-I SIB subdomain indicated a significant effect for both time (admission and discharge only) and by verbal ability group with fluent verbal patients having significantly less SIB compared to non-verbal patients (p<0.001). The ABC-I TB subdomain indicated a significant effect for time only (all three time points), p<0.001.
Conclusions:
Findings suggest that children in a specialized inpatient psychiatry unit reported a significant reduction in their child's overall problem behavior on the ABC-I from admission to 2-months post-discharge, regardless of the child's verbal ability. There appears to be important differences, however, in the response of self-injurious behavior based on verbal ability, which are not seen in the aggression/tantrum behaviors. Change in the SIB subdomain of the ABC-I is significantly affected by verbal ability.

69 **164.069** Association of Atypical Communication Characteristics with Psychiatric, Social, and Academic Functioning in Clinic-Referred Children with and without Autism Spectrum Disorder

***E. Kang**, M. D. Lerner and K. D. Gadow, Stony Brook University, Stony Brook, NY*

Background:
Children with autism spectrum disorder (ASD) experience a variety of atypical communication characteristics (ACC), such as echolalia, odd pitch, and pragmatic difficulties, which play a significant role in life adjustment. Although it is well established that ACC are associated with emotional and behavioral problems in non-ASD clinic-referred youth (Baker & Cantwell, 1987), little is known about their relation in children with ASD, despite common psychiatric comorbidities in children with ASD (Gadow et al., 2005). Of equal or greater interest is the relation between ACC and psychiatric symptoms across ASD and non-ASD populations, and how most common ACC in ASD influence functional outcomes.
Objectives:
This study explored the association of ACC with psychiatric symptoms in clinic-referred children with and without ASD, and of specific ACC with social and academic functioning in those with ASD.
Methods:
Clinic-referred children (6-18 years) with (N=283) and without (N=724) ASD were assessed with a well-validated parent-report questionnaire of psychiatric symptoms, ACC, and social (peer relations) and school functioning (i.e., special education, inclusion classroom).
Results:
Rates of ACC are summarized in Table 1. Bonferroni-corrected chi-square tests revealed higher rates of specific types of ACC in ASD versus non-ASD groups (p<.001). When analyses were confined to the youth with ACC, those with ASD evidenced higher rates of nonverbal behavior, speech delay, repeating words, echolalia, odd tone of voice, and pragmatic difficulties (p ≤.005). ROC results revealed an AUC=0.69 (p<.001) for pragmatic difficulties, followed by speech delay, repeating words, echolalia, perseveration, and odd voice (all AUC≥.559, p≤.026).
Two-way ANOVAs revealed interactions between group (ASD, non-ASD) and global ACC (present, not present) in predicting ADHD (p≤.007) and ASD (p≤.019) symptoms, with increasing severity with higher ACC in the ASD group. Controlling for age, gender, and IQ yielded same pattern of results.
We conducted moderation analyses of specific ACC shown in our ROC analyses to distinguish ASD from non-ASD groups in predicting ADHD and ASD symptoms. There were significant (all p<.05) interactions between ASD status and repeating words in predicting ADHD inattention and all ASD symptom domains; perseverative speech in predicting ADHD hyperactive-impulsive and ASD repetitive symptoms; speech delay in predicting ASD communication; echolalia in predicting all ASD domains; and odd voice predicting ASD communication and repetitive behavior. Post-hoc analyses revealed such associations *only* in the ASD sample (all B≥1.21, p≤.03 vs. all p>.07 in non-ASD).
In the ASD sample, we examined associations of specific ACC with functional outcomes: speech delay with intellectual disability (r=.22, p=.001), being in inclusion classroom (r=.31, p<.001), dominating play (r=.28, p<.001), having a best friend (r=-.15, p=.019) and wanting friend (r=-14, p=.039). Repeating words was associated with inclusion classroom (r=.18, p=.006). Echolalia was associated with intellectual disability (r=.24, p<.001), being in inclusion classroom (r=.22, p=.001), having any friend (r=-.18, p=.009) and wanting friend (r=-14, p=.044). Odd voice was associated with difficulty relating to peers (r=.16, p=.02).
Conclusions:
ACC are associated with more severe psychiatric symptoms and social and academic difficulties, and relations differ from non-ASD referrals. Results have implications for both clinical management and nosology.

Table 1

Rates of Current Atypical Communication Characteristics

	ASD sample (*N*=283)	Non-ASD sample (*N*=724)	Between-group differenes (χ^2)		Effect size (*d*)	
(F/%)			Total[a]	Sub-sample[b]	Total[a]	Sub-sample[b]
Global	264 (93.3)	282(39.0)	242.01*		1.13	
Nonverbal	31 (14.0)	15 (2.1)	51.94***	13.62***	.48	.34
Babbling	22 (9.9)	18 (2.5)	22.95***	3.04	.32	.16
Speech Delay	78 (36.3)	35 (4.8)	147.41***	44.24***	.86	.63
Repeating Words	83 (37.2)	50 (6.9)	129.78***	31.38***	.78	.52
Echolalia	52 (23.3)	30 (4.1)	79.25***	18.61***	.60	.40
Neologism	29 (13.0)	21 (2.9)	34.80***	5.88*	.39	.22
Pronoun Reversals	35 (15.8)	31 (4.3)	34.53***	3.92*	.39	.19
Stammering	19 (8.5)	11 (1.5)	27.24***	5.99*	.34	.22
Perseveration	116 (52.0)	128 (17.7)	105.10***	6.23*	.71	.23
Odd Voice/Monotone	53 (23.8)	18 (2.5)	111.33***	36.44***	.73	.57
Lecturing	54 (24.4)	57 (7.9)	44.80***	2.83	.45	.15
Pragmatic Difficulties	161 (72.2)	117 (16.2)	258.15***	67.75***	1.22	.80
Facial Affect	51 (23.0)	42 (5.8)	56.52***	7.97**	.50	.26

* $p<.05$; ** $p<.01$; *** $p<.001$.

[a] Between-group differences (ASD, non-ASD) in the total sample (*N*=1,007).

[b] Between-group differences (ASD, non-ASD) in the sub-sample with current ACC (*N*=546).

70 **164.070** Attempt of Training Basic-Set of Communication with Small Humanoid Robot for Autism Spectrum Disorder

T. Onishi[1], *Y. Yoshikawa*[2], *H. Kumazaki*[3], *Y. Matsumoto*[4] *and H. Ishiguro*[2], *(1)Center for Special Needs Education, Nara University of Teacher Education, Nara, Japan, (2)Osaka University / JST ERATO, Osaka, Japan, (3)University of Fukui Research Center for Child Development, Yoshida-gun, Japan, (4)National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan*

Background:

One of the most important distinction on children with Autism Spectrum Disorder(ASD) is communication disability. Many of them lack eye-contact and joint attention, besides they don't pay attention and don't show interest to conversation partners. Their difficulty is responsible for a surfeit of information. They don't know where and what to watch during conversation.

A small humanoid robot, CommU, is expected to be recognized as a friendly and less-obtrusive interlocutor of the subjects due to its cute and moderately humanlike embodiment. It can produce verbal and nonverbal signals to engage in conversation with subjects by the tele-operation method based on the predefined scripts. CommU has a possibility of resolving this problem; it has a very simple appearance, shows less emotion, deals with others always in same way, and it has an obvious novelty.

We hypothesized that after practice of conversation with robot children's basic attitude toward person would be improved.

Objectives:

The objective is to ascertain the prediction that having interaction with a small humanoid robot would improve their basic-set of communication.
Methods:
10 boys with high functioning ASD, aged between 4 and 10 (mean age=6.13, IQ≧70) were randomly assigned to two groups. Three conditions were set; Room A=Human A, Room B=Human B, and Room C= Robot(CommU). Group 1 visited three rooms in order of 'HumanA - Robot - HumanA', and the order of Group 2 was 'HumanA - HumanB - HumanA'. In each room children had to talk with human or robot according to programed scenarios including communication tasks. All sessions were recorded by 3 videos which were located in different corner of the room.
Results:
First, four target behaviors were evaluated; Smile, Nodding/ Showing interest, Eye-contact, and Synchronizing with partner by listening music. Second, records of gaze following task were analyzed. About these results, Group 1 and Group 2 were compared for the purpose of excluding an effect of habituation.
There was no change in Group 2(HumanA - HumanB - HumanA) , on the other hand, in Group 1 'Nodding' and 'Synchronizing' increased at the third session [Nodding: $T(10)=-2.27$, $p<.05$; Synchronizing: $T(10)=-2.23$, $p<.05$)]. Gaze following was increased at the second session of Group 1 [$T(10)=3.07$, $p<.05$] though Group 2 didn't show any change.
Conclusions:
This study shows that conversation practice with robot has potential to improve the basic-set of communication of ASD. There are some factors listed; first, the novelty of robot raised their arousal level. Second, some listening skills formed because children had to adjust themselves to robot. Moreover, 70% of subjects responded that the conversation with robot was more fun and more strained. From these results, it is expected that they can face on the training with apposite feeling and arousal level.

71 **164.071** Auditory Responding to Joint Attention Skills and Language in Toddlers with Autism, Other Developmental Difficulties, and Typical Development

S. E. Vogt, *R. Bakeman, K. Suma and L. B. Adamson, Psychology, Georgia State University, Atlanta, GA*

Background: Joint attention skills, especially responding to bids for joint attention (RJA), are pivotal to language development. RJA skills are often compromised by autism spectrum disorder (ASD) even if a child with ASD begins to acquire language. RJA is usually assessed using multimodal bids for joint attention (RJA-M). Here we also assess responses to *auditory* bids for joint attention (RJA-A)—bids that rely solely on saying the child's name and labeling the target. Contrasting responses to multimodal and auditory bids can help clarify further the early relationship between joint attention skills and language.
Objectives: Our aim is to document how toddlers with ASD, other developmental difficulties (DD), and typical development (TD) respond to auditory and multimodal joint attention bids and to determine if preverbal children can respond to these bids.
Methods: 53 toddlers (mean age=22.5 months) participated: 18 with ASD, 24 with DD, and 11 TD. Joint attention skills were assessed using the Joint Attention Scales-Auditory (JAS-A) that includes 3 RJA-M trials adapted from the Early Social Communication Scales (Mundy et al., 2003) and 3 new RJA-A trials. In each trial, the examiner bids for joint attention twice to one of 6 target (pictures or toys with names that most 12-month olds understand according to the MacArthur Communication Development Inventory [MCDI; Fenson et al., 1993] norms). In RJA-M trials, the examiner says the child's name and then shifts gaze and points at the target; In RJA-A trials, she says his name and labels the target (e.g., "There's a ball!"). A pass indicated that the child responded by seeking the target. Children were categorized as preverbal if their parent reported 10 or fewer words on the MCDI.
Results: The percentage of children passing at least 2 of the 3 trials for RJA-M was 100%, 75%, and 22% and for RJA-A trials was 45%, 21%, and 17% in the TD, DD, and ASD groups, respectively (see Figures). Thus children in the TD and DD groups did significantly better on multimodal than auditory trials, with little difference for children with ASD. No TD children were preverbal. For children with DD, the odds of failing all multimodal trials was 8.50 times greater when children were preverbal and 12.0 times greater for auditory trials. For children with ASD, there was essentially no effect; corresponding odds ratios were 1.11 and 0.60, respectively.
Conclusions: Our results replicate previous studies that document an RJA deficit to multimodal bids in ASD. They also demonstrate that paring down bids so that they are solely auditory heightens their difficulty, even for TD two-year-olds who readily follow multimodal bids. Children with DD who are preverbal were less likely to follow multimodal and, even more so, auditory bids, suggesting that language delays may be affecting RJA. But the link between RJA and emerging language was less clear in ASD: regardless of language status, toddlers in the ASD group performed relatively poorly, suggesting that a core JA difficulty, not a language difficulty, might be paramount. Implications for intervention are discussed.

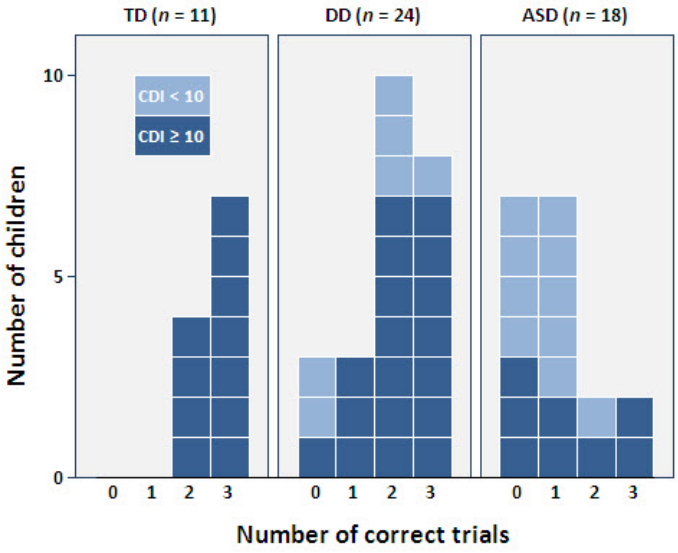


Figure 1. Number of children responding to 0, 1, 2, and 3 multimodal RJA trials for each diagnostic group.

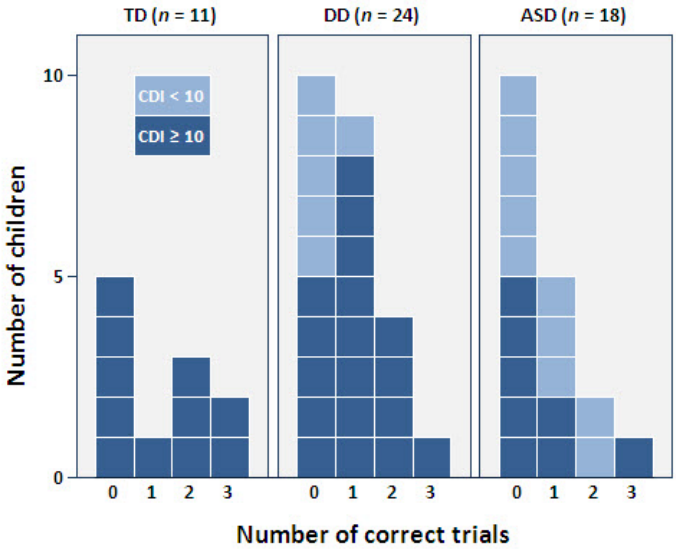


Figure 2. Number of children responding to 0, 1, 2, and 3 auditory RJA trials for each diagnostic group.

72 **164.072** Autism Severity and Language Improvements Using a Social Engagement Intervention for Toddlers with ASD

A. Barrett[1], *T. Vernon*[1], *A. Navab*[2], *J. Ko*[3], *J. Bradshaw*[4], *E. J. Horowitz*[1], *T. German*[1] *and R. L. Koegel*[1], *(1)University of California, Santa Barbara, Santa Barbara, CA, (2)University of California Santa Barbara, Los Angeles, CA, (3)Koegel Autism Center, University of California Santa Barbara, Santa Barbara, CA, (4)Marcus Autism Center, Emory University, Atlanta, GA*

Background: Early language learning is strongly dependent upon the frequency and consistency of social interaction and engagement (Kuhl, 2015). Young children with autism demonstrate significant vulnerabilities in early engagement skills, such as social orienting and joint attention behaviors, which are found to be significant predictors of later language ability (Dawson et al., 2004). It is logical that early autism interventions that prioritize social interaction and engagement over the use of repetitive learning paradigms will result in superior improvements in core areas of development, including language acquisition. Research suggests that early interventions that integrate social elements into reinforcement paradigms can dramatically improve collateral levels of interpersonal engagement (Vernon, 2014; Vernon et al., 2012; Koegel et al, 2009). This study will report on the status of ongoing research efforts to optimize social engagement between adult and child as a means to bolster receptive and expressive language communication skills in children with autism.
Objectives: The study's objective was to evaluate the effectiveness of this 6-month social engagement intervention as an effective means for targeting social engagement and language skills.
Methods: Participants were 10 toddlers (ages 18-48 months) with ASD who had completed an ongoing randomized controlled trial. Participants were age-matched and randomly assigned to treatment or waitlist conditions. The active treatment group received early intervention using a modified Pivotal Response Treatment paradigm in which language efforts were reinforced using engaging social activities derived from each child's pre-existing (but non-social) interests. Comprehensive developmental assessment batteries were completed to thoroughly characterize participants and assess treatment effects. The measures of interest used for this preliminary investigation included the Autism Diagnostic Observation Schedule-2 and Mullen Scales of Early Learning. A multivariate analysis of variance test was conducted to assess for differences in autism symptom severity and language abilities between groups at post time-points.
Results: The treatment group demonstrated significant decrease in autism symptom severity (ADOS Social Affect and Restricted Repetitive Behaviors Score: pre = 16.2, post= 10.6) compared to the waitlist control group (pre=15.4, post=15.2; p=.036). Additionally, participants in the treatment condition demonstrated significant improvements on standardized language assessments in comparison to waitlist controls. Significant improvements in receptive language skills were evidenced in the treatment group (Mullen Receptive Language t-score: pre=35.4, post=52.0) that were not replicated in the waitlist group (pre=28.4, post=28.4; p=0.030), The treatment condition also demonstrated a trend toward improvement in expressive language (Mullen Expressive Language t-score pre=32.6, post=39.2) that was not observed in the waitlist condition (pre=28.8, post-test=28.8), although this finding was not significant given the preliminary nature of the data and small n.
Conclusions: Study results suggest that toddlers receiving an embedded social-reinforcement intervention demonstrate significant improvements in receptive and possibly expressive language skills not observed in wait-list controls. It also suggests that overall autism symptom severity can improve dramatically after six months of engaging intervention that combines their pre-existing interests with social elements. These preliminary findings suggest that efforts to target social engagement in a larger cohort of children with autism may have similar transformative effects to early single subject design empirical findings.

73 **164.073** Can Children with ASD Learn Language through Overhearing?

R. Luyster[1] *and S. Arunachalam*[2]*, (1)Communication Sciences and Disorders, Emerson College, Boston, MA, (2)Dept. of Speech, Language & Hearing Sciences, Boston University, Boston, MA*

Background: Much of the literature on language learning in children has focused on 'child-directed speech' – language directly addressed to a child. However, cross-cultural research has indicated that children do not REQUIRE child-directed speech in order to learn new words (Ochs & Schieffelin, 1984), and laboratory-based research has confirmed that young children learn new words via overheard speech (Akhtar et al., 2001). This is a valuable observation, because it highlights the extent to which children are very skillful at 'mining' their environment for useful language input, making good use of information that may not be provided explicitly for their benefit.
Children with autism spectrum disorder (ASD) often have language delays, but some children with ASD do not (Kjelgaard & Tager-Flusberg, 2001). We hypothesize that the ability to learn language through overhearing may help to explain why some children develop language faster than others: a child with ASD who is capable of learning via overheard speech has access to much larger set of useful language input than a child with ASD who is not capable of learning via overheard speech. Given previous findings associating *quantity* of adult language input with language and communication development for both typically developing children (Hart & Risley, 1995) and those with ASD (Warren et al., 2009; Bang & Nadig, 2015), these invididual differences may help to explain the variability in language ability for children with ASD.
Objectives: This pilot study serves as a first step in exploring the role of overhearing in language learning for children with ASD; the immediate objective was to address whether overheard language is 'accessible' for children with ASD.
Methods: This pilot study included two preschoolers with ASD (aged 4;3 and 4;6); diagnosis was confirmed using the Module 2 of the ADOS-2 (both children were speaking in phrases). Each child completed a within-subject quasi-experimental design (from Akhtar et al., 2001), comprised of two word-learning training conditions and subsequent test trials. In the 'addressed' training condition, children were directly addressed by an experimenter, who introduced a novel label for a new toy. In the 'overheard' training condition, the experimenter instead addressed a second experimenter, offering a second new label for a different toy (while the child with ASD was seated across the room). After the training conditions were complete, the child's comprehension of each novel label was tested. The primary question was whether the children were able to learn the new word in the 'overheard' training condition.
Results: Both children were successful at learning new words in the 'addressed' condition, as well as in the 'overheard' condition.
Conclusions: These preliminary results suggest that some children with ASD are capable of monitoring the conversations of others in order to learn new words. The extent to which children are able to do this could be a variable of interest in explaining heterogeneity of language development. In the upcoming months, we will enroll additional participants (estimated N=36) and include additional measures of social communication and language to better understand the correlates of this language-learning capability.

74 **164.074** Changes in Parenting Stress As a Predictor of Treatment Outcome

D. Swain[1]*, G. W. Gengoux*[2]*, M. B. Minjarez*[3]*, A. Y. Hardan*[4] *and A. Scarpa*[5]*, (1)Virginia Tech, Blacksburg, VA, (2)Psychiatry and Behavioral Sciences, Stanford University School of Medicine, Stanford, CA, (3)Seattle Children's Hospital, Seattle, WA, (4)Stanford University, Stanford, CA, (5)Psychology, Virginia Polytechnic Institute and State University, Blacksburg, VA*

Background: Social communication impairment is a hallmark characteristic of ASD that may manifest in delayed acquisition and use of functional language. These communication difficulties not only impact the individual (e.g. inability to express needs) but also caregivers. More specifically, parents of children with ASD have reported elevated levels of stress, in comparison to parents of typically developing children as well as parents of children with developmental disabilities. In addition, parent involvement in child directed therapies have become nearly commonplace, which results in increased amounts of time and resources on their child (e.g. therapy involvement, appointments, problem behaviors), leaving little time for them to focus on their own emotional and psychological needs. Several treatment studies have begun to target parent well-being and stress separately; however, it is important to note that multiple studies targeting specific parent characteristics correspond with increased levels of dropout rates. Pivotal Response Treatment (PRT) is an empirically based, naturalistic therapeutic approach that teaches parents how to elicit language for minimally verbal children with ASD. Previous studies by our group have demonstrated significant parent gains in treatment implementation as well as child gains in functional language skills through a group format. However, while improvement was noted, parenting stress remained at elevated levels during post treatment assessment. An important first step to understanding the relationship between parent stress and child outcomes is examining the change in parent stress over the course of treatment and its effects on treatment outcome (e.g. spontaneous child language).
Objectives: This study evaluated the predictive nature of parent stress in relation to the parent-child relationship on the amount of spontaneous words produced during a Structured Laboratory Observation (SLO). Parents participated in a randomized controlled trial who were randomly assigned to either PRT group or parent psychoeducation control group.
Methods: 27 parents of children with ASD between the ages of 2.3 and 6.5 (M= 4.2, SD = 1.2) participated in a 12-week group PRT parent training to target child language. Parents completed the Parenting Stress Index, Short Form at baseline and week 12 of the training. Children's frequency of spontaneous language was scored during SLO, which took place under standard conditions. Parents were instructed to elicit child language during a 10-minute period of time.
Results: A percent change score in parent stress related to dysfunctional parent-child relationship was computed for all parents who completed the PSI-SF at baseline and week 12. While controlling for age and gender, the change score in parent stress remained as a significant predictor of SLO spontaneous language for children at week 12 ($B = -2.793$, $p = .033$) and uniquely accounted for 19.2% of the variance in child spontaneous language at week 12.
Conclusions: Grounding parent-focused strategies squarely within a child intervention may increase levels of retention while still addressing important parental difficulties such as stress. Overall, the need for a treatment to concomitantly target parent and child difficulties appears to be imperative.

75 **164.075** Comparing Structural and Pragmatic Language Abilities in Subgroups of ASD Children with and without Comorbid Intellectual Disability

A. Whitten[1] *and J. W. Bodfish*[2]*, (1)Vanderbilt University, Nashville, TN, (2)Vanderbilt University School of Medicine, Nashville, TN*

Background: Currently, the general consensus is that structural features of language (e.g., syntax, phonology) are intact while the social use of language, referred to as pragmatic language, is universally impaired in ASD. However, most of the research on language impairment in autism has been restricted to high-functioning individuals with autism. Consequently, it is not known whether a comorbid intellectual disability further affects language impairment in low-functioning individuals, and thus may require more extensive interventions. Furthermore, studies that directly compare structural and pragmatic language are necessary to advance knowledge of the language phenotype within all of ASD.
Objectives: We aimed to compare both structural and pragmatic aspects of language across three groups: low functioning children with ASD (LFA), high functioning children with ASD (HFA), and an age-matched typically developing group (TD).
Methods: Using the Children's Communication Checklist-2 (CCC-2), we compared mean scores between LFA (n=15, Nonverbal IQ < 80, mean age = 12 years, range = 5 – 17 years), HFA (n=57, Nonverbal IQ > 80, mean age = 10 years, range = 6 – 17 years), and TD (n=52, mean age = 11 years, range = 6 – 17 years). We used one-way ANOVAs with planned post-hoc tests across 4 subscales measuring structural language (Speech, Syntax, Semantic, Coherence) and 4 subscales measuring pragmatic language (Initiation, Scripted Language, Context, Nonverbal Communication).
Results: There was a significant main effect of group for all four structural language subscales ($F(2, 21)$ = Speech: 18.75, Syntax: 49.49, Semantic: 93.34, Coherence:101.80, all $p < .001$). Post hoc Tukey tests revealed the same pattern for all four structural subscales ($p < .001$), such that there were no significant differences between LFA and HFA, while both LFA and HFA groups scored significantly lower than TD. This same pattern was replicated across all four pragmatic subscales, with a main effect of group ($F(2, 66)$ = Initation: 61.32, Scripted Language: 64.58, $F(2, 121)$ = Context: 175.04, Nonverbal Communication: 170.12, all $p < .001$). Again, post hoc Tukey tests showed no significant differences between LFA and HFA, with both LFA and HFA scoring significantly lower than TD. Pearson correlations between IQ and structural and pragmatic CCC-2 subscales found no significant associations, with one exception. The pragmatic subscale 'Context' was significantly associated with IQ within the LFA group only ($r = 0.60$, $p < .05$).
Conclusions: We found evidence that the language deficits do not differ between LFA and HFA groups. Furthermore, our results refute the idea that structural features of language are spared in ASD, as both LFA and HFA groups tended to score well below the TD group on all structural language subscales. Our results suggest that future studies on language impairment in ASD should no longer exclude low functioning individuals, and examine both structural and pragmatic aspects of language; such research will be vital to improving language interventions in ASD, especially for children with ASD whose language deficits do not respond to intervention.

76 **164.076** Comparison of Two Speech Therapies for Minimally Verbal Children with Autism

K. V. Chenausky[1,2] *and G. Schlaug*[3]*, (1)Neurology, Beth Israel-Deaconess Medical Center, Boston, MA, (2)Brain and Psychological Sciences, Boston University, Boston, MA, (3)Beth Israel Deaconess Medical Center, Boston, MA*

Background: Up to 25% of children with autism remain minimally verbal past the age of 5. Inadequate communication skills are related to challenging behaviors such as aggression, self-injury, and property destruction (Dominick et al., 2007; Matson et al., 2009). Thus, it is vital for children with minimally verbal ASD (MV ASD) to acquire at least some spoken language.
Objectives: We report on a comparison of two interventions to teach minimally-verbal children with autism their first words. One, Auditory-Motor Mapping Training (AMMT), aims to promote speech production directly by training the association between sounds and articulatory actions using intonation and bimanual motor activities. The other, Speech Repetition Therapy (SRT), is a traditional therapeutic approach involving neither musical intonation nor bimanual motor activity.
Methods: Minimally verbal children with autism between the ages of 5 and 9 years of age were treated with either AMMT (n=23) or SRT (n=7). Inclusion criteria included a

diagnosis of autism and the ability to imitate at least 2 speech sounds. Exclusion criteria included other known neurological conditions and use of more than 20 words or word approximations functionally. Therapy consisted of 1-hour sessions, five days per week for 25 sessions. Probe assessments were conducted periodically during baseline, therapy, and post-therapy follow-up sessions to assess children's speech production on a set of 15 trained two-syllable words and a set of 15 untrained two-syllable words.
Results: Two-way mixed-measures ANOVAs showed that number of consonants correct, vowels correct, CV syllables correct, and CV syllables approximately correct all improved significantly with therapy (all $p < .01$). Trained words showed significantly more consonants correct, CVs correct, and CVs approximately correct than untrained words (all $p < .005$). Both types of therapy resulted in statistically similar magnitudes of improvement; however, children receiving AMMT showed steeper improvement trajectories.
Conclusions: Both AMMT and SRT resulted in significant improvement in speech production and in children's ability to produce or approximate the pronunciation of two-syllable words. Because these children had no or minimal vocal output prior to treatment, the acquisition of speech sounds and word approximations through therapy represents a critical step in expressive language development in children with autism. Participant factors associated with therapeutic success will be discussed, as will changes in speech production ability associated with therapeutic progress.

77 **164.077** Family Experiences in Bilingual Children with Autism Spectrum Disorder (ASD)

K. Jalalian[1], *K. Oshiro*[2], *M. Lorch*[3], *S. J. J. Webb*[4], *N. Navot*[4], *S. Ghods*[5], *S. Corrigan*[6] *and K. Toth*[6], *(1)Seattle Children's Research Institute, Auburn, WA, (2)University of Washington Autism Center, Seattle, WA, (3)Birkbeck, University of London, London, United Kingdom, (4)University of Washington, Seattle, WA, (5)Seattle Children's Research Institute, Issaquah, WA, (6)Seattle Children's Research Institute, Seattle, WA*

Background: Many parents of children with autism spectrum disorders (ASD) have been discouraged by clinicians and medical practitioners from exposing their child to more than one language (Wharton et al., 2000; Kremer-Sadlik, 2005; Jegatheesan, 2011; Yu, 2013). Four studies have explored the relationship between multiple language exposure and language development in children with ASD (Hambly & Fombonne, 2012; Ohashi et al, 2012; Peterson et al., 2012; Valicenti-McDermott et al., 2012). All rejected the claim that multiple language exposure has an adverse effect on language and social development for children with ASD. Whereas bilingual children with ASD are more likely to vocalize and utilize proto-imperative gestures than monolingual counterparts (Valicenti-McDermott et. al, 2012), and have larger total production vocabularies (Peterson et al., 2012), with similar patterns to typically developing bilingual children (Pearson et al., 1993). Furthermore, non-native English parents elicit greater responsiveness from their children when communicating in their native language then in English (Wharton et al., 2000). To date, there is a lack of data regarding the effect of advice on language choices to bilingual parents of children with ASD.
Objectives: We investigated the relationship between language environments and the impact of family dynamics on language choices based on the advice given by health and educational professionals in diagnosed bilingual children with ASD.
Methods: Preschool aged children with ASD (N=13) averaging from 24-60 months from bilingual families were selected for this study. The study included a standardized observational testing for social interaction, communication and autism severity (ADOS), nonverbal (visual) reasoning (Mullen Scales of Early Learning) and expressive and receptive language (Preschool Language Scale IV). Measures were repeated at three time points in English. Parents answered 25-questions for the Family Experience Bilingual Questionnaire regarding their child's ASD diagnosis, language choices and ability in both languages, and advise regarding bilingualism four years after their initial entry to the study.
Results: Bilingual parents with children with ASD expressed three common concerns: language and social development and behavioral issues. Their children had different levels of exposure in both languages, beginning their first year of 71% English and 28% non-English and current exposure as 78% English vs. 20% non-English. Parents reported anxiety over their language choices, leading to consultation with professionals and peers. This consultation process was often uninformative: 66% of parents received no recommendation, while 17% of the families were encouraged, and 17% discouraged about bilingualism. Overall, parents who raised their child bilingually reported positive experiences, while parents who raised their child monolingually reported negative experiences specifically, family relationships and dynamics.
Conclusions: While evidence suggests that bilingual children with ASD have similar language development in comparison to monolingual children with ASD, parents reported a lack of advice from professionals on language choices. Specifically parents that raised their child bilingually reported more positive experiences than their monolingual counterparts because of the maintenance of communication and cultural exchange with extended family members. Supporting families in maintaining more than one language, even if English is the dominant language, is critical in supporting social skills and family relationships.

78 **164.078** Differences in Caregiver Behaviors of Infants at Risk for Developing Autism and Typically Developing Infants during an Object Sharing Paradigm

S. Srinivasan[1], *T. Nguyen*[2], *M. Hoffman*[2], *A. Dinar*[2], *M. Pugliese*[2], *M. Kaur*[1] *and A. N. Bhat*[1], *(1)University of Delaware, Newark, DE, (2)Physical Therapy, University of Delaware, Newark, DE*

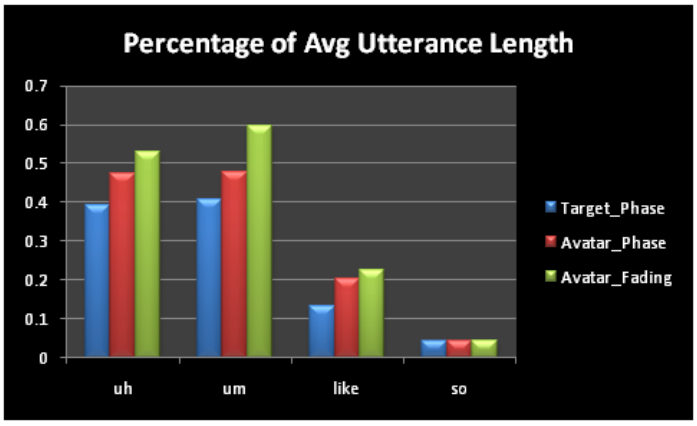
Background:
Towards the end of first year, infants begin to share object play with their caregivers through pointing, showing, and giving (Bakeman & Adamson, 1984). Advancements in infants' perceptuo-motor skills and onset of walking lead to a surge in object sharing skills. Advances in infants' motor and social development may influence the way caregivers interact with their infants, which in turn may further influence infant behaviors. Our previous work shows that infants at risk for developing Autism Spectrum Disorder (ASD) (i.e. infant siblings of children with ASD or AR infants) demonstrated poor object sharing skills compared to typically developing (TD) infants over the first 15 months of life.
Objectives:
In the current study, we explored differences in caregiver behaviors between TD and AR infants during an "object sharing" paradigm. We were specifically interested in the differences in caregiver proximity/social distance, verbalizations, and gestural use as they communicated with their infant.
Methods:
16 AR infants and 16 TD infants were observed during an object sharing task at 9, 12, and 15 months with developmental follow-up and autism screening at 18 and 24 months. Infants were provided a set of standard toys to play with in the presence of their caregivers and played spontaneously or with caregiver reinforcement. We coded for the caregivers' social distance, gestures, and verbalizations. Specifically, we coded all instances of caregiver initiated proximity-seeking behaviors. In terms of caregiver gestures, we coded for rates of object-directed, attention directing, reinforcing, requesting, and grabbing behaviors. Lastly, in terms of caregiver verbalizations, we coded for rates of directives, prohibitions, reinforcements, and attention-seeking phrases used.
Results:
Caregivers of AR infants engaged in greater rates of proximity-initiating behaviors (0.84 ± 0.76) compared to caregivers of TD infants (0.22 ± 0.21, $p = 0.008$) at 15 months. In terms of gestural use, caregivers of AR infants demonstrated greater rates of grabbing objects compared to TD caregivers ($p = 0.03$) at 15 months. In terms of verbalizations, caregivers of AR infants (12 months: 0.66 ± 0.24, 15 months: 0.72 ± 0.24) used greater directives, attention-seeking phrases, and prohibitions at 12 and 15 months compared to caregivers of TD infants (12 months: 0.50 ± 0.14, 15 months: 0.46 ± 0.13, $p$values < 0.03).
Conclusions:
There were significant differences in the way caregivers of AR infants interacted with their infants compared to caregivers of TD infants. These differences in caregiver behaviors stem from the different social cues offered by AR infants and may differentially contribute to the future motor and social development of AR infants. Future studies should test this hypothesis by examining the effects of reduced versus excessive caregiver scaffolding on future outcomes of infants at risk for developing ASD.

79 **164.079** Discourse Marker Usage in School-Aged Children with ASD and ADHD in a Virtual, Public Speaking Task

N. S. Alpers-Leon[1], *L. Naigles*[2], *N. S. McIntyre*[3] *and P. C. Mundy*[4], *(1)University of Connecticut, Vernon, CT, (2)University of Connecticut, Storrs, CT, (3)University of California at Davis MIND Institute, Davis, CA, (4)Education and Psychiatry, University of California at Davis, Sacramento, CA*

Background: There has been little previous research regarding usage of discourse markers (DM's), small words which not only 'glue' conversational utterances together (e.g.,'so', 'like', 'uh', 'um'; Shiffrin, 1988) but also signal to an interlocutor that a conversational turn is not finished (Kam & Edwards, 2008.) DM's may also signal a disfluency (Arnold et al., 2007) that can affect the way a listener will interpret what is to come next in the conversation and perhaps the way they judge the speaker. Previous research found that children with ASD produce 'uh' but not 'um' (Canfield et al., in press) suggesting that 'um' may be more social in nature as children with ASD experience social impairment.
Objectives: This study examined children's language during a virtual reality public speaking task, designed for use with school-aged children with HFA. Language use was assessed across conditions that varied in social and non-social context, as well as higher versus lower attention demands.
Methods: 98 children aged 8-16 are currently participating in a longitudinal study of attention, social, and academic development in children with HFA. Data are presented on 21 HFA, 22 TD, 24 ADHD, and 31 comorbid children Age- (Ms = 11.60, 12.45, 11.93, 12.12 respectively) and Verbal IQ- (Ms= 96, 111, 97,and 96 respectively) matched participants. Children viewed a virtual classroom through a head-mounted display and were asked to answer questions about their interests and daily activities while addressing 9 targets. There were three 3-minute conditions: In the Non-Social Attention condition children talked to 9 "lollipop" shaped forms positioned to their left and right in the classroom; in the Social Attention Condition children talked to 9 avatar "peers" to the left and right, and in the High-Demand Social Attention Condition they talked to 9 avatars that faded if children did not fixate on them every 15 seconds. Children's speech was audiotaped, transcribed, and analyzed for seven measures of language use (Mean-Length-of-Uttreance (MLU), noun types and tokens, verb types and tokens, discourse marker types and tokens).
Results: ANOVAS revealed no significant group effect for each DM individually; however usage of particular DM's varied across phases. 'Um' $F(3, 94)=6.021$ $p = .003$ and

'like' $F(3, 94)= 3.653$, $p = .028$ usage varied across phase. There was no significant difference between 'um' and 'uh' usage across phase, but there was a group effect for the usage of 'um' vs. 'uh,' $F(3, 94)=3.448$ $p = .020$.
Conclusions: All children in this study, including those with HFA are producing the DM 'um' contrary to previous findings. The usage of 'um' increases across the phases, which could be the result of a non-threatening social situation of talking to avatars or the result of cognitive load due to higher attention demands. 'Like' appears to be used in a similar fashion as 'um' or 'uh,' increasing in usage across phases, whereas the usage of 'so' remains constant across all phases and perhaps signals a causal event or conclusion.



80 **164.080** Discrimination of Non-Native Speech Pitch and Autistic Traits in Non-Clinical Population

L. S. Iao[1], *A. Wippich*[1], *G. Y. H. Lam*[2] *and C. K. S. To*[3], *(1)Division of Psychology, Nottingham Trent University, Nottingham, United Kingdom, (2)School Psychology Program, Department of Educational and Psychological Studies, University of South Florida, Tampa, FL, (3)University of Hong Kong, Hong Kong, Hong Kong*

Background: Children with Autism Spectrum Disorders (ASD) shows enhanced discrimination of speech pitch. However, this enhancement seems no longer exist in adulthood due to a developmental increase in pitch discrimination abilities, which is associated with receptive vocabulary in native language, in individuals without ASD (Mayer, Hannent, & Heaton, 2014). If this is the case, it is possible that their increased discrimination of speech pitch is tied to native speech only and may not be carried over to non-native speech. Given that autistic traits are evident in individuals without ASD, those with higher levels of autistic traits may be more able to discriminate non-native speech pitch.
Objectives: This study investigated the discrimination abilities of non-native speech pitch and its relationships with autistic traits in typically developed adults without ASD.
Methods: One hundred English-speaking university students (52 females; mean age = 21.65 years, SD = 3.55 years, range = 18 – 35 years) participated in the study. All participants took a pitch discrimination task, in which they determined whether there were pitch differences between pairs of monosyllabic Cantonese words presented at either 0, 1, 2 or 3 semitone difference, and filled in the Autism Spectrum Quotient questionnaire (AQ; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001).
Results: Participants' performance in discriminating non-native speech pitch was significantly above chance level and was comparable to previous findings using native speech pitch (Mayer et al., 2014). Correct judgement of 'same' pitch was near ceiling and correct discrimination of 'different' pitches significantly improved with increases in semitone intervals. There was no correlation between pitch discrimination and overall autistic traits but pitch discrimination was negatively correlated with the social skill subscale in the AQ even after musical training was controlled.
Conclusions: Contrary to our prediction, adults without ASD performed well in discriminating non-native speech pitch. Moreover, those who were less sociable were less able to discriminate non-native speech pitch. This finding suggests a link between autistic-like social traits and speech processing in general population.

81 **164.081** Disfluencies Distinguish the Speech of Children with Autism Spectrum Disorder

M. Santulli[1], *J. Parish-Morris*[2], *E. F. Ferguson*[2], *L. Bateman*[2], *R. T. Schultz*[3] *and J. G. Donaher*[4], *(1)Temple University, Philadelphia, PA, (2)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (3)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (4)Center for Childhood Communication and the Department of Speech-Language Pathology, Children's Hospital of Philadelphia, Philadelphia, PA*

Background: Communication skills vary substantially in children with autism spectrum disorder (ASD), but receptive, expressive and pragmatic language deficits are frequently reported (Tager-Flusberg, Paul, & Lord, 2005). A growing body of research suggests that individuals with ASD, especially those with high functioning autism and Asperger's Syndrome, are more prone to produce a variety of disfluencies while speaking (Shriberg et al., 2001). However, research has yet to determine whether certain disfluency patterns are unique markers of ASD or whether they define a subgroup of individuals with ASD who are struggling with coexisting cognitive-linguistic, motor and/or pragmatic impairments.
Objectives: Compare and categorize disfluency rates in the speech of children with ASD and typical development during a semi-structured interview, and assess correlations with clinical and parent ratings of social impairment.
Methods: Research-reliable PhD-level clinicians administered the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2012) to 30 children with ASD and 14 typically developing controls that were matched on age, IQ, and sex ratio (Table 1). The conversation and reporting section of the ADOS was extracted and all utterances, were transcribed verbatim. Two reliable raters blind to diagnostic status coded disfluent behaviors, which were classified as stuttering-like disfluencies (SLD), repetitions (REP) or atypical disfluencies (AD; see Table 2). Interjections, revisions, and abandoned phrases (ABD) were analyzed independently. We used Welch's t-tests to compare group means for total disfluency level (TDL), frequency per type of disfluency, and proportion of disfluencies. Clinicians assigned each child a calibrated severity score based on behavior during the ADOS, and parents completed the Social Responsiveness Scale (SRS; Constantino, 2005).
Results: Participants in the ASD and TDC groups produced an equal number of total words with no significant differences in TDL (ASD=.09, TDC=.08, p=ns). However, the ASD group produced higher rates of SLD (t=-1.99, p=.05) as compared to the TDC group. No significant differences were found in rates or counts of AD, REP, ABD, interjections, or revisions, although the percentage of children that produced abandoned phrases in the ASD group (63%) was marginally higher than the TDC group (36%, Chi-square=2.94, p=.09). In the ASD group, TDL correlated positively with ADOS severity scores (*Pearson*=.39, p=.03), as did REP (*Pearson*=.44, p=.02). In the TDC group, higher SLD rates were associated with more social impairment as measured by the SRS (*Pearson*=-.56, p=.04).
Conclusions: Higher rates of certain disfluency types may contribute to the perception of impaired pragmatic language in ASD. Consistent with previous studies, the ASD group in the current study produced higher rates of SLDs than the TDC group, and disfluency rates correlated with clinical ratings of autism severity. Interestingly, 30% of participants in the ASD group produced prolongations (initial, mid-word, and/or final) versus 0% in the typical group. This latter, atypical finding warrants further exploration and may indicate enhanced diagnostic specificity when compared to other disfluency types. Transcription and coding of an extended sample is currently underway, and will be complete by May 2016.

Table 1. Groups did not differ on age, IQ, verbal IQ, or nonverbal IQ. SRS t-scores and ADOS severity scores were significantly higher in the ASD group than the TDC group, all *ps*<.001.

Dx	ASD Mean (SD)	TDC M (SD)
N	30	14
Age	10.67 (2.01)	11.10 (1.61)
Sex ratio M:F	19:11	8:6
Overall IQ[1]	105 (14.06)	108 (12.13)
Verbal IQ	107 (15.32)	111 (12.66)
Nonverbal IQ	108 (15.00)	104 (14.23)
SRS (t-score)[2]	82.23 (16.76)	40.57 (5.21)
ADOS severity	6.43 (2.92)	1.43 (.94)

[1] Overall IQ is the Global Composite Ability from the Differential Abilities Scales - II
[2] Four participants in the ASD group did not have scores on the Social Responsiveness Scale.

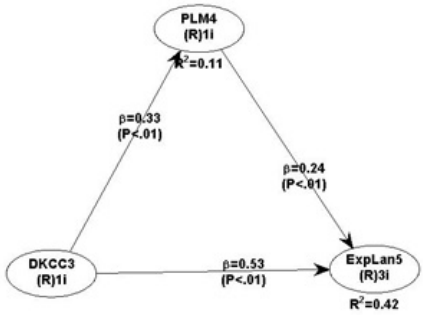
Table 2. Disfluencies were classified as stuttering-like disfluencies (SLD), repetitions (REP) or atypical disfluencies (AD). Interjections, revisions, and abandoned phrases (ABD) were analyzed independently.

SLD	AD	REP
Part-word repetitions	Mid-word prolongations	Multi-syllable word repetitions
Initial position prolongations	Final-word prolongations	Phrase repetitions
Blocks	Final- part-word repetitions	Single-syllable whole-word repetitions produced without tension

82 **164.082** Empirical Support for a Transactional Model of Spoken Language Acquisition in Preschoolers with Autism Spectrum Disorder

T. Woynaroski[1], *P. J. Yoder*[2] *and L. R. Watson*[3], *(1)Vanderbilt University, Thompsons Stn, TN, (2)Vanderbilt University, Nashville, TN, (3)University of North Carolina at Chapel Hill, Chapel Hill, NC*

Background:
There is a pressing need to explain individual differences in “useful speech” of young children with autism spectrum disorder (ASD) because learning to use spoken language to communicate early in life has been repeatedly linked with long-term outcomes in this population. Transactional theory suggests that models considering both parent and child factors, and the dynamic way in which such factors interact, will best account for individual differences in spoken language acquisition. One instantiation of transactional theory specifically suggests that early child vocalizations that are more “speech-like” or “complex” elicit parent linguistic responses, which in turn scaffold spoken language learning. We have previously confirmed this model in a group of young children with developmental disabilities not due to autism (Woynaroski, Yoder, Fey, & Warren, 2014).
Objectives:
The present study tests whether the transactional model of spoken language acquisition additionally applies to preschoolers with ASD.
Methods:
We drew on extant data from a recent longitudinal investigation of useful speech development involving 87 preschoolers with ASD (Yoder, Watson, & Lambert, 2015). An index of the complexity of children’s vocalizations (i.e., consonant inventory in communicative vocalizations) was measured at Time 1 from the Communication and Symbolic Behavior Scales-Developmental Profile (CSBS-DP). Children’s spoken language outcomes were measured 8 months later at Time 3 using an aggregate of scores from the CSBS-DP word scale, the Macarthur-Bates Communicative Development Inventories: Words and Gestures expressive vocabulary checklist, and the number of different words produced in a semi-structured communication sample with an examiner. Midpoint parental linguistic mapping was measured at Time 2 (4 months after Time 1) in a 10 minute parent-child interaction. Mediation analysis with stochastic regression handling of any missing data points was used to test the statistical significance of the indirect effect of early child vocal complexity on later spoken language outcomes through mid-point parental linguistic mapping (Hayes, 2009).
Results:
As expected, children’s early vocal complexity predicted their later spoken language outcomes ($r = .61$; $p < .001$). Additionally, early child vocal complexity was positively associated with mid-point parent linguistic mapping ($r = .33$; $p < .001$), and mid-point parent linguistic mapping predicted later spoken language outcomes, controlling for early child vocal complexity ($r = .24$; $p < .01$). The indirect effect of early child vocal complexity on later spoken language outcomes through mid-point parent linguistic mapping was statistically significant. Thus, mid-point parent linguistic mapping mediated the relation between early vocal complexity and later spoken language in our sample.
Conclusions:
These findings lend empirical support to the transactional theory of spoken language development in preschoolers with ASD. We confirmed that one child factor (early vocal complexity) and one parent factor (linguistic mapping) contribute in a dynamic manner to impact spoken language outcomes in children with ASD. This result suggests that we might best support spoken language acquisition in this population by targeting both the complexity of children’s vocalizations and parents’ responses to such prelinguistic child productions. Implications for theory, research, and practice will be discussed.



83 **164.083** Evaluating the Utility of Narratives in Assessing Language Abilities of Bilingual Children with Autism Spectrum Disorders

S. B. Vanegas *and K. Acharya, University of Illinois at Chicago, Chicago, IL*

Background:
To date, there is sparse research on how children with ASD raised in bilingual environments develop language. The few studies that have explored this issue have primarily focused on young children (i.e., 1.5 – 5 years of age), with most results showing no significant delay or deviance in the early stages of language development (Ohashi et al., 2012; Valicenti et al., 2012). An additional concern is the use of standardized instruments in measuring language development in children, as these may underestimate the abilities of children from diverse backgrounds. Narratives have been identified as useful tools in the assessment of bilingual typically developing children (Bedore et al., 2010); however, to date there is no published research evaluating its utility in the assessment of children with ASD from diverse language backgrounds.
Objectives:
The current study aims to clarify how narratives can be used to measure language abilities of children from diverse language backgrounds.
Methods:
Monolingual (English) and bilingual (English/Spanish) children with Autism Spectrum Disorders who were between 8 and 14 years of age were recruited to participate. Children were eligible to participate if they were verbal and had a nonverbal IQ of 70 or higher. Data collected thus far includes six monolingual and nine bilingual children. All children completed a standardized language assessment and two narratives in English (*Frog, Where Are You?, Frog on his Own)*. Bilingual children also completed a standardized language assessment and two narratives in Spanish (*Frog Goes to Dinner; One Frog Too Many*). Parents of all children also completed a Language Background Questionnaire and the Social Communication Questionnaire.
Results:
Preliminary analyses on the age of early language milestones found no differences between bilingual and monolingual children on the age of babbling and single words; however, differences emerged in the development of short phrases and sentences with bilingual children reaching these milestones later than monolingual children (*p*'s < .05). A MANOVA was then conducted on the English-language narratives controlling for age. These findings showed that bilingual and monolingual children with ASD did not differ on the mean length of words per utterance (MLUw) or number of utterances containing grammatical errors (all *p*'s > .05). The only difference that emerged between groups was on the Type/Token ratio, with monolingual children exhibiting a greater lexical variety than bilingual children with ASD ($p = .032$).
Conclusions:
The preliminary results indicate that although bilingual children with ASD had lower scores on a standardized language test than monolingual children with ASD, narratives may provide a more complete profile of language abilities in bilingual children with ASD. These results are relevant as diverse families often receive recommendations to maintain English-only households (Bird et al., 2012) and these recommendations often result in feelings of loss, decreased communication in the home, and isolation from their community (Garcia et al., 2012). These findings contribute to the growing literature on the development of two languages in children with ASD and provides a support for the utilization of narratives in the language assessments of children with ASD.

Table 1

Demographic and language characteristics of Bilingual and Monolingual children with ASD

	Bilingual (n = 9)	Monolingual (n = 6)	Sign.
Age (Years)	10.6 (1.95)	12.5 (1.38)	$p = .057$
Gender (M:F)	8:1	5:1	ns
Nonverbal Reasoning	98.9 (14.47)	97.0 (9.78)	ns
Age of First ASD Diagnosis	5.5 (3.02)	4.7 (2.17)	ns
Social Communication Questionnaire	23.6 (6.04)	19.5 (8.46)	ns
Core Language (English)	79.9 (14.32)	105.7 (21.79)	$p = .026$
Core Language (Spanish)	83.3 (17.99)	---	---
Language Milestones			
Babbling (in years)	1.1 (0.8)	1.1 (1.1)	ns
Single Words (in years)	1.9 (0.9)	1.3 (0.9)	ns
Short Phrases (in years)	3.1 (1.1)	1.8 (1.1)	$p = .046$
Sentences (in years)	4.9 (1.0)	3.2 (1.6)	$p = .019$
Regression (% Yes)	22.0%	0.2%	*ns*
Services			
Speech Therapy (% Yes)	88.9%	83.3%	ns
Home Usage (%)			
English	44.4%	100.0%	ns
Spanish	100.0%	---	---
School Usage (%)			
English	100.0%	100.0%	---
Spanish	50.0%	---	---

84 **164.084** Examination of Script-Based and Non-Script Based Narrative Retellings in Children with Autism Spectrum Disorder

E. Hilvert[1]*, D. Davidson*[2] *and P. B. Gámez*[1]*, (1)Psychology, Loyola University Chicago, Chicago, IL, (2)Loyola University Chicago, Chicago, IL*

Background: Narrative production is often challenging for children with Autism Spectrum Disorders (ASD), particularly in terms of creating coherent and cohesive stories (see Stirling et al., 2014). However, differences between the narratives of children with and without ASD may be minimized when the cognitive and linguistic demands are reduced (e.g.,Losh & Capps, 2003; Novogrodsky et al., 2013). Research on neurotypical (NT) children indicates that incorporating a script-framework into a story can improve narrative coherence and cohesion because having prior event knowledge can help children predict what will happen in a story (Davidson, 2006; Shapiro & Hudson, 1991). It is not known, however, how event knowledge might improve narratives in children with ASD.

Objectives: The current study was designed to 1) gain a comprehensive understanding of the pervasiveness of narrative difficulties in children with ASD by examining whether providing more structure, in the form of a script-framework, would allow children with ASD to produce more well-formed narratives, and 2) examine how Theory of Mind (ToM) ability may predict narrative production in children with ASD, regardless of script or non-script framework.

Methods: This study compared the narrative abilities of 19 children with ASD and 26 NT children (*M*= 10;0, *SD*= 1.6), on two story-retelling tasks: a script-based and a non-script based story. Children were matched on age, nonverbal-reasoning, and receptive language (Table 1). Narratives were coded for a number of microstructure and macrostructure variables. Script-based stories were examined for the types of events included (script, non-script) to gain an understanding of children's script knowledge. ToM was assessed using a battery of measures (e.g., Birthday Puppy Task, Strange Stories Test).

Results: Lexical diversity and productivity were relative strengths for children with ASD. Unexpectedly, the narration of both stories was equally difficult for children with ASD for the majority of narrative variables assessed, including grammatical complexity, appropriate use of references, adverbials, and connectivity, structure, content, which resulted in narratives that were less cohesive and coherent than the NT group (Table 2). All children told *non-script based* stories that were more semantically complex. Closer examination of the script-based story revealed that children with ASD were including the same number of script details as the NT children, but were less likely to include the non-script details that were essential to the plot of the story. ToM ability predicted narrative coherence and cohesion for both story types, but only for the children with ASD.

Conclusions: These findings provide evidence that impairments in narrative microstructure and macrostructure may be pervasive across narrative type for children with ASD, even when using a retelling task. Although children with ASD did not use the script-framework to produce more well-formed script-based narratives, the apparent difficulties with the script-based story appear to reflect more general narrative impairments, instead of abnormalities in their representation of script knowledge. These findings confirm the importance of considering socio-cognitive (ToM) impairments when studying the narrative abilities of children with ASD.

Table 1. ***Comparison of Matching Variables and Participant Characteristics***

	Diagnostic Group	
	ASD (N=19)	***NT (N=26)***
Age	10;03 (1.5)	9;09 (1.7)
Males/Females	17:2	18:8
SRS-2 T-Score'''	66.6 (5.5)	50.25 (5.9)
CARS-2 Raw Score	33.7 (3.9)	---
CARS-2 T-Score	50.2 (5.5)	---
WASI-2 FSIQ	95.1 (14.7)	102.0 (11.7)
Nonverbal Reasoning	47.8	50.1
PPVT-4 Standard Score	100.4 (24.7)	105.1 (17.5)
ToM Total Score (out of 25)'''	10.9 (7.7)	17.7 (3.7)

Note. SRS-2: Social Responsiveness Scale-2. CARS-2: Childhood Autism Rating Scale-2. WASI-2: Wechsler Abbreviated Scale of Intelligence-2. WASI-2 FSIQ refers to the full-scale IQ score obtained from the Wechsler Abbreviated Scale of Intelligence. The score on Nonverbal Reasoning indicates the mean scaled score on the matrix-reasoning subtest of the WASI-2. PPVT: Peabody Picture Vocabulary Test, Fourth Test. The ToM total score was a combined score from children's scores on the unexpected contents task, Birthday Puppy, and Strange Stories Test. * p < .05. ** p < .01. *** p < .001.

Table 2. ***Mean Score on Microskills and Macroskills by Story Type and Diagnostic Group***

	Diagnostic Group	
	ASD	NT
Productivity		
Non-script based	130.4 (91.9)	150.7 (58.3)
Script-based	140.8 (91.8)	161.2 (60.5)
Lexical Diversity		
Non-script based	67.7 (37.9)	73.5 (23.4)
Script-based	66.9 (35.2)	74.2 (21.9)
Grammatical Complexity		
Non-script based	6.6 (3.8)	10.0 (2.5)
Script-based	7.2 (4.2)	11.0 (3.5)
Vocabulary (out of 3)		
Non-script based	1.73 (.99)	2.04 (.76)
Script-based	1.47 (1.2)	2.27 (.68)
References (out of 3)		
Non-script based	1.58 (1.1)	2.62 (.55)
Script-based	1.42 (1.3)	2.62 (.70)
Connectors (out of 3)		
Non-script based	1.11 (.94)	2.13 (.88)
Script-based	1.21 (1.3)	1.44 (.80)
Adverbials (out of 3)		
Non-script based	1.16 (1.0)	2.19 (1.1)
Script-based	1.05 (1.0)	1.85 (.83)
Narrative Structure (out of 3)		
Non-script based	1.62 (1.1)	2.56 (.72)
Script-based	1.58 (1.2)	2.42 (.70)
Narrative Content (out of 3)		
Non-script based	1.26 (1.2)	2.42 (.70)
Script-based	1.23 (1.0)	2.03 (.53)

Note. Productivity was measured by total number of words, lexical diversity was assessed by total number of different words, and grammatical complexity was measured by mean length of utterance (MLU). All other mircoskills and macroskills were rated on a 4-point scale (0-3) using the coding rubric from Peter and the Cat Narrative Assessment (Leitao & Allan, 2003), the non-script based narrative used in the current study.

85 **164.085** Eye Movement during Reading and Answering Inferential Questions in High-Functioning Autism: Strategies and Cognitive Components

M. Micai[1], *H. Joseph*[2], *M. Vulchanova*[3] *and D. Saldana*[1], *(1)Department of Developmental and Educational Psychology, University of Seville, Seville, Spain, (2)Department of Psychology, Oxford Brookes University, Oxford, United Kingdom, (3)Department of Language and Literature, NTNU, Trondheim, Norway*

Background:
Reading comprehension problems in Autism Spectrum Disorder (ASD) are well documented in the literature, however, it is still unclear which processes contribute to this deficit (Brown, Oram-Cardy & Johnson, 2013). The ability to make inferences has been shown to be essential for discourse (Snyder & Caccamise, 2010) and reading comprehension (Cain, Oakhill, Barnes & Bryant, 2001). The results in literature regarding inference generation across ASD individuals are not entirely consistent. Studies have shown individuals with ASD interpret expressions literally (Loukusa, et al., 2007) and have difficulty drawing inferences (Arciuli et al. 2013; Huemer and Mann 2010; Ricketts et al. 2013). However, others have reported that inference generation was intact in ASD when primed for implicit inferences (Saldaña & Frith, 2007). Hence, the reading strategies underlying inference generation in ASD remain unclear.
Objectives:
First, the present research aimed to investigate whether ASD were as accurate as typically developing (TD) individuals in answering inferential questions. Second, eye movement strategies of ASD and TD during the reading of texts that required answering text-based or inferential questions were explored. Finally, it aimed to explore cognitive components related to gaze behavior during inference generation in ASD.
Methods:
Twenty-two high-functioning children and adolescents with ASD and twenty-two TD participants, matched for chronological age, intelligence scores, language skills, and reading ability, read five stories, each divided into six paragraphs. Following each paragraph participants answered an inferential or text-based question. Global and target word (word defined *a priori* as fundamental to question responding) eye movement data was recorded continuously during text reading. Cognitive abilities were measured using the Wechsler Intelligence Scale for Children or Wechsler Adult Intelligence Scale, and the Spanish Peabody Picture Vocabulary Test.
Results:
Results showed that ASD were as accurate as TD in responding to inferential and text-based questions. Analyses of eye movement data revealed longer reading time in the inferential condition only for ASD with respect to the target word. No group differences were found with respect to global paragraph reading and responding time or eye movement around distractor words. With regard to cognition, in the ASD group only, results revealed a positive relationship between vocabulary size and inferential accuracy and a negative relationship between perceptual reasoning and re-reading time of the target word in the inferential condition. Finally, analyses of correct answers revealed that ASD spontaneously fixated on the question prior to the text more often in inferential condition and that a positive relationship existed between the frequency of the question-before-text strategy and score of total intelligence, perceptual reasoning, and working memory.

Conclusions:
Despite similar accuracy scores and global paragraph reading, ASD exhibited delayed processing of the target words in the inference condition. In addition, higher cognitive functions appeared to be related to inferencing ability, target word eye movement behavior, and self-initiated question reading strategy.

86 **164.086** Contextual and Visual Cues in the Interpretation of Idioms in High Functioning Autism

S. Chahboun[1], *V. Vulchanov*[1], *B. Sullivan*[2], *D. Saldana*[3], *H. Eshuis*[1] *and M. Vulchanova*[1], *(1)Department of Language and Literature, NTNU, Trondheim, Norway, (2)Tobii Company, Stockholm, Sweden, (3)University of Seville, Seville, Spain*

Background:
The difficulties experienced by autistic individuals with regard to communication and language are widely known and well documented. Individuals with High functioning autism (ASD) are distinguished by relative preservation of linguistic and cognitive skills. However, problems with pragmatic language skills have been consistently reported across the autistic spectrum, even when structural language is intact. Many studies establish failure to understand metaphors, idioms and other forms of figurative language (Gold & Faust, 2010; Vulchanova, Talcott, Vulchanov & Stankova, 2012).
Objectives:
Our main goal was to investigate how ASD individuals process idioms as a type of figurative language, and, specifically, how they integrate information from multiple sources (e.g. visual modality and language) in this process. In this study, we were interested in the extent to which visual context, e.g., an image corresponding to either the literal meaning or the idiomatic meaning of the expression can facilitate responses to such expressions.
Methods:
Four categories of figurative expressions were included: biological idioms, cultural idioms, instructive idioms (proverbs) and novel metaphors. Participants with high-functioning autism and their typically developing peers (matched in intelligence and language level) had to complete a sentence-picture matching task for idioms and their target meaning represented in images. The expressions were presented visually on a computer screen or auditorily via loudspeakers. We measured the participants' performance based on their accuracy, reaction times, mouse tracking data and eye tracking data.
Results:
We hypothesized that since individuals with ASD have a tendency for literal interpretation, they would have difficulties in appreciating the non-literal or extended nature of idioms and figurative language in general. Analyses of accuracy (ACC) and reaction times (RTs) showed clearly that the ASD participants were less accurate. In addition, the modality in which the stimuli were presented turned out to be an important variable in task performance. The auditory modality seems to assist the control group for better understanding. We also found differences in performance depending on the category of the expression. Participants with ASD had more difficulties understanding cultural and instructive idioms. In contrast, controls were faster and more accurate in all categories and showed no differences between the two modalities. Furthermore, ASD participants presented longer RTs and errors in the instructive idioms in comparison with the other categories in both modalities. Eye-tracking and mouse-tracking data were interpreted to support these findings.
Conclusions:
This research highlights the way in which the processing figurative language differs from typically developing individuals and individuals in the autistic spectrum. In addition, this study can contribute to better understanding of the causes of pragmatic language problems in autism, and more broadly the well-attested comprehension and communication problems in that population.

87 **164.087** Family Matters: Children and Adolescents with ASD Talk More about Family Than Friends

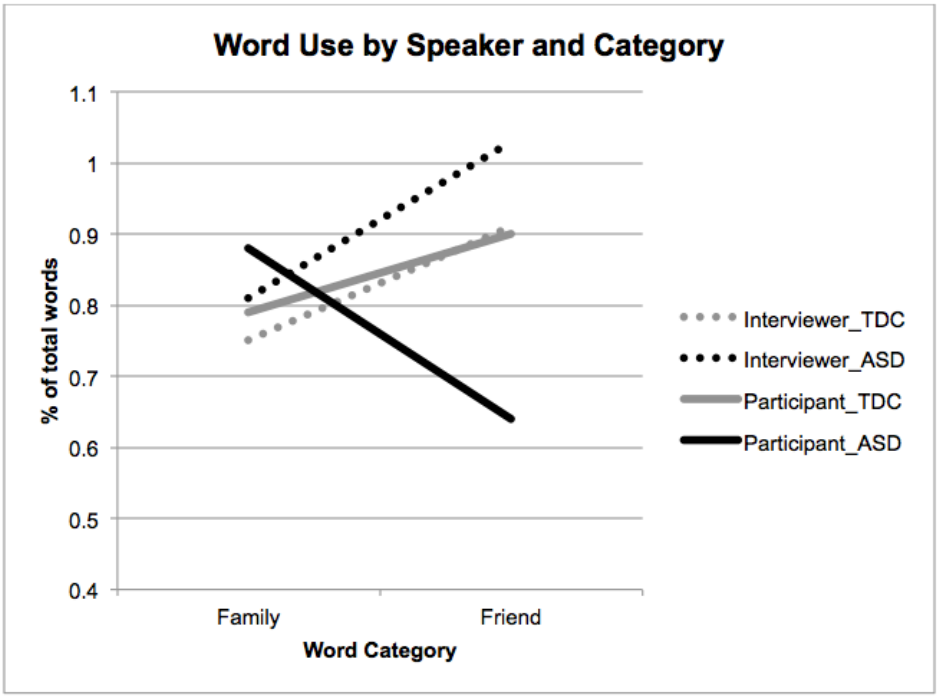
L. Bateman[1], *E. F. Ferguson*[1], *K. J. Payton*[1], *R. T. Schultz*[2] *and J. Parish-Morris*[1], *(1)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (2)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA*

Background: As children grow older, their focus naturally broadens to include peers as well as family (Berndt, 1992). Autism Spectrum Disorder (ASD) is characterized by varying degrees of social impairment, and individuals often have smaller social networks and friend groups than age-matched children without ASD (Kasari et al., 2011). Measuring the frequency of friend words (e.g., friend, acquaintance, buddy) versus family words (e.g., mom, dad, cousin) produced in natural language is one way to assess the relative prominence of friends versus family in a child's life.
Objectives: Measure how often children with ASD, typically developing controls (TDC) and interviewers use "friend" and "family" words during the conversation and reporting section of the Autism Diagnostic Observation Schedule (ADOS), and correlate rates of "friend" and "family" word usage with social functioning (ADOS calibrated severity scores and scores on the Social Responsiveness Scale).
Methods: Research reliable PhD-level clinicians administered the ADOS to 65 participants (ASD: 48, TDC: 17). Participants were matched on full-scale IQ and sex ratio, with a slightly younger ASD group (Table 1). Trained annotators transcribed the words produced by clinicians and participants during the conversation and reporting section of the ADOS (~20 minutes). We processed each transcript using the Linguistic Inquiry and Word Count software (Tausczik & Pennebaker, 2010), then extracted the ratio of words categorized as "friend" words and "family" words for each speaker, relative to the total number of words produced. There were no significant correlations between age and word use between- or within-groups, so age was not included as a covariate in our primary analyses. Due to significant correlations between interviewer and participant word use (.3-.4), we controlled for interlocutor language in our omnibus tests.
Results: We conducted an ANCOVA for each speaker type, with word category (friend, family) as a repeated measure and diagnosis as a between-group factor. There was a trending interaction between participant word category use and diagnosis, $F(1,61)=2.77$, $p=.10$, and no significant effects of interviewer language. Paired t-tests showed that participants in the ASD group produced a significantly higher percentage of family words than friend words, $p=.01$, while TDCs used family and friend words at equal rates (Figure 1). Interviewers in both groups used significantly more friend than family words, $ps<.01$. After partialing out interviewer language, we found a significant positive correlation between the rate of "family" words used by all participants and their SRS t-scores, and a significant negative correlation between ADOS calibrated severity scores and "friend" words.
Conclusions: Natural language processing holds great promise as research tool. It has the potential to provide highly granular, quantitative data that varies dimensionally in the majority of individuals with ASD. In this study, we explored one metric of social functioning that emerged in the language produced by in children with ASD and non-ASD peers. The difference between "friend" and "family" words held even after controlling for interlocutor language, suggesting that participants with ASD may engage in less linguistic accommodation than peers. Future research with a larger cohort will explore age effects in older adolescents.

Table 1. Demographics and cognitive/social profiles by group. The ASD group was younger than the TDC group, t=2.04, p=.05, but groups did not differ on sex ratio or IQ. IQ is the General Conceptual Ability score from the DAS-II (Elliott, 2007). Three participants in the TDC group were missing ADOS severity scores and four participants in the ASD group were missing SRS t-scores.

	ASD (N=48)	TDC (N=17)	Difference
Sex (M, F)	33, 15	8, 9	Chi-square=2.54, p=.11
Age in years - Mean (SD)	10.10 (2.01)	11.29 (2.20)	t=2.04, p=.05
IQ - Mean (SD)	103 (12.54)	105 (14.04)	t=.30, p=.77
SRS t-score - Mean (SD)	82.57 (17.55)	39.82 (5.05)	t=-9.84, p<.001
ADOS severity - Mean (SD)	6.35 (2.66)	1.43 (.94)	t=-6.77, p<.001

Figure 1. Estimated Marginal Means for each speaker by word category, after controlling for the other speaker's word use in each category. Although there appears to be a main effect of diagnosis on the amount of family/friend words produced by interviewers, this effect does not reach statistical significance (independent samples t-tests revealed no statistically significant main effects of group in either category by interviewer or participant, all ps>.15).



88 **164.088** Fathers' and Mothers' Responsiveness and Broad Autism Phenotype Characteristics and the Language Skills of Children with ASD

M. Flippin[1] *and L. R. Watson*[2]*, (1)Communicative Disorders, University of Rhode Island, Kingston, RI, (2)University of North Carolina at Chapel Hill, Chapel Hill, NC*

Background: Given that parent verbal responsiveness is strong predictor of later language outcomes for children with autism spectrum disorder (ASD), increasing parent responsiveness is a popular target of communication intervention for young children with ASD. However results of interventions to improve communication skills via increasing parent responsiveness have been mixed. Some communication interventions have been unsuccessful in improving either parent responsiveness or child communication skills, others have shown effects in increasing both parent responsiveness and child communication outcomes, whereas other interventions have been shown to improve parent responsiveness but not child communication skills. One proposed explanation for differences in treatment effect for parent-implemented social communication interventions is pre-treatment child characteristics (e.g., baseline cognitive, joint attention, imitation, communication skills). A less explored explanation for differences in treatment effect of parent-implemented social communication intervention may be parental pre-treatment characteristics. Compared to both parents of children who are typically developing and parents of children with other developmental disorders, parents of children with ASD are more likely to present with milder variants of the characteristics associated with ASD, known as the broad autism phenotype (BAP). Parents who demonstrate BAP characteristics with resulting difficulties in social and communication skills, may need more tailored supports to effectively deliver parent-implemented social communication interventions.
Objectives: This observational study examined the interactions of 16 young children with ASD and their mothers and fathers in order to investigate concurrent associations between parental verbal responsiveness and three characteristics of the parental broad autism phenotype (i.e., aloofness, rigidity, pragmatic language deficits), and child language skills.
Methods: Child language skills were assessed by the Preschool Language Scale- 4 (Zimmerman, Steiner & Pond, 2002). Parental BAP characteristics were measured with Broad Autism Phenotypes Questionnaire BAPQ (Hurley, Losh, Parlier, Reznick & Piven, 2006). Parent verbal responsiveness was coded from video recordings of naturalistic parent-child play sessions using interval-based coding.
Results: Fathers' BAPQ scores were not related to child language skills. Concurrent negative associations were found between child language skills and mothers' scores on two subscales of the BAPQ, (i.e., Aloof and Rigid). After accounting for maternal verbal responsiveness, mothers' scores on the Aloof subscale were no longer negatively associated with child language scores; negative associations between child language skills and mothers' scores on the Rigid subscale remained significant after controlling for maternal verbal responsiveness.
Conclusions: In this study, negative concurrent associations were found between child language skills and maternal scores on two BAPQ subscales (i.e., Aloof and Rigid). However, after controlling for maternal verbal responsiveness associations between aloof characteristics and child language skills were no longer significant, whereas negative concurrent correlations between Rigid Subscale scores and child language remained significant. These data warrant the investigation of pre-treatment parental characteristics in future observational research and research of parent-implemented social communication intervention for children with ASD.

89 **164.089** Gesture Development from 9 to 24 Months in Infants with Fragile X Syndrome, Infant Siblings of Children with Autism and Typically Developing Infants

L. Ragué[1]*, K. E. Caravella*[2]*, J. Klusek*[2] *and J. Roberts*[1]*, (1)Psychology, University of South Carolina, Columbia, SC, (2)University of South Carolina, Columbia, SC*

Background: Individuals with autism experience deficits in the realm of social communication. One important and early emerging aspect of social communication is gesture

use, an area shown to predict important later communication outcomes (Rowe, Özçalışkan, & Goldin-Meadow, 2008). Two populations at risk of developing autism and social communication deficits are individuals with fragile X syndrome (FXS; Kover & Abbeduto, 2010) and children who have an older sibling diagnosed with autism (ASIB; Yirmiya et al., 2006). Characterizing gesture development is an important first step in identifying the best approach to intervention in these populations.
Objectives: Identify developmental trajectories of gesture use in infants with fragile X syndrome and infants with an older sibling with autism contrasted to typically developing infants.
Methods: The sample includes 80 males recruited through two longitudinal studies conducted at UNC-Chapel Hill and at the University of South Carolina. Participants included 31 infants with FXS, 25 ASIBs and 24 TD infants. The Visual Reception domain of the Mullen Scales of Early Learning (MSEL) was used as a measure of nonverbal ability, and the Early Gesture score on the MacArthur-Bates Communication Development Inventory (CDI) was used as a measure of gesture use. The MSEL and the CDI were collected at 9, 12 and 24 months of age.
Results: A growth model was run with time centered at 24 months to determine whether rates of gesture development differed between groups, controlling for nonverbal ability. Analyses indicated that at 24 months, infants with FXS have developed, on average, about 4 less gestures than TD infants (β=-4.29, p=0.00), while ASIB infants have developed about 3 less gestures than TD infants (β=-2.94, p=0.01). All three groups increased in the number of gestures used over time (β=0.46, p=0.00). The rate of increase did not differ between the TD and FXS groups (β=0.15, p=0.07) or between the TD and ASIB groups (β=-0.12, p=0.12).
Conclusions: FXS and ASIB infants both demonstrate fewer gestures used by 24 months than TD infants. The rates of gesture development in these two high-risk groups do not differ from the rate of gesture development in TD infants. Therefore, while FXS and ASIB infants are delayed, they are still gaining gestures at a similar rate as TD infants in their first two years of life. These findings suggest that targeting gesture use before 24 months for these high-risk groups may improve their chances of demonstrating gesture use consistent with typical development at later time points.

90 **164.090** Idioms As a Measure of Pragmatic Language Abilities in Adolescents with Autism Spectrum Disorders

A. Canfield *and I. M. Eigsti, University of Connecticut, Storrs, CT*

Background:
Individuals with autism spectrum disorders (ASD) have well-documented deficits in pragmatic language, such as narrative production and use of idiosyncratic language; however, few studies have examined comprehension of idiomatic expressions in ASD. (e.g., *spilled the beans*). While clinicians and parents of children with ASD often cite idiomatic expressions as an area of weakness, studies of idiom comprehension have found that, in the absence of significant structural language deficits, children with ASD tend to perform similarly to their peers with typical development (TD) peers in defining idioms.
Objectives:
Our objective was to study the comprehension of idioms in ASD as a means of understanding the pragmatic language deficits associated with the disorder. We compared idiom definitions produced by adolescents with TD and ASD using standardized testing, quantitative methods (i.e., coding) and through the use of quality ratings from naïve readers.
Methods:
Participants were adolescents with ASD (diagnoses confirmed by ADOS, n = 13) with a history of language delay but functioning in the average cognitive range and TD (n = 12). Groups did not differ on chronological age, gender, and full scale IQ. Participants completed the "Figurative Language" subtest of the Test of Language Competence (TLC), where they were asked to interpret an idiom used in context (i.e., "Situation: A boy talking about his girlfriend. Expression: She is easily crushed."). Participants also read several common American idioms in isolation (*turn a corner*, *swim against the tide,* etc.) and were asked to define their meaning. Their responses were transcribed and coded for: 1) accuracy, 2) focus on literal definition, and 3) whether an example was included. The transcribed definitions were rated by 10-12 college students, naïve to diagnosis and study hypotheses, for *goodness* and *accuracy*.
Results:
The ASD group scored lower than the TD group on the TLC Figurative Language subtest (i.e., idioms used in context; $F(1, 23) = 6.44$, $p < 0.02$, $h^2 = 0.22$). Scores on the experimental idiom task did not differ (p's > 0.22) on any of the coding measures (i.e., how accurate or literal the definition was, whether an example was used in the definition), indicating that the groups were similarly able to define idioms when presented in isolation, rather than in context. Furthermore, naïve readers were unable to detect differences between the ASD and TD definitions (p's > 0.38), a notable result given that naïve readers have been shown to detect differences between ASD and TD in narrative quality.
Conclusions:
For idioms presented and defined in isolation, adolescents with ASD and TD produced similar idiom definitions, according to quantitative coding and quality ratings from untrained raters. However, when asked to interpret the meaning of idioms in the context of a social situation, adolescents with ASD performed significantly worse than their peers. This indicates that deficits in idiom comprehension likely reflect social deficits rather than language or word knowledge deficits. Interventions that teach idiomatic expressions should emphasize the use of idioms in context, rather than in isolation, to most effectively impact pragmatic language use.

92 **164.092** Joint Attention and Language in Children with ASD and Typical Development

E. F. Geib[1]*, K. J. Hamilton*[1,2] *and B. Wilson*[1]*, (1)Clinical Psychology, Seattle Pacific University, Seattle, WA, (2)Seattle Pacific University, Seattle, WA*

Background:
Children with autism spectrum disorders (ASD) exhibit language impairments when compared to their typically developing (TD) peers (APA, 2013; Tager-Flusberg, 2000). Children with ASD tend to develop language along an atypical pattern often acquiring expressive language before receptive language (Charman, 2003). Preliminary research suggests that joint attention serves as protective factor against language impairments in children with ASD (Bates, 1979; Charman, 2003; Mundy, Sigman, & Kasari, 1990). Mundy and Gomes (1998) found that the initiation of joint attention uniquely related to expressive language while responsivity to joint attention related to receptive language. In children with ASD, joint attention significantly correlated with expressive and receptive language (Charman, 2003). Murray et al. (2008) found that responsivity to joint attention uniquely related to receptive language. The language children gain in moments of joint attention may represent an important factor for social and cognitive development for children with ASD.
Objectives:
The purpose of our study was to examine language ability profiles in relation to children's joint attention skills during a parent-child reading task. We hypothesized children with ASD who engaged in increased moments of joint attention would display receptive language abilities similar to their TD peers.
Methods:
Our analysis included 85 children ages 3:1 to 6:11 and their parents. Forty-five children were diagnosed with ASD and forty were typically developing. Subjects were recruited from local preschools, elementary schools, and autism treatment clinics. Language ability was assessed by the Differential Ability Scale-II (Elliot, 2007) and joint attention was assessed through a coded parent child reading task (Vo, 2011).
Results:
A mediation analysis was conducted using PROCESS (Hayes, 2013) to examine the indirect effects of developmental status on receptive language ability through joint attention. Developmental status significantly correlated with receptive language, r = -.328, p = .002, but not expressive language, r = -.155, p = .156. Developmental status negatively related to joint attention, $t(85)$= -3.852, p < .001) and significantly predicted receptive language ability while controlling for developmental status ($t(85)$= 3.004 p = .004). The direct effect of status on receptive language ability while controlling for joint attention, $t(85)$= -1.877, p = .064) represented a trend toward significance. The Sobel test (z_{ab} =-2.32, p = .02) supports joint attention as a mediator between developmental status and receptive language ability; however, a bootstrap confidence interval (95%) using 1,000 bootstrap samples (-12.87, 0.38) included zero. Therefore, these results may not support that the full mediation, but nonetheless provide data for further implications of the relation between joint attention and language development in children with ASD.
Conclusions:
The acquisition of joint attention skills is a significant predictor of language development in children with ASD. Our results support past findings regarding the complexity of language ability in children (Tager-Flusberg, 2000). In terms of language profiles, joint attention is uniquely related to receptive language. More specifically, these results support the role of joint attention to support receptive language development in children with ASD.

93 **164.093** Language Abilities at the Age of 36 Months in Children at Risk for Autism Spectrum Disorder

E. Bruyneel*, P. Warreyn, E. Demurie, M. Dereu, S. Van der Paelt and H. Roeyers, Ghent University, Ghent, Belgium*

Background:
Research shows that language problems are highly prevalent in children with autism spectrum disorder (ASD). The profile of language problems, however, is variable across children and changes with age. Almost all children with ASD show significant difficulties in pragmatics. On the contrary, only some children with ASD show difficulties regarding vocabulary and grammatical language skills. Language ability is a critical element in the overall development and quality of life of individuals with ASD. Furthermore, the quality of early language and speech development is highly predictive of adult outcome. Younger siblings of children with ASD have a higher risk of developing the disorder themselves, a mild expression of the disorder and/or other developmental problems such as delayed language development or atypical general development. It is therefore important to investigate possible language problems and their locus in high-risk siblings.
Objectives:

The aim of the current study was to systematically investigate language at 36 months in children at high and low risk for ASD by looking into different linguistic levels of language.
Methods:
Younger siblings of children with ASD (high-risk siblings, n = 58) and typically developing children (low-risk siblings, n = 65) are followed as part of a larger longitudinal study. Preliminary analyses were conducted with a subsample of 17 high-risk siblings and 16 low-risk siblings. At 36 months expressive and receptive language abilities were assessed using the Dutch version of the Reynell Developmental Language Scales (RTOS). Scores for the different linguistic levels were acquired by combining item scores on the RTOS. Regarding receptive language, scores were obtained for three linguistic levels: lexicon, syntax and semantics. Concerning expressive language, scores for six linguistic levels were calculated: lexicon, morphology, syntax, semantics, pragmatics and grammar (morphology and syntax).
Results:
High-risk siblings showed similar age equivalents when compared to low-risk siblings on receptive, expressive and total language as measured by the RTOS. Nonetheless, differences were found at linguistic level. High-risk siblings scored significantly lower on lexicon ($U = 58.5$, $p = .004$) and syntax ($U = 81.5$, $p = .049$) in receptive language and on lexicon ($U = 74.0$, $p = .043$) in expressive language.
Conclusions:
At the age of 36 months language abilities of high-risk siblings were in general similar to language abilities of low-risk siblings. Despite similar general language scores, high-risk siblings did show significantly lower scores with regard to lexicon (receptive and expressive) and syntax (receptive). It seems to be important to look at the language abilities of high-risk siblings in detail as difficulties might be missed otherwise. In contrast to what was expected from the literature no significantly lower scores were found for pragmatics and semantics. Results of an extended sample of low-risk and high-risk siblings as well as the diagnostic outcome of the latter group will be presented at the conference.

94 **164.094** Linking Language: Characterizing Developmental Traits in Preschoolers with ASD

K. Berry[1], *J. Panganiban*[2], *W. I. Shih*[3] *and C. Kasari*[4], *(1)UCLA, Los Angeles, CA, (2)University of California Los Angeles, Arcadia, CA, (3)UCLA, Monrovia, CA, (4)University of California Los Angeles, Los Angeles, CA*

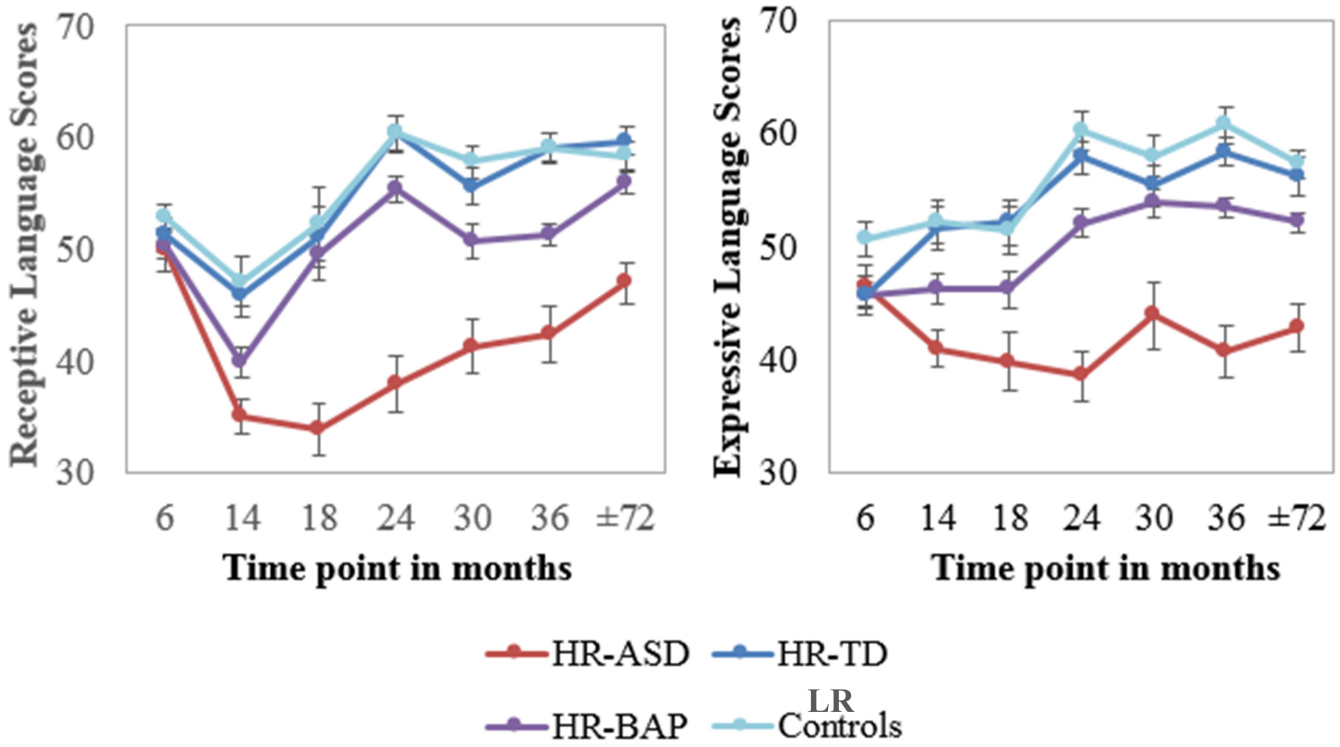
Background: Children with autism spectrum disorders (ASD) are characterized by marked impairment in communication. It is estimated that as much as 30% of children with ASD remain minimally verbal, even after receiving intervention.
Objectives: The goal of this study is to examine developmental characteristics of verbal and minimally verbal children with ASD between the ages of 2 and 5.
Methods: Eighty- five children between 24 and 63 months old (M= 46 mos.) diagnosed with ASD were included in this study. All participants completed a battery of experimental and developmental assessments such as the Mullen Scales of Early Learning to measure cognitive functioning, the Early Social Communication Scale which measures social communication and the Structured Play Assessment which is coded for spontaneous play acts. Participants were identified as minimally verbal based on their language produced during the ADOS (less than 5 words spoken). The groups were compared to examine developmental characteristics associated with expressive language group designation.

Results: Of the 85 children included in the sample 33 (39%) were identified as minimally verbal. Results indicate that the minimally verbal group is significantly lower in their overall DQ (p<.001), initiations of requests (p= .001), chronological age (p= .001), symbolic play types (p= .006) and frequency of symbolic play acts (p= .012). Surprisingly, initiations of joint attention gestures (IJA), excluding joint attention language, in the verbal group (M = 5.88) and minimally verbal group (M = 4.57) did not differ significantly.
Conclusions: These findings highlight several important factors in studying young, minimally verbal children with ASD. As expected, minimally verbal children with ASD scored lower on cognitive measures and were younger in age. Because younger children would be expected to be minimally verbal, these children should likely be considered preverbal. Longitudinal follow up data are critical to determine if younger preverbal children acquire spoken language or if there are particular characteristics that place them at high risk for remaining minimally verbal. Finally, contrary to expectations, minimally verbal children with ASD exhibited comparable levels of IJA gestures compared with their verbal counterparts. Considering the important role of social communication skills, such as IJA, in language acquisition, these data require further investigation.

95 **164.095** Longitudinal Predictors of Receptive and Expressive Language Outcomes at 6 Years in Younger Siblings of Children with ASD

R. Landa[1] *and K. J. Greenslade*[2], *(1)The Kennedy Krieger Institute, Baltimore, MD, (2)Kennedy Krieger Institute, Baltimore, MD*

Background: During the second and third years of life, younger siblings of children with ASD have a higher risk of developmental difficulties, including reduced receptive and expressive language abilities.
Objectives: To explore receptive and expressive language functioning in younger siblings of children with ASD, at school-age, and to identify early predictors of these outcomes.
Methods: Receptive and expressive language performance in 157 younger siblings of children with ASD (high risk, HR) and 33 low risk (LR) controls were assessed at least once between 4 and 12 years of age, using the *Test of Language Development* (*TOLD*), and at least once between 6 and 36 months (6,14,18,24,30, and/or 36 months), with the *Autism Diagnostic Observation Schedule* (*ADOS*; Lord et al., 2002, 2012) and *Mullen Scales of Early Learning* (*MSEL*; Mullen, 1995). Based on the 36-month assessments, siblings were subgrouped into ASD (HR-ASD, n=39), broad autism phenotype (BAP) (HR-BAP, n=73), and typically developing (HR-TD, n=45). The three HR groups and LR group were compared at each time point between 6 and 36 months, and the time point closest to 72 months (±72months). Analyses also examined predictive relationships with the *ADOS* and *MSEL*.
Results: Analyses of variance (ANOVAs) with the 3 HR groups and LR group revealed no significant differences at 6 months. ANOVAs at each subsequent time point revealed significant between-group differences (all p's<.001). LR and HR-TD groups did not differ significantly on receptive or expressive language scores at any time point. In contrast, after 14 months, the HR-ASD group consistently demonstrated significantly lower receptive and expressive language than the HR-TD group (p's≤.002). The HR-BAP group also demonstrated significantly lower receptive language at 14,24,30,36, and ±72 months (p's ≤.04) and expressive language at 14,18,24,36, and ±72 months (p's≤.04) in comparison with the HR-TD group. To examine early predictors, multiple linear regression models were generated for receptive and expressive language outcomes at ±72 months, using *ADOS* Communication+Social scores and *MSEL* Expressive Language scores at 24 months as predictors. The predictors accounted for a significant amount of variance in receptive and expressive language scores at ±72 months, p<.001. Both predictors had a unique effect on receptive language (positive for *MSEL*, p<.001; negative for *ADOS*, p=.03) and on expressive outcomes (positive for *MSEL*, p<.001; negative for *ADOS*, p<.01).
Conclusions: Younger siblings of children with ASD as a group are susceptible to reduced receptive and expressive language functioning compared to LR children. However, this susceptibility manifests differently based on 36-month diagnostic status: children meeting ASD or BAP criteria have the highest susceptibility to later lower language functioning. *ADOS* Communication+Social scores and *MSEL* Expressive Language scores at 24 months appear to be predictive of later language outcomes.



96 **164.096** Longitudinal, Cross-Modal Associations Appear to Differ in Typically Developing Toddlers As Compared to Children with ASD

K. Bottema-Beutel[1], *T. Woynaroski*[2] *and P. J. Yoder*[3], *(1)Lynch School of Education, Boston College, Chestnut Hill, MA, (2)Vanderbilt University, Thompsons Stn, TN, (3)Vanderbilt University, Nashville, TN*

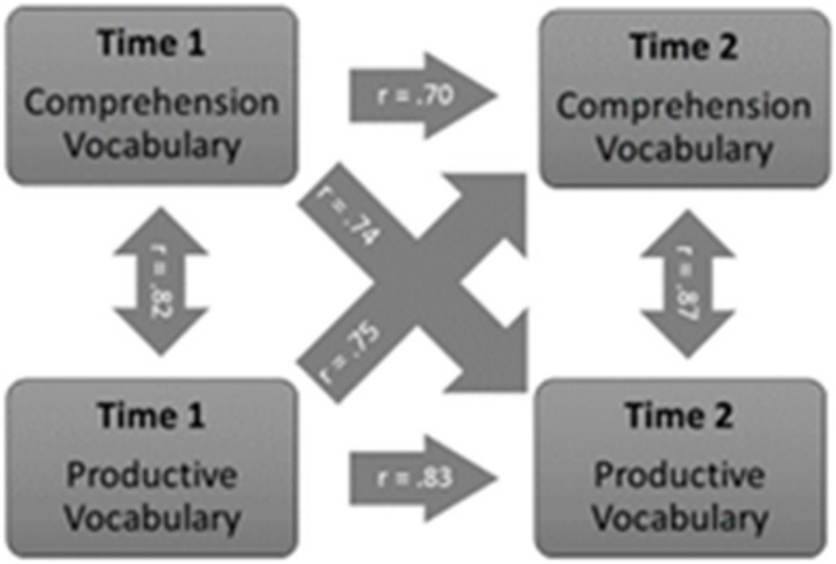
Background:
Recent research has found evidence that expressive language "drives" later receptive language in young, minimally verbal children with autism spectrum disorder (ASD) (Woynaroski et al., 2015). This result was interpreted as "atypical" because receptive language is presumed to drive expressive language in typically developing (TD) children. This assumption regarding what constitutes "typical" language development, however, rests largely on findings from descriptive research. For example, TD children have been observed to understand words before they are able to produce words and, at any given point in time, to have a larger receptive vocabulary than expressive vocabulary (e.g., Benedict, 1979). However, cross-modal longitudinal associations between expressive and receptive language in TD children have not been explicitly tested. Doing so would help researchers understand how the developmental trajectory found in ASD differs from typically developing children.
Objectives: To compare the cross-modal, longitudinal associations between expressive and receptive vocabulary in mental-age-matched TD toddlers and in young children with ASD who participated in Woynaroski et al. (2015).
Methods:
Participants included 62 TD toddlers with an average mental age equivalent of 14.4 months as assessed by the Mullen Scales of Early Learning. Parent-reported vocabulary was assessed at two time points, eight months apart, via the MacArthur Bates Communicative Development Inventories (MCDI) vocabulary checklist. Receptive and expressive vocabulary sizes were operationalized as the raw number of words that parents reported their children "understood" and "said", respectively. Missing data was handled using multiple imputation. . In making the cross-lagged comparison, this statistic takes into account concurrent associations across modalities and longitudinal associations within each language modality. We descriptively contrast our current results to Woynaroski et al.'s (2015) report on an ASD sample (n= 87), whose mental age equivalent was similar to the existing sample. Data collection and analysis procedures in the present study were identical to those employed by Woynaroski and colleagues.
Results: Cross-lagged, cross modal associations were high for both early receptive language to later expressive language (r = .74), *and* early expressive language to later receptive language (r = .75) for our TD sample. The difference in cross-lagged, cross-modal correlation magnitudes was not statistically significant (ZPF = -0.17, p= 0.87; See Figure 1). Table 1 juxtaposes results with the previously reported ASD sample.
Conclusions: This study provides added support for Woynaroski et al.'s interpretation of an "expression driven" profile observed for children with ASD as "atypical." Surprisingly, we did not find evidence that receptive language drives expressive language for TD children, as has previously been theorized. Unlike children with ASD, TD children experience a bi-directional effect of reception and expression. Further research is needed to tease apart divergent developmental trajectories in these two groups.

Table 1

Zero-order Correlations (Pearson's r), Test Statistic, and p Value for the Cross-lagged Panel Comparisons of the Associations between Early to Late Comprehension and Production Vocabulary for Typically Developing Children

Association		TD Sample Panel	ASD Sample Panel (Woynaroski et al., 2015)
Early Comprehension and Later Production		**.74*** **	**.42*** **
Early Comprehension and Early Production		.82***	.58***
Early Comprehension and Later Comprehension		.70***	.83***
Early Production and Later Production		.83***	.80***
Later Comprehension and Later Production		.87***	.53***
Early Production and Later Comprehension		**.75*** **	**.57*** **
	ZPF	-.17	-1.94
	p	.87	.05

Note. Scores are raw MCDI scores presenting size of comprehension and production vocabulary. Bolded coefficients are for associations of primary interest. ZPF is the test statistic for the difference between the nonindependence-adjusted partial correlations. For zero-order correlations, * p < .05, ** p < .01, *** p < .001.



Note. Coefficients are zero-order correlations.

Figure 1. Typically developing children do not show the atypical cross-modal profile that we have previously seen in a mental-age matched sample of children with autism spectrum disorder.

97 **164.097** The Relationship Between Joint Attention and Language in Autism Spectrum Disorder and Typical Development: A Systematic Review and Meta-Regression Analysis

***K. Bottema-Beutel**, Lynch School of Education, Boston College, Chestnut Hill, MA*

Background: Research has shown that joint attention plays a crucial role in the development of expressive and receptive language. However, joint attention is a complex construct, and the relative correlations of all different types on development have not been sorted out. In children with autism spectrum disorder (ASD), parsing the impacts of of joint attention is especially important, as joint attention delays negatively impact language development. This study used a structured literature search and meta-regression procedures to synthesize Pearson's *r* effect sizes measuring correlations between joint attention and language in typically developing (TD) children and children with ASD.
Objectives: To determine: 1) summary associations between joint attention and receptive and expressive language, for TD and ASD children, 2) whether diagnostic group moderates effect sizes, 3) whether joint attention type moderates effect sizes, and 4) which moderators maintain significance when significant moderators from simple meta-regressions were entered together.
Methods: Studies were located using database searches, hand searches, and electronic requests for data from approximately 200 experts in the field. The search resulted in 71 reports or datasets and 605 Pearson's *r* effect sizes, representing 1,859 participants with ASD and 1,835 TD participants (see Table 1 for sample and study characteristics). Robust variance estimation was used to account for clustering of effect sizes within studies. Meta-regression was used to answer research questions

regarding potential moderators of effect sizes. Joint attention types were categorized into initiating joint attention, responding to joint attention (RJA), coordinated attention, supported joint engagement, and coordinated joint engagement.
Results: Summary effect sizes collapsed across joint attention types varied by diagnostic group and language outcome (receptive language, $r = .27$ and $r = 43$ for TD children and children with ASD respectively; expressive language, $r = .22$ and $r = .45$ for TD children and children with ASD respectively). Meta-regression analyses indicated that effect sizes were significantly higher for the ASD group as compared to the TD group, and for RJA as compared to non-RJA joint attention types for both expressive and receptive language. Approximate mental age trended toward significance for expressive language, even after controlling for diagnosis and RJA (see Table 2 for full results of regressions).
Conclusions: Joint attention may be more tightly tied to language in children with ASD as compared to TD children because TD children exhibit joint attention at sufficient thresholds so that language development is a 'sure thing' and untethered to variations and joint attention. Conversely, children with ASD who exhibit deficits in joint attention develop language contingent upon their joint attention abilities. Because RJA was more strongly related to language than other types of joint attention, future research should consider carefully the operationalization and measurement of joint attention constructs. The results of this meta-analysis support intervention approaches that facilitate joint attention as a means to improve language outcomes in children with ASD.

Table 1

Means and standard deviations for continuous variables by diagnostic group and language variable

	ASD		TD	
	Expressive	Receptive	Expressive	Receptive
% male	81.16 (16.20)	80.52 (19.28)	47.75 (10.23)	52.03 (6.27)
Approx. MA at T1†	23.80 (13.06)	24.58 (16.08)	15.08 (5.21)	14.79 (5.78)
Time to Follow-up††	16.32 (27.17)	5.77 (12.76)	11.93 (19.86)	5.39 (6.47)
Year	2010 (5.52)	2010 (4.19)	2005 (6.26)	2005 (6.15)

† Chronological age in months for TD children, mental age in months for children with ASD, ††Months between joint attention assessment and language assessment
ASD = Autism Spectrum Disorder, MA = Mental Age, T1= Time 1, TD = Typically Developing

Table 2

Results of meta-regression analyses by language variable

	Coef.	SE	T^2	*k*	*n*
Expressive			0.071	54	334
Diagnostic Group	0.16**	0.06			
Approx. MA at T1	0.21†	0.11			
RJA	0.11†	0.06			
Receptive			0.056	40	209
Diagnostic Group	0.18**	0.06			
RJA	0.13*	0.06			

* $p = < 0.05$, ** $p = <0.01$, † $p = .07$ (for one tailed test, $p = .035$)
Coef. = Coefficient, *k* = number of studies or 'clusters', *n* = number of effect sizes, MA = Mental Age, RJA = Response to Joint Attention, SE = Standard Error, T^2 = Tau squared, T1 = Time 1

98 **164.098** Mobile Technology Usage By the Other Numbers: User Analytics for Assessing and Justifying Implementation of Mobile Applications

M. G. Zentner, *Information Technology, Purdue University, West Lafayette, IN*

Background:
Internet based businesses routinely collect data regarding customer behavior in order to exploit such behavior to expand their business. However, such companies also use these data to understand their effectiveness in serving their customers. The translation of research efforts in autism technology demands these same types of user analytics as rationale for those who would invest in and seek to promote the commercial enterprises that are essential for the translation of such research into practice. Translation necessitates the confluence of at least 4 key elements: societal recognition of a problem, a common understanding of the economics involved in addressing the problem, proof that delivery of a solution to the problem is accepted in the marketplace, and protectable intellectual property that allows an enterprise to recover the costs of translating the research into practice in the market.
Objectives:
The objectives of our activity are to address the double bottom line problem: how to translate research into practice in a manner that is economically feasible and

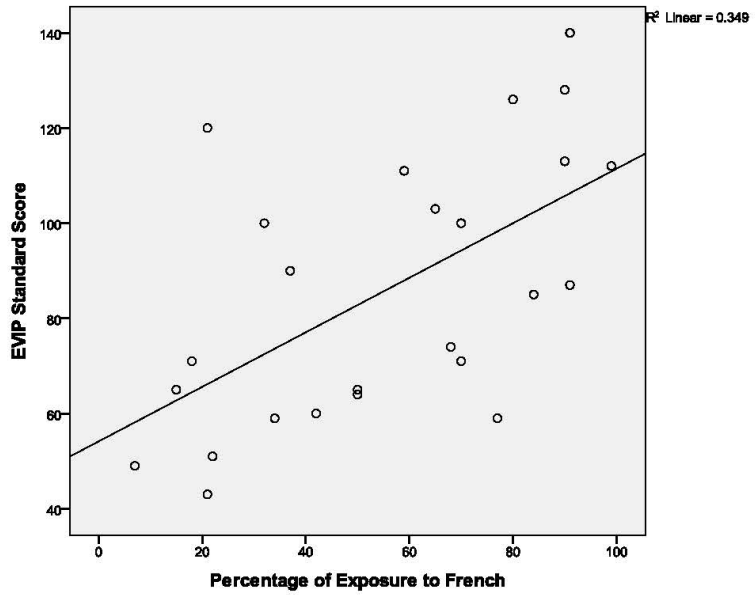
simultaneously provides societal benefit. The former activity is addressed by assessing the societal value of delivering more effective mobile technology solutions to the population affected by autism, while the latter focuses on measuring the degree to which this activity has the potential for impact.
Methods:
Autism tools created for today's popular tablet architectures (e.g. iOS, Android) can be fitted with common usage analytics collection tools (e.g. Google Analytics) as a first order usage information collection mechanism. We illustrate this scenario using an application for augmentative and alternative communication (AAC) training in minimally-verbal autism: The SPEAKall!® tablet application was instrumented with the Google analytics package to begin measurement of the communication activities performed by the population using SPEAKall!. This instrumentation allows the collection of usage patterns from a large population of AAC users, which is distinct from the assessment of individual effectiveness in and immediately after therapy delivery sessions. While collecting such usage patterns does not suffice as evidence for the effectiveness of a therapeutic approach, it does demonstrate the market acceptance and employment of an approach in practice, and is a completely objective measure of mobile technology usage intensity.
Results:
We present results of a population of users with autism using the SPEAKall! application instrumented with usage analytics. Specifically, we examine the difference in usage behaviors between those who receive free applications versus those who pay for the application. We also review the intensity of usage across the user population by studying the length of messages produced with the AAC solution. Further, we examine vocabulary growth by studying the degree to which users create new symbol vocabulary for use in their AAC applications. Finally, we also present a study of session length that provides a view into the frequency and timespan of user interaction with the AAC tool.
Conclusions:
Analytic collection tools can be used to track detailed usage of nearly all application features and provide a population based view of how mobile applications are used in intervention.

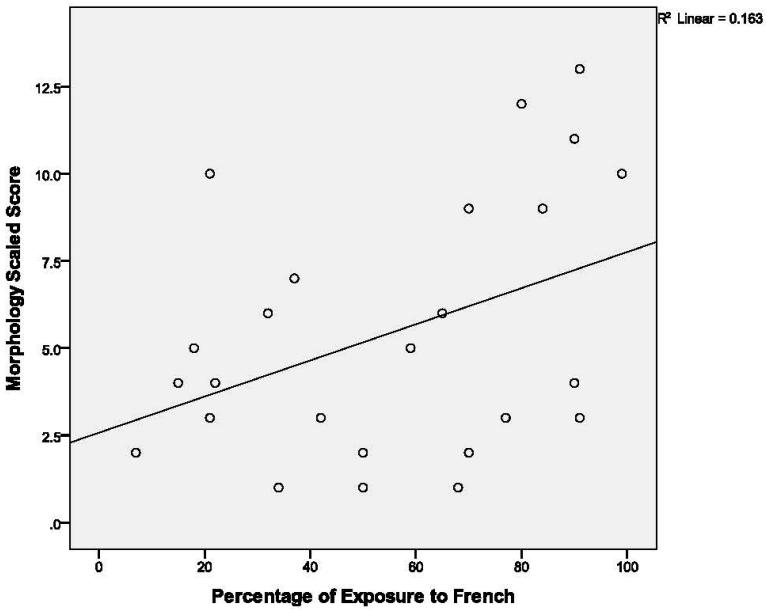
99 **164.099** Multilingual Language Environments and ASD: Relationships Between Amount of Language Exposure and Language Proficiency

A. M. Gonzalez Barrero *and A. Nadig, McGill University, Montreal, QC, Canada*

Background: It is commonly thought that children with communication disorders should only be exposed to one language, though research does not indicate additional language delays from bilingual exposure (e.g. Ohashi et al., 2012). To gauge the impact of bilingual environments on language development in Autism Spectrum Disorders (ASD), it is critical to understand the relationship between amount of language exposure and language proficiency**.** A recent study found that expressive vocabulary (by parent report) in the second language was highly correlated with the amount of recent exposure to that language in bilingual children with ASD (Hambly and Fombonne, 2014), suggesting that children with ASD learn a 2nd language when given adequate exposure. However, relationships between exposure and proficiency in different language domains (e.g., vocabulary, morphology, sentence repetition) for children with ASD in bilingual environments have not been studied.
Objectives: We examine relationships between amount of language exposure and language proficiency in children with ASD with varying degrees of exposure to French via direct assessment on standardized measures. Based on Hambly and Fombonne (2014) we hypothesize that amount of exposure to the target language will be highly correlated with proficiency in that language. We explore the relationship between amount of exposure and two previously unstudied expressive language skills: morphology and sentence repetition, as well as receptive vocabulary.
Methods: Twenty five 5- to 10-year-old children with ASD were included. Participants were exposed to varying amounts of French throughout their lifetime, ranging from French monolinguals to balanced bilinguals in French and another language (English or Spanish). Parents completed a detailed language exposure questionnaire. Following Thordardottir's (2011) methodology, each child was classified in one of five French exposure groups (e.g., 0-20%, 80-100%). Across these 5 groups children were matched on nonverbal IQ, chronological age and socio-economic status (via maternal education). Language proficiency was assessed using the morphology and sentence repetition sub-tests of the French version of the Clinical Evaluation of Language Fundamentals (CELF-4; Semel et al., 2003). Vocabulary was evaluated through the French version of the Peabody Picture Vocabulary Test (*EVIP*; Dunn, Theriault-Whelan, & Dunn, 1993).
Results: Groups did not differ significantly on nonverbal IQ (p=.18), chronological age (p=.85) or SES (p=.08). We found marginally significant correlations on the expressive language measures of morphology (r=.40, p=.045) and sentence repetition (r=.39, p=.056). A strong, significant correlation was found for receptive vocabulary (r=.59, p=.002).
Conclusions: We found correlations between language exposure and proficiency on a range of standardized measures. As reported for typical development (e.g., Pearson et al., 1997), amount of language exposure was not perfectly correlated with language skills and other factors play a role, especially for expressive language. Some children who had low levels of exposure to the target language still performed in the normal range on language measures. Additional analyses will explore relationships between exposure and both parent and observer-rated proficiency in French. These results support previous findings suggesting that children with ASD acquire two languages when provided with optimal opportunities to do so.

Figures



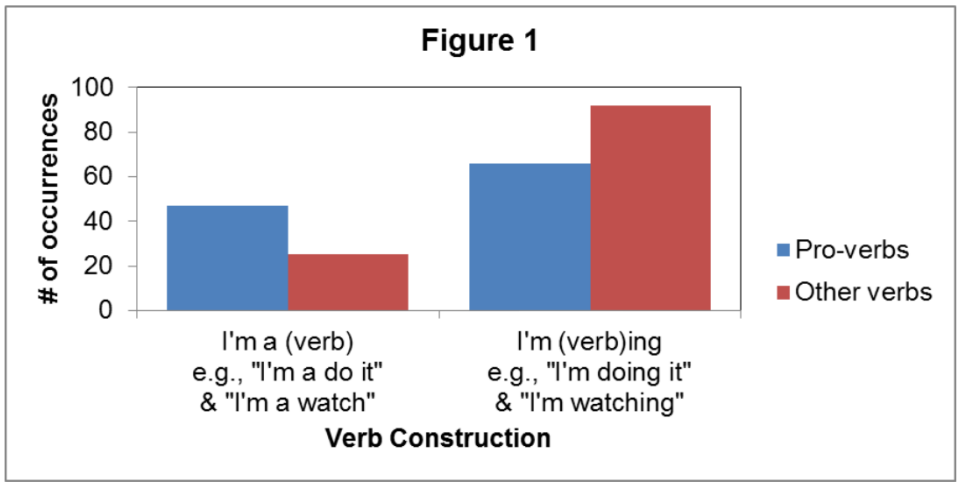


100 **164.100** Neologisms: A Case Study

N. N. Soja[1]*, M. S. Goodwin*[2] *and L. Naigles*[3]*, (1)Health Sciences, Northeastern University, Boston, MA, (2)Northeastern University, Boston, MA, (3)University of Connecticut, Storrs, CT*

Background: Children with Autism Spectrum Disorder (ASD) use neologisms (i.e., invented words or phrases) more frequently and more persistently than typically developing children (Volden & Lord, 1991). This unusual prevalence suggests a value to these made-up expressions and thus justifies and motivates the clarification of their function. One such neologism was found by Chin (2013) from a child, Audrey, with high-functioning ASD. Audrey said "I'm a (verb)," as in "I'm a watch," 72 times with 26 different verbs. Chin and colleagues (Chin et al., 2012, 2013) conjectured that the frame referred to the future, demonstrated that it was unattested in her input, and documented that it had mostly disappeared by the end of the study; however, the exact meaning of the frame is still unclear, as was Audrey's purpose in producing it.
Objectives: We investigated whether Audrey's "I'm a" frame was an alternative form of an existing expression by examining its privileges of occurrence relative to her future and present frames.
Methods: Audrey was a participant in the Speechome Project, which collected densely-sampled, high-quality audio-video recordings in homes during normal activities over four months (Vosoughi et al., 2012). At the time of the study, Audrey was 2;10-3;1, with a Mean Length of Utterance range of 2.2-3.5. Audrey's utterances of "I'm a (verb)" were compared with her uses of a conventional future frame ("I'm gonna (verb)") and a conventional present frame ("I'm (verb)ing"), as follows. First, her uses of "I'm a" and "I'm gonna" were coded as 'present' if they overlapped with their referent event or occurred within 30 seconds of it, because of children's difficulty with the boundaries of 'present'

(Harner, 1980). Referent events occurring more than 30 seconds later were coded as 'future'. Implications of this criterion are discussed further in the results. Second, her utterances of "I'm a (verb)" and "I'm (verb)ing" were coded according to the verbs they appeared with. Verbs were categorized as Pro-verbs (i.e., the verbs that children use first with multiple verb inflections: "go," "do," "make," "get," "eat," "sit," "ride," and "fix"; Bloom et al., 1980), or Other verbs (all others).
Results: (1) All but 1 of Audrey's uses of "I'm a" were produced in the context of 'present' activities, whereas 15 of 73 instances of "I'm gonna" referred to the future (chi2=12.12, p<.001). Moreover, those 15 cases of "I'm gonna" were not boundary cases, but referred to events happening in the distant future (e.g., bed time). (2) Audrey used "I'm a" more often with Pro-verbs, but "I'm (verb)ing" (N=158) more often with Other verbs (Figure 1, chi2=10.93, p<.001).
Conclusions: Audrey's usage of "I'm a" differed from both her use of the conventional future frame "I'm gonna" as well as of the conventional present frame "I'm (verb)ing". Thus, it does not appear to be an alternative form of either one, but possibly a wholly distinct construction. We continue to analyze its semantic/syntactic properties, as well as the contributions from Audrey's emotional state and cognitive demands, to discover just why it emerged.



K. J. Greenslade[1] *and R. Landa*[2]*, (1)Kennedy Krieger Institute, Baltimore, MD, (2)The Kennedy Krieger Institute, Baltimore, MD*

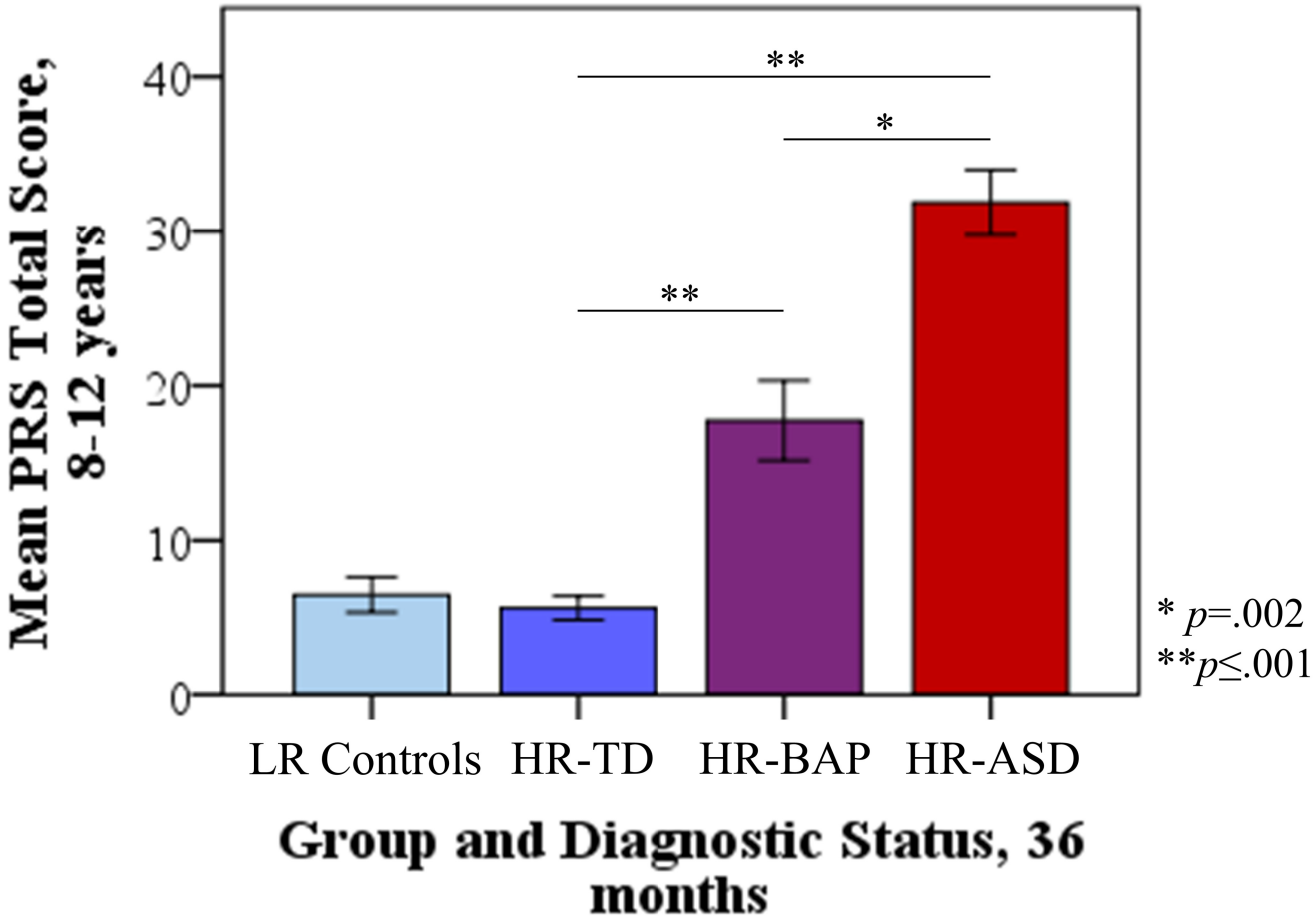
Background: Pragmatic language impairments are a hallmark of children with autism spectrum disorder (ASD; Simmons et al., 2014), and are sometimes observed in their parents (Hurley et al., 2007; Landa et al., 1992) and younger siblings (Ben-Yizhak et al., 2010; Miller et al., 2015). Limited research has examined predictors of later pragmatic language functioning (Gillespie-Lynch et al., 2015).
Objectives: To examine pragmatic language abilities in school-aged siblings of children with ASD, and identify early predictors of these abilities.
Methods: Between 8 and 12 years of age, 34 younger siblings of children with ASD (high-risk, HR) and 10 low-risk (LR) controls were assessed with the *Pragmatic Rating Scale–School-Age* (*PRS-SA*; Landa), scored based on behaviors observed during the *Autism Diagnostic Observation Schedule* (*ADOS*; Lord et al., 2002, 2012), Module 3 or 4. All participants also had been assessed at least twice between 14 and 36 months (14/18,24/30,and 36 months), with the *ADOS* and *Mullen Scales of Early Learning* (*MSEL*; Mullen, 1995). Based on 36-month assessments and clinical impressions, high-risk siblings were classified as ASD (HR-ASD,n=15), broad autism phenotype (BAP; HR-BAP,n=8), and typically developing (HR-TD, n=11). Nonparametric analyses compared *PRS-SA*scores across HR-ASD, HR-BAP, HR-TD, and LR controls; early predictors of later pragmatic language abilities were examined using Pearson's correlations and linear regression.
Results: A Kruskal-Wallis Chi-Square test revealed significant between-group differences in *PRS-SA* scores, $X(3)=33.28, p<.001$. Follow-up Mann-Whitney tests revealed:

- no significant difference between LR controls ($M=6.50, SD=3.60$) and HR-TD ($M=5.64, SD=2.58$), $Z=-0.57, p=.57$
- significantly lower (better) *PRS-SA* scores for HR-TD than HR-ASD ($M=31.87, SD=8.17$), $Z=-4.29, p<.001$, and HR-BAP ($M=17.75, SD=7.30$), $Z=-3.36, p=.001$
- significantly lower *PRS-SA* scores for HR-BAP than HR-ASD, $Z=-3.13, p=.002$.

Pearson's correlations were found between *PRS-SA* scores and 24-month:

- *ADOS* Communication+Social scores, $r=.60, p<.001, r^2=.36$.
- *MSEL* Receptive Language, Expressive Language, and Early Learning Composite scores, $r=-.60, p<.001, r^2=.36$; $r=-.51, p<.001, r^2=.26$; and $r=-.55, p<.001, r^2=.30$, respectively.

Linear regression analyses revealed that the *MSEL* Receptive Language score had a unique negative effect and *ADOS* Communication+Social scores had a unique positive effect on *PRS-SA* scores, ($b=-.35, SE=.15$), $t_{(36)}=-2.40, p=.02$ and ($b=.99, SE=.41$), $t_{(36)}=2.43, p=.02$, respectively. The model with both predictors accounted for a significant amount of variance in later pragmatic language functioning, $R^2=.45, F(2,39)=15.70, p<.001, R^2_{adjusted}=.42$.
Conclusions: The present data confirm poorer pragmatic language abilities in school-aged high-risk siblings with ASD and characteristics of the BAP, but not in siblings developing typically. These findings support recommendations to subdivide unaffected siblings into those who do and do not demonstrate BAP characteristics when examining pragmatic language (Ben-Yitzhak et al., 2011). Findings also suggest that autism-related social-communication and early learning abilities at 24 months are predictive of later pragmatic language functioning in high-risk siblings and low-risk controls. Continued investigation into the pragmatic language abilities of younger siblings of children with ASD and predictors of these abilities is warranted.



102 **164.102** Profiles of Pragmatic Language in Individuals with ASD and Their Parents

L. Bush[1]*, M. Lee*[1]*, N. M. Heckel*[1]*, A. Taylor*[1]*, A. L. Hogan-Brown*[2]*, G. E. Martin*[3] *and M. Losh*[4]*, (1)Northwestern University, Evanston, IL, (2)Psychology, University of South Carolina, Columbia, SC, (3)Communication Sciences and Disorders, St. John's University, Staten Island, NY, (4)Department of Communication Sciences and Disorders, Northwestern University, Evanston, IL*

Background: Pragmatic (i.e., social) language abilities are universally impaired in individuals with autism spectrum disorder (ASD; Tager-Flusberg, 2002). Previous research indicates that parents of individuals with ASD may demonstrate subtle differences in pragmatic language that reflect genetic risk and comprise a component feature of the broad autism phenotype (BAP; Landa, 1991, 1992; Losh et al., 2008, 2012). This study aimed to build on these findings by examining parallel pragmatic language features in parents and children during semi-naturalistic conversation, using the Pragmatic Rating Scale (PRS; Landa, 1992) and Pragmatic Rating Scale-School Age (PRS-SA; Landa, 2011). We employed factor analyses in each sample to identify whether similar pragmatic language violations were observed in individuals with ASD and their parents. Further, we examined a range of potential phenotypic correlates in each group.
Objectives: To define potentially overlapping profiles of pragmatic language in individuals with ASD and their parents (with and without the BAP), and to explore correlated skills.
Methods: The PRS-SA and PRS consist of similar, operationally-defined pragmatic language features rated by blind coders from videotaped semi-structured conversational tasks (ADOS, and Life History Interview, respectively). To identify factors comprising pragmatic language characteristics of each group, Principal Component Analyses were completed on PRS-SA/PRS data from 53 school-aged individuals with ASD (IQ>80, age ≤19) and 186 parents of individuals with ASD. PRS-SA/PRS data were also included

from controls (22 children and 60 parents) to examine group differences and related correlates. Analyses controlled for differences in IQ and chronological age. Given prior research demonstrating links between social cognition and pragmatic language use (Losh & Piven, 2007), all participants completed a social cognition battery. BAP status was determined using the Modified Personality Assessment Scale (Tyrer, 1988).
Results: Findings indicated a two-factor model of pragmatic language in parents of individuals with ASD, characterized by Reserved and Dominant conversational features. A three-factor model emerged in individuals with ASD, which included nearly identical profiles as their parents plus an additional Disinhibited factor. Individuals with ASD scored significantly higher than controls and BAP+ parents scored significantly higher than BAP- and control parents across factors. In the ASD group, Reserved scores positively correlated with ADOS severity overall (r = .47) and social affect severity (r = .61), whereas Dominant (r = .54) and Disinhibited (r = .44) styles were positively associated with severity of restricted and repetitive behaviors. Finally, higher Dominant scores were negatively associated with social cognitive ability in parents and their children with ASD (rs > .3).
Conclusions: To our knowledge, this is the first study to employ factor analysis to identify overlapping pragmatic language profiles in individuals with ASD and their parents. Results suggest that qualitatively similar types of pragmatic language differences characterize ASD and the BAP, although these features are very subtly expressed in parents. Further, factors related to different aspects of ASD severity, and social cognition emerged as key correlates of pragmatic language across groups. Together, findings highlight pragmatic language as a valuable marker of genetic risk.

103 **164.103** Pronoun Interpretation Problems in Primary School-Aged Children with Autism Spectrum Disorder

J. Overweg[1]*, C. A. Hartman*[2] *and P. Hendriks*[1]*, (1)University of Groningen, Groningen, Netherlands, (2)University of Groningen and University Medical Center Groningen, Groningen, Netherlands*

Background: Personal pronoun reversal, i.e. saying *you* when meaning *I* and vice versa, is a well-known linguistic characteristic of children with Autism Spectrum Disorder (ASD). It is described as an idiosyncratic language problem in the DSM-5 diagnosis of ASD (American Psychiatric Association [APA], 2013). Pronoun reversals are viewed as manifest only in early development (Tager-Flusberg, 1994). However, Mizuno and colleagues (2011) showed that, in interpretation, even adults with high-functioning ASD have problems with personal pronouns and that these problems may be due to a failure in perspective-shifting between the roles of hearer and speaker.
Objectives: This study aimed to determine 1) whether primary school-aged children diagnosed with ASD show problems with pronoun interpretation in situations that require a perspective-shift and 2) which cognitive processes are needed to arrive at a correct interpretation of pronouns in these situations.
Methods: Forty-eight average functioning children with ASD and 43 typically developing (TD) children (age 6-12) participated in a larger study on language and communication in children with ASD. Clinical diagnosis of children in the ASD group was confirmed by the Autism Diagnostic Interview and/or Autism Diagnostic Observation Schedule. In a pronoun task children watched a short movie with three animals. An example of an item is: Pig whispered something in Frog's ear. After that Frog reported to Dog: "Pig said: 'You get the car'". The participant had to select the correct referent of *you*. To arrive at the correct interpretation of *you*, a perspective-shift is needed from the reporting context, where Dog is the referent of *you*, to the reported context, where Frog is the referent of *you*. In addition, cognitive tasks were administered to measure these children's Theory of Mind (ToM), cognitive inhibition, cognitive flexibility, working memory (WM), IQ and verbal ability.
Results: All children had problems interpreting pronouns in situations that required a perspective-shift. Whereas the TD children made less errors the older they were, the children with ASD did not show improved pronoun interpretation with age. An investigation of the cognitive processes involved in pronoun interpretation in perspective-shifting situations showed that, in all children, ToM, WM, IQ and verbal ability are needed for a better understanding of pronoun interpretation. Specifically for children with ASD, problematic pronoun interpretation was found to be related to second-order ToM understanding. Children with ASD with high second-order ToM understanding did not improve with age in pronoun interpretation, whereas TD children did.
Conclusions: Our findings suggest that primary school-aged children with ASD show a delayed development of pronoun interpretation. This delay seems to be due to problems with ToM. Our findings suggest that the pronoun interpretation problems in children with ASD should be seen as a perspective-taking problem in language, rather than an idiosyncratic language problem. Also, the pronoun problems in ASD should not be viewed as only manifest in early development, but in later development as well.

104 **164.104** Psychometric Properties, Classification, and Clinical Correlates of the Children's Communication Checklist – 2nd Edition in Autism Spectrum Disorder

J. Parish-Morris[1]*, A. de Marchena*[1]*, L. M. DePolo*[1]*, L. Bateman*[1]*, E. F. Ferguson*[1]*, K. J. Payton*[1] *and R. T. Schultz*[2]*, (1)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (2)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA*

Background: The Children's Communication Checklist-2ndEdition (CCC-2; Bishop, 2006) is a widely used measure of structural and pragmatic language that has been shown to capture the social communication deficits of autism spectrum disorder (ASD). The CCC-2 is more sensitive to the pragmatic language impairments of ASD than the Test of Pragmatic Language (Volden & Philips, 2010), and distinguishes ASD from other disorders such as Attention Deficit Hyperactivity Disorder (Geurts et al., 2004) and Specific Language Impairment (Bishop, 2006). The CCC-2 consists of 10 subscales (A-J) of 7 questions each. Scales A-D measure structural language, E-H pragmatic language, and I-J behaviors specific to ASD. The General Communication Composite (GCC) and the Social Interaction Difference Index (SIDI) measure overall communication ability and special impairments not due to structural language problems, respectively. The original standardization sample from Bishop (2006) included just 62 participants with ASD, and internal consistency was not reported for any clinical population.
Objectives: Estimate the internal consistency of the CCC-2 scales in a large sample of individuals with and without ASD; provide descriptive data on CCC-2 performance in a subsample of ASD and TDC matched on age and race/ethnicity; determine the utility of the CCC-2 for classifying ASD, TDC, and Other (Rule Out ASD); assess relationships between CCC-2 scores and parent report/clinical observations of social impairment (Social Responsiveness Scale (SRS; Constantino, 2003) and ADOS calibrated severity subscores).
Methods: Parents/caregivers of children aged 6-18 provided CCC-2 data in the context of participation in several specific studies. Research reliable PhD-level clinicians classified children as having a diagnosis of ASD, Other (Rule Out ASD), or typical development (TDC). The analyzed sample consisted of 668 participants with summary scores; 473 with item-level scores, and 429 ASD/TDC matched on age, race, and ethnicity. Cronbach's coefficient alpha was used to estimate reliability and unidimensionality, logistic regression for classification; Pearson correlations assessed relationships to other parent/clinician ratings.
Results: Subscale reliability ranged from .62-.82 in the ASD group and .67-.83 in the Other group (Table 1). Estimated marginal means for subscale, GCC, and SIDI scores differed significantly between the ASD and TDC groups (Table 2). Logistic regression controlling for age, nonverbal and verbal IQ, sex, race, and ethnicity revealed a significant contribution of GCC to distinguishing ASD from TDC (Beta=-.27, p<.001), increasing sensitivity from 88% to 97% and increasing specificity from 46% to 94%; there was no classification benefit of the GCC for distinguishing ASD from Other. In all three groups, the GCC and SIDI correlated negatively with SRS scores (all ps<.05). The ADOS severity subscore for social affect correlated negatively with GCC in the ASD group and SIDI in Other (ps<.05). Correlations with the ADOS repetitive behaviors/restricted interests severity subscore were not significant.
Conclusions: The CCC-2 is a valuable tool for assessing pragmatic language in ASD, with most subscales and the GCC reaching internal reliabilities of >.7. The GCC distinguishes between ASD and TDC (but not ASD and Other), and correlates with clinician/parent measures of social impairment. 195 additional item-level sets will be included by May 2016.

Table 1. Cronbach's coefficient alpha for TDC, ASD, and Other (Rule Out ASD). Groups were not matched on age, sex, IQ, race, or ethnicity, so columns should interpreted independently. The current TDC group has lower subscale reliability than the original standardization sample, which may be attributable to different age ranges (6-18 vs. 4-16) and sample size.

	TDC (N=147)	ASD (N=264)	Other (N=62)
Scale A - Speech	0.68	0.80	0.83
Scale B - Syntax	0.26	0.82	0.80
Scale C - Semantics	0.48	0.71	0.74
Scale D - Coherence	0.70	0.76	0.80
Scale E - Initiation	0.63	0.72	0.76
Scale F - Scripted Language	0.44	0.70	0.78
Scale G - Context	0.57	0.73	0.76
Scale H - Nonverbal Communication	0.43	0.71	0.70
Scale I - Social Relations	0.43	0.66	0.68
Scale J - Interests	0.57	0.62	0.67
GCC - item-level sample (A-H)	0.83	0.88	0.91
GCC - full sample (TDC=184, ASD=393, Other=91)	0.82	0.88	0.90

Table 2. Estimated marginal means and standard error of the mean for the comparison subsample matched on age (TDC: 11.18; ASD: 11.47), race (TDC: 76% White, ASD: 77% White), and ethnicity (TDC: 6% Hispanic, ASD: 10% Hispanic), but not sex (TDC: 79% male, ASD: 89% male) or IQ (TDC: 113, ASD: 93), which we controlled in the GLM.

	TDC (N=184)		ASD (N=245)	
	EMM	SEM	EMM	SEM
Scale A - Speech	11.01	0.19	8.78	0.16
Scale B - Syntax	10.78	0.18	8.14	0.16
Scale C - Semantics	11.50	0.17	7.77	0.14
Scale D - Coherence	11.47	0.18	5.96	0.15
Scale E - Initiation	12.40	0.19	6.17	0.16
Scale F - Scripted Language	11.82	0.18	6.03	0.15
Scale G - Context	11.72	0.17	5.66	0.15
Scale H - Nonverbal Communication	11.69	0.17	4.39	0.15
Scale I - Social Relations	11.81	0.17	5.10	0.15
Scale J - Interests	12.83	0.20	5.34	0.17
GCC	113.11	0.82	79.08	0.71
SIDI	4.32	0.60	-9.56	0.51

105 **164.105** Rapid Automatized Naming As a Marker of Genetic Liability to Autism: An Eye Tracking Study

K. Nayar[1], *A. L. Hogan-Brown*[2], *C. La Valle*[3], *W. McKinney*[3], *P. C. Gordon*[4], *G. E. Martin*[5], *E. Norton*[3] *and M. Losh*[3], *(1)Northwestern University, Chicago, IL, (2)Psychology, University of South Carolina, Columbia, SC, (3)Northwestern University, Evanston, IL, (4)University of North Carolina at Chapel Hill, Chapel Hill, NC, (5)Communication Sciences and Disorders, St. John's University, Staten Island, NY*

Background: Rapid Automatized Naming (RAN) is a complex skill that indirectly measures the automaticity of cognitive and linguistic processes, associated with left hemispheric language and right cerebellar regions (Norton and Wolf, 2012). Evidence suggests that RAN is affected in autism spectrum disorder (ASD) and in the broad autism phenotype (BAP) among first-degree relatives (Losh et al., 2010; Hogan-Brown et al., 2014). Smaller eye voice span (EVS) (i.e., less lead in eye movement compared to speech) is associated with less fluent and automatized language processing in individuals with ASD and their siblings (Hogan-Brown, 2014). This study extends upon these findings by further examining eye movement during RAN in parents with and without the BAP, in addition to high functioning individuals with ASD. Comprehensive analyses of eye movements (e.g., EVS, saccades) in parents and individuals with ASD can provide fruitful clues into the automaticity and executive efforts exhibited during RAN and their genetic liability to ASD.

Objectives: To use eye tracking to examine underlying mechanistic processes of RAN abilities in individuals with ASD and their parents, and explore correlations with conceptually related clinical-behavioral phenotypes.

Methods: Fifty-five individuals with ASD, 43 controls, 136 parents of individuals with ASD, and 57 control parents completed RAN on an eye tracker. The RAN task involved quickly naming arrays of stimuli (letters, colors, numbers, objects). Naming time and errors were measured. Eye-tracking analyses included three indices of automaticity and efficiency: 1) *EVS*; 2) *average saccades per vocalization;* and 3*) perseverative saccades,* the number of repeated saccades made at the target or a previously-visited target during a vocalization. The BAP was measured in parents using the Modified Personality Assessment (Tyrer, 1988).

Results: Results indicate slower naming time and more errors in individuals with ASD and their parents (ps <.05), with differences in parents restricted to the less highly automated color and object trials. Eye movement analyses show smaller EVS in individuals with ASD (p <.01) and similar trends in their parents. Individuals with ASD and their parents made more perseverative saccades (ps <.05) than controls. Eye movement differences were evident specifically in the BAP(+) group, and predicted narrative ability in parents. In ASD, errors were associated with restricted and repetitive behaviors (RRBs) and errors and saccadic patterns were associated with poorer pragmatic language and narrative abilities (ps <.05).

Conclusions: Differences in RAN performance and associated eye movements indicate reduced automaticity in ASD and the BAP. This illustrates the reliance on greater attentional and executive resources during language processing among these groups. Further, associations between RAN time, errors, and perseverative saccades were associated with rigid personality traits in parents and restricted and repetitive behaviors in their children, highlighting perseverative tendencies commonly implicated in ASD

(Hill 2004). Together, results suggest that reduced automaticity is associated with downstream cognitive indices of executive flexibility and language, emphasizing automaticity as a critical precursor to complex language skills and a potential indicator of genetic liability to ASD.

106 **164.106** Relations Among Parent-Reported and Spontaneous Gestures, Fine Motor, and Language in Young Children with ASD: A Structural Equation Model Approach

D. L. Mead[1], *S. S. Manwaring*[2], *L. B. Swineford*[1] *and A. Thurm*[1], *(1)Pediatrics and Developmental Neuroscience Branch, National Institute of Mental Health, Bethesda, MD, (2)University of Utah, Salt Lake City, UT*

Background: Gestures and fine motor skills have been found to be related to language outcomes in young children with and without autism spectrum disorder (ASD). Evidence suggests some measurement variability between parent report and direct observation of gestures, resulting in research using either one mode of measurement or creating a standardized composite score for overall gesture use to predict language outcomes. To our knowledge, studies have not examined gesture use as an underlying, latent construct in a structural equation modeling framework, a powerful method of analysis that captures the variability and covariance of many individual components.
Objectives: This study examined the relationship among gesture, fine motor ability, and language in young children with ASD using structural equation modeling.
Methods: A total of 197 children were classified into three groups: ASD (n=110), non-spectrum developmental delay (DD; n=35), and typical controls (TYP; n=52) based on an evaluation conducted between the ages of 12 to 48 months (M=34.55, SD=8.41). Behavioral assessments included the Mullen Scales of Early Learning (MSEL) and the Autism Diagnostic Observation Schedule (ADOS), and parent-report measures included the Communication and Symbolic Behavior Scales Developmental Profile Caregiver Questionnaire (CSBS-CQ), the Vineland Adaptive Behavior Scales, Second Edition (VABS-II), and the MacArthur-Bates Communicative Development Inventories (CDI). CSBS-CQ and ADOS gesture items, MSEL and VABS-II age equivalents for fine motor, receptive, and expressive language, and CDI words understood/produced were used in analyses.
Results: A series of confirmatory factor analyses (CFA) was first run that found individual gesture items on the CSBS-CQ and the ADOS loaded significantly onto underlying gesture use. Next, a model testing the correlations between the factor scores from the CSBS-CQ, ADOS, and Fine Motor (MSEL, VABS-II) across all children revealed a strong, positive correlation (r=.70) between fine motor and parent-reported gestures (CSBQ-CQ), and strong, negative correlations between spontaneous gesture use (i.e., fewer gestures result in higher scores in ADOS) and both fine motor (r=-.52) and parent-report of gestures (r=-.80) (Figure1). The fit indices for the overall model revealed good fit; however, when models were run separately for the ASD and non-ASD groups (DD+TYP), the results indicated good model fit only for the ASD group. Finally, a model was run to identify if the CSBS-CQ, ADOS, and Fine Motor domains loaded significantly onto one, latent construct of “gestures” to predict concurrent language outcomes (MSEL and VABS-II, CDI). For expressive language, the model did not fit across the entire sample, or in either grouping. However, for receptive language, the ASD-only model revealed good fit, resulting in better overall gesture use predicting better performance on receptive language measures (Figure2).
Conclusions: An underlying construct of gesture use was found among parent-reported and spontaneous gestures, as well as fine motor, which differs from the traditional method of analyzing each domain separately or as with composite scores. Overall gesture use predicted concurrent receptive language in ASD, but not expressive language. The predictive model was not found in the non-ASD group, which may be due to reduced variability among gesture use.

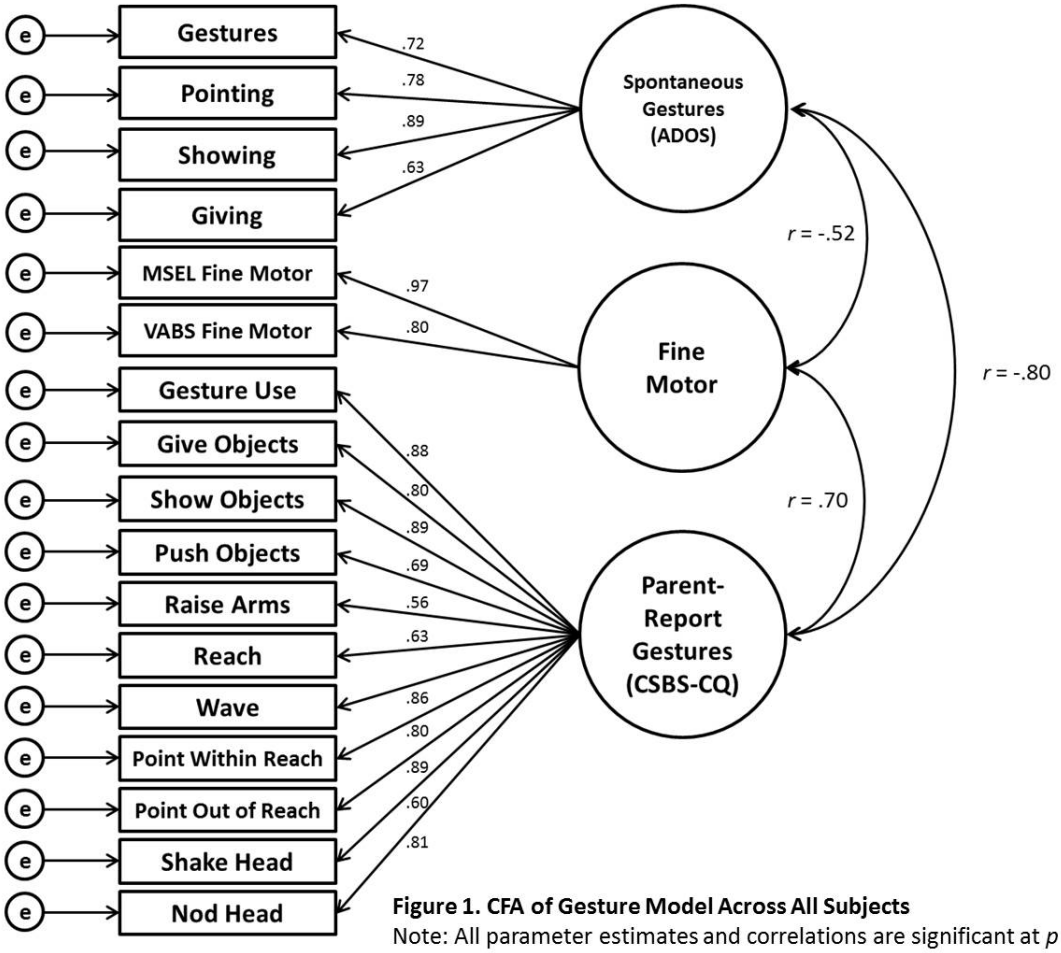


Figure 1. CFA of Gesture Model Across All Subjects
Note: All parameter estimates and correlations are significant at $p < .001$,
Fit indices: $\chi 2(116)=160.40$, $p<.05$; RMSEA=0.04, CFI=0.98

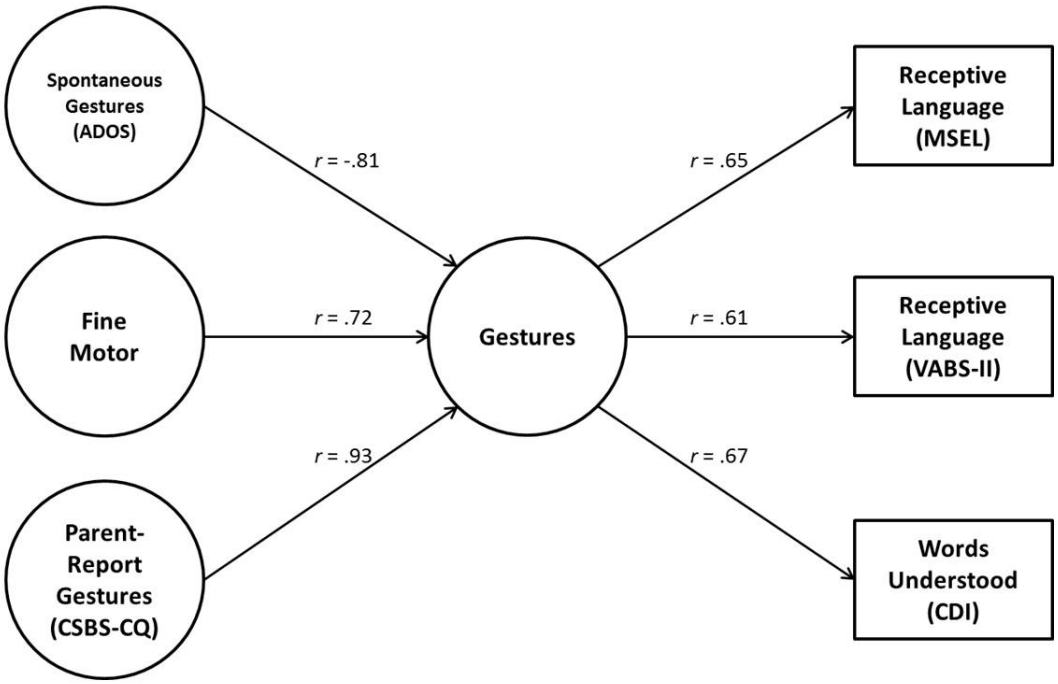


Figure 2. SEM model for Gestures Predicting Receptive Language in ASD-only
Note: All parameter estimates and correlations are significant at $p < .001$,
Fit indices: ($\chi 2(6)=9.13$, $p=.17$; RMSEA=0.07, CFI=0.99)

107 **164.107** Relations Between Computerized LENA Recordings of Conversational Turns and Lab-Based Measures of Social Engagement in Children with Autism Spectrum Disorder

M. Sabatos-DeVito, *E. Paisley, C. H. Stoute, J. Newman, K. S. Davlantis and G. Dawson, Duke Center for Autism and Brain Development, Duke University School of Medicine, Durham, NC*

Background: Social communication impairments are core deficits and prognostic indicators of Autism Spectrum Disorder (ASD). A key challenge in the design and evaluation of ASD treatments is identifying measures of social communication that are ecologically valid, quantitative, and scalable for large clinical trials. Computerized home-based recordings of social communication, such as conversational turns, are promising alternatives to lab-based measures that require labor-intensive human coding. However, more research is needed to determine the extent to which such computerized recordings correlate with well-established, lab-based measures of social communication.

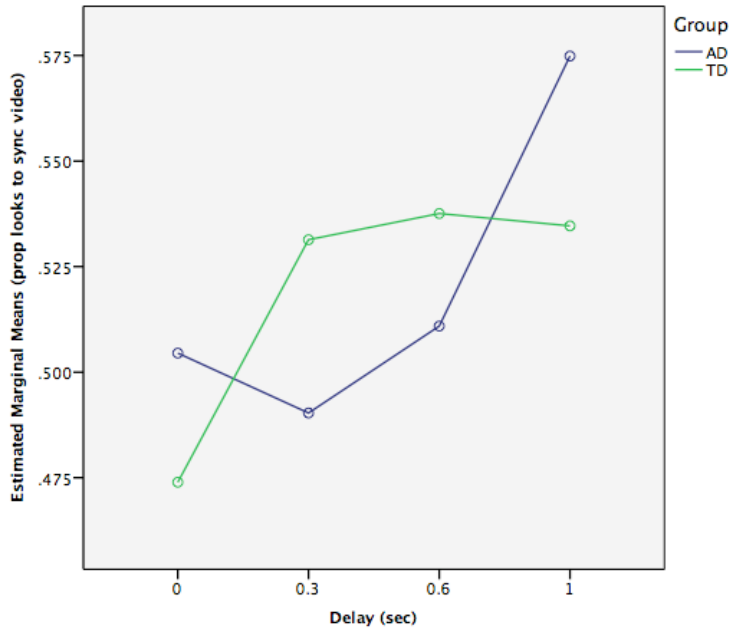
Objectives: Aim one of this study was to examine the correlation between a computerized home-based measure of social communication and a measure of social

communication derived from human coding of a laboratory-based parent-child play interaction. Aim two assessed the relationships between expressive language in children with ASD and both home-based computerized measures and lab-based coded measures of social communication.
Methods: Data were collected on children with ASD (N=25, Mean Age=4.47 years, Range=2.27-5.98 years; Mean Nonverbal IQ=64.3 +/- 24.6). ASD diagnosis was based on the ADOS-2 and ADI-R. Measures consisted of (1) a computerized measure of social communication collected with the LENA (Language Environmental Analysis) System at home, which automatically recorded adult and child word/vocalizations and conversational turns (Mean: 15.95 recorded hours; Range: 14.8 – 16 hours), (2) reliable human coding of the duration of child social engagement states during a lab-based, parent-child interaction, and (3) a standardized measure of expressive language (Expressive One Word Vocabulary Test). Parent-child play (8 minutes) was coded for six child-focused engagement states: Unengaged, Onlooking, Object, Person, Supported, Coordinated (Adamson et al. 1998). Using LENA, we calculated the average number of conversational turns during each conversation, the average duration of conversational blocks, and adult word count and duration during conversations. Data collection and coding are ongoing; final results will include additional data.
Results: Analyses of coded parent-child interactions (N=11) revealed that average parent-child conversational turns during conversational blocks at home (LENA) was significantly negatively related to the proportion of time in unengaged and supported engagement states (r=-0.701, p<0.05; r=-0.69, p<0.05, respectively), and positively related to the proportion of time in coordinated engagement (r=0.75, p<0.01) during lab-based play. Results were the same for average duration of conversational blocks. Adult word count during conversations (LENA) was significantly negatively correlated with proportion of time unengaged (r=-0.648, p<0.05) and positively related to coordinated engagement (r=0.661, p<0.05) during parent-child play. Child expressive vocabulary scores were significantly negatively related to supported engagement (r=-0.658, p<0.05) and positively related to coordinated engagement (r=0.916, p<0.001). Coding is ongoing and additional analyses will compare engagement states, conversational turns, and adult words of minimally verbal and verbal children.
Conclusions: This study is one of the first to investigate associations between home-based computerized measures and lab-based coded measures of social communication between a parent and child with ASD. Results suggest that home-based computerized measures of social communication may offer a scalable, reliable, and quantitative outcome measure for use in clinical trials of treatments for social communication impairments in young children with ASD.

108 **164.108** Sensitivity to Audio-Visual Synchrony and Its Relation to Language Abilities in Children with ASD

G. Righi[1], *E. Tenenbaum*[2], *D. Amso*[3] *and S. J. Sheinkopf*[4], *(1)Alpert Medical School of Brown University, rumford, RI, (2)Brown Center for the Study of Children at Risk at Women and Infants Hospital, Providence, RI, (3)Cognitive, Linguistic, and Psychological Sciences, Brown University, Providence, RI, (4)Brown Center for the Study of Children at Risk, Women & Infants Hospital The Warren Alpert Medical School of Brown University, Providence, RI*

Background: Recent findings show that increased attention to the mouth is related to greater success in language learning among typically developing children and children with autism (Tenenbaum, Amso, Abar, & Sheinkopf, 2014; Tenenbaum, Sobel, Sheinkopf, Malle, & Morgan, 2014). What is not yet clear is the mechanism by which attention to the mouth may be related to language development. Children with impaired language abilities may have trouble processing speech because it is a complex multimodal signal comprised of both auditory and visual information. Hence, children might look away from the mouth in an attempt to simplify their perceptual experience. Previous findings suggest that children with autism show impaired recognition of audio-visual synchrony (Bebko, Weiss, Demark, & Gomez, 2006; Irwin & Brancazio, 2014; Irwin, Tornatore, Brancazio, & Whalen, 2011; Smith & Bennetto, 2007) and look less at the mouth than typically developing peers in audio-visual processing tasks (Irwin & Brancazio, 2014).
Objectives: (1) To replicate findings showing reduced sensitivity to audio-visual synchrony among children with autism; (2) To determine whether sensitivity in processing of audio-visual synchrony is related to language ability among children with autism.
Methods: Children with ADOS confirmed diagnoses of autism (AD; n = 23, M = 5.76 years, SD = 1.76) and typically developing children (TD; n = 19, M = 2.62, SD= 1.75) matched on language ability viewed twelve trials. Each trial was composed of two videos of a woman speaking in animated infant directed speech. One side of the screen displayed a video that was synchronized with the audio track and the other showed a video that was asynchronous at one of four delays (0ms, 330 ms, 660ms, and 1000ms). The dependent measure was proportion of looking time to the synchronous video.
Results: Repeated measure mixed general linear model was used with group (TD vs. AD) as a between subject factor and delay (0, 330, 660, 1000ms) as a within-subject factor. Results showed a significant main effect of delay ($F(3,37) = 11.8$, p<0.01). Post-hoc tests revealed a significant difference between the 0- and 1000-ms-delay conditions (p<0.05). No overall group differences or significant interactions were observed. Visual inspection of within group means suggests that TD children were sensitive to all delays whereas AD children were only sensitive to the 1000 ms condition (though differences were not statistically significant). Bivariate correlations revealed a marginally significant relationship between the dependent measure at 1000 ms delay and PLS Expressive Scores in the AD group (r = -.38, p<0.1); TD children showed the reverse pattern (r = 31, ns).
Conclusions: These preliminary results suggest that consistent with prior findings TD children are more sensitive to audio-visual synchrony than AD children. Contrary to predictions, AD children with higher expressive language abilities did not show a preference for synchronous videos. This surprising result may reflect differences in the mechanisms underlying language learning in ASD. Data collection is still underway and final analyses will explore this relationship further.



109 **164.109** Sensitivity to Subtle Changes: A Signal Detection Analysis of Memory for Faces, Objects, and Spoken Words in ASD

A. Hogstrom*, J. Green, A. Canfield, B. Castelluccio, M. Smith and I. M. Eigsti, Psychological Sciences, University of Connecticut, Storrs, CT*

Background:
Individuals with autism spectrum disorder (ASD) demonstrate hyperspecificity of information processing (McClelland, 2000). More detail in initial sensory/perceptual encoding (Mottron et al 1999) could potentially play a causal role in social and communicative deficits (Eigsti & Fein, 2013). A diagnosis of ASD will broadly impact recall for *socially-relevant* stimuli, but hyperspecific perceptual encoding might impact recognition of stimuli when presented with novel perceptual features.
Objectives:
The current study was designed to assess memory for stimuli that varied in social relevance and sensory modality. We predicted that individuals with ASD would be less accurate than their peers with typical development (TD) in recalling faces and spoken words, relative to non-social objects. The study also assessed the impact of enhanced sensory encoding in ASD on recall of non-meaningful changes in a memory task. We expected the ASD group to show greater effect of non-meaningful changes, across categories.
Methods:

Adolescents ages 12-18 with high-functioning ASD (*n*=10, IQs > 85) and TD (*n*=12; no group differences in gender or FSIQ) completed a stimulus recall task. Subjects were presented with, and asked to remember, three blocks of randomly-ordered stimuli: pictures of household objects, pictures of emotionally-neutral faces, and spoken high-frequency words. Order of block presentation was random. After a 30-minute delay, subjects were presented with the original and novel stimuli, and asked to report whether each item had been presented previously ("Old") or not ("New"), ignoring (with explanation) any changes. Of the Old stimuli, 50% were unchanged; 50% ("Change") were presented at 30° rotation (Faces, Objects) or spoken by a new talker (Words).

Results:

Accuracy was calculated using d'. Analyses revealed main effects of category and group, and a category-by-group interaction, *p*'s<.05. Across groups, accuracy was highest for Words, then Objects, and lowest for Faces (see Table 1). While the ASD group was generally less accurate, group differences were significant only for Faces. Second, a within-group analysis of accuracy for Old versus Change stimuli showed a near-significant (*p*=.07) difference in Word recall, for the TD group only. Across groups, Faces were most difficult to recall, with low accuracy regardless of Change status; recall for Objects was relatively unaffected by small changes. In contrast, the TD group was somewhat less accurate in recalling Change Words, whereas the ASD group showed no such decrement. Our final sample of 30 will be powered to reveal whether these preliminary results hold.

Conclusions:

As expected, the ASD group showed impaired recall; however, this deficit only appeared for Faces, and not for spoken Words. Faces accuracy was very low, obscuring effects of changes in orientation. Contrary to prediction, results for Objects and Words did *not* suggest heightened specificity of encoding in the ASD group. Indeed, the data suggested that any such effect was limited to the TD group, and to Words only. This suggests either that sensory information is not encoded with hyperspecificity in ASD, or that recall does not benefit from hyperspecific encoding. Future work will aim to disentangle these accounts.

Table 1. D' (accuracy) results for Old/New judgments by Category (Faces, Objects, Words) and Group

	ASD	TD	*F*	*p*	Cohen's *d*
Faces - Old	**-0.03 (0.47)**	**0.71 (0.73)**	**7.50**	**.01**	**1.21**
Faces - Change	**-0.11 (0.47)**	**0.47 (0.61)**	**6.15**	**.02**	**1.07**
Objects-Old	0.44 (0.44)	0.65 (0.55)	0.95	.34	0.42
Objects - Change	0.46 (0.32)	0.69 (0.52)	1.56	.23	0.53
Words-Old	0.80 (0.68)	0.90 (0.42)	0.17	.68	0.18
Words - Change	0.83 (0.46)	0.76 (0.33)	0.14	.71	0.17

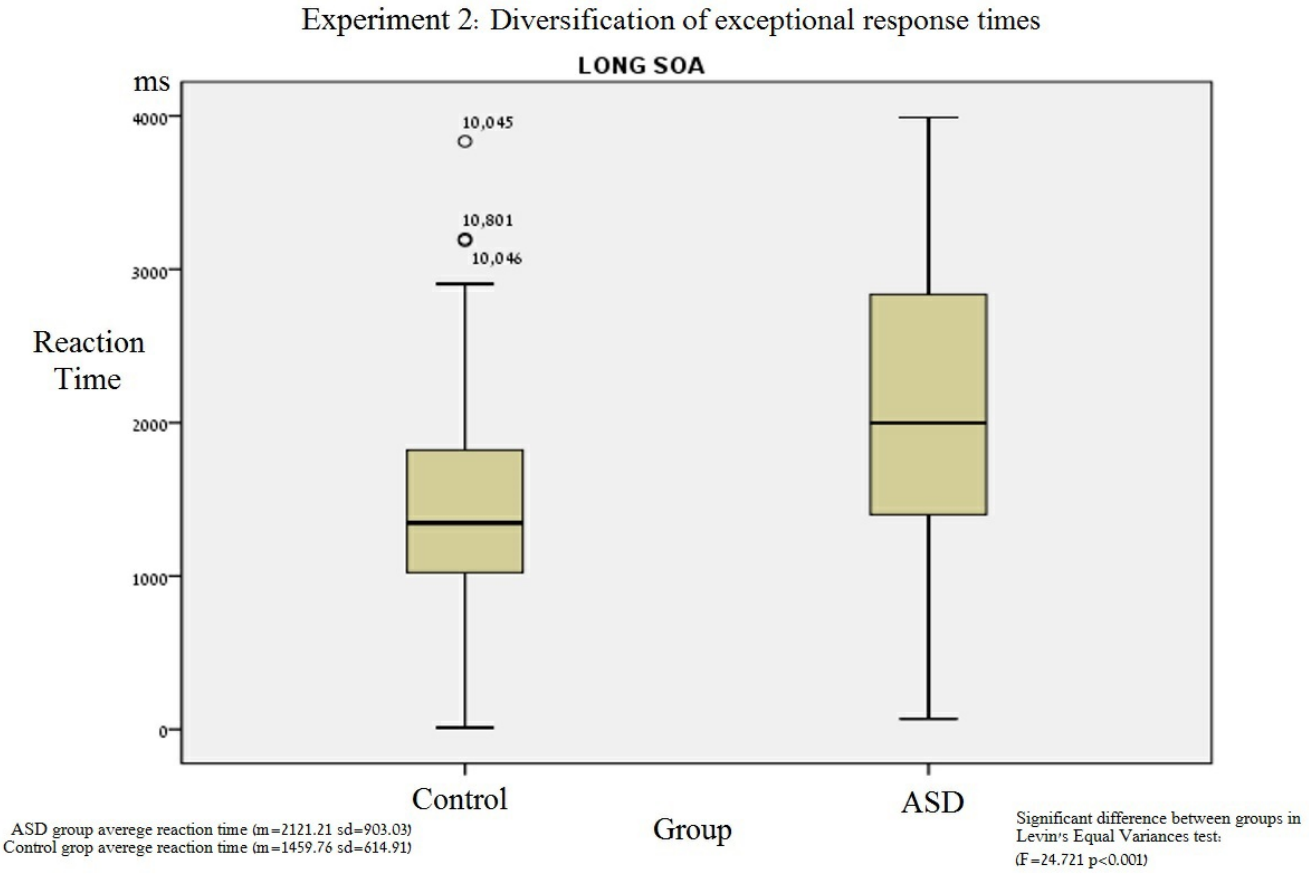
Data are shown as *M* (*SD*).

110 **164.110** Single Word Semantic Priming in High Functioning Individuals with Autistic Spectrum Disorder

ABSTRACT WITHDRAWN

Background:
Current research literature is controversial with regard to the higher-level linguistic processing capacity of young individuals with autistic spectrum disorder (ASD), and more specifically whether they utilize Semantic Priming similarly to neurotypical individuals (Lopez & Leekam, 2003; Kamio et al, 2006; Henderson et al, 2011; Norbury, 2013 in Dromi, Rum & Goldberg-Florian, in press).
No data was found with regard to the Semantic Priming Effect in young individuals with ASD who acquire and use a language other than English.
Objectives:
This study explores the Semantic Priming Effect, as well as the speed and accuracy of identifying words and non-words, in high-functioning Hebrew-speaking adolescents with ASD.
Methods:
We recruited two groups of participants: 22 adolescents with ASD in the age range of 14-27 (m=20.62 sd=2.59) comprised the experimental group, while 17 participants in the age range of 15-26 (m=21.13 sd=3.09) comprised the comparison group. A list of 36 semantically related word-pairs was constructed for use as stimuli for each experiment. A lexical chice task was administered using a computerized testing system that measured response time for a word versus that for non-word.
Two experiments were conducted. The first experiment was designed to encourage a quick, automatic, and subconscious response in determining the semantic relation

between paired words (Stimulus-Onset Asynchrony – SOA of 100 ms).The second experiment was designed to elicit strategic thought processes in making the judgment on the semantic relation between the same pairs of words (SOA of 1000 ms). The findings were analyzed several times in order to isolate the variables and examine their effect on the results.
Results:
In both experiments, the response time of participants in the experimental group was slower compared to the comparison group, and this was especially so when the target words were non-words.
The Semantic Priming Effect findings were different in the two experiments: In the first experiment, the experimental group demonstrated a Semantic Priming Effect similar to the comparison group. In the second experiment, a Semantic Priming Effect was not found in the experimental group, and the elimination of the subjects with reading difficulties did not change the outcome. Only the exclusion of cases of exceptional response times (±2 standard deviations) resulted in the experimental group demonstrating a Semantic Priming Effect similar to the comparison group. In all analyses, the heterogeneity and lack of uniformity in the responses of participants with ASD was evident.
Conclusions:
The findings suggest a need to differentiate between participants with ASD who exhibit linguistic impairment (Autistic with Language Impairment - ALI) and those who show efficient linguistic processing capacity even in highly demanding tasks (Autistic without Language Impairment - ALN). Moreover, in future research, more attention should be paid to the selection of participants, including controlling for those with and without reading difficulties. Finally, it is recommended that Semantic Priming experiments be administered to larger groups of individuals with ASD who learn and use different languages.



111 **164.111** Social-Communication Outcomes in Preschoolers Identified As at-Risk for ASD at 12 Months

S. W. Nowell[1], *L. R. Watson*[2] *and L. Turner-Brown*[3], *(1)UNC-Chapel Hill, Chapel Hill, NC, (2)University of North Carolina at Chapel Hill, Chapel Hill, NC, (3)UNC TEACCH Autism Program, University of North Carolina at Chapel Hill, Carrboro, NC*

Background: Early social-communication weaknesses are associated with poor social inclusion outcomes in adulthood. Therefore, early identification and treatment of social-communication deficits is critical in order to optimize outcomes. Research in the area of child development has consistently linked mother's responsiveness to their young children with later developmental outcomes. The current study follows up on 3-5 year old children identified as at-risk for ASD on the First Year Inventory at age 12 months. The children participated in a RCT of an Adapted Responsive Teaching (ART) intervention between their 1st and 2nd birthdays, with families randomized to the ART group or a "referral to early intervention and monitoring" (REIM) control group.
Objectives: Our aim was to determine if parent responsiveness at 24 months in children identified as at-risk for ASD was predictive of social-communication skills at 3-5 years. We hypothesized that parents with higher Maternal Behavior Rating Scale (MBRS) scores on the factors of Responsiveness and Affect at 24 months would have children who show better social-communication skills at 3-5 years. Because parent responsiveness was a target of the ART intervention, and was significantly increased for parents in the ART group compared to the REIM group, we also hypothesized that children in the ART group would have reduced diagnostic severity in the dimension of social-communication at 3-5 years compared to children in the REIM group.
Methods: Families who had participated in the RCT were re-recruited for a follow-up study when the children were 3-5 years old. The original sample consisted of 87 children; so far, 55 families have returned for follow-up assessments. The following measures were used:
At 24 months

- ***Parent Responsiveness***: *Maternal Behavior Rating Scale- Revised* (MBRS)
- ***Social-Communication Skills:*** *Communication and Symbolic Behavior Scales* (CSBS)

At 3-5 years

- ***Structural Language*** *- Preschool Language Scales- Fifth Edition* (PLS-5), Children's Communication Checklist (CCC-2) Structural language subscales
- ***Social-Communication Skills***- The *Children's Communication Checklist – Second Edition* (CCC-2) Pragmatic Language subscales, the *Pragmatic Rating Scale – School Age* (PRS-SA), the Autism Diagnostic Observation Scales (ADOS-2), the *Vineland Adaptive Behavior Scales* (VABS-2), and the PLS-5 narrative retell task.

Results: Preliminary analyses were conducted with data on 32 children between 49-70 months old using the MBRS subscales of Responsivity, Affect, and Directiveness at 24 months to predict preschool outcomes on the CCC-2. The CSBS total standard score was used to control for baseline social-communication skills. All three MBRS subscales accounted for significant ($p<.05$) variance in the CCC-2 Structural Language subscales, above the variance accounted for by the CSBS (R^2 change=0.167), with Responsiveness having a positive effect as predicted, but the directions of effects for Directiveness and Affect opposite of what was predicted. The MBRS subscales did not significantly account for variance in the CCC-2 Pragmatic Language subscales. No intervention group differences were apparent in either structural or pragmatic language.
Conclusions: Preliminary findings support parent affect, responsivity, and directiveness at 24 months as significant predictors of preschool children's structural language. Future analyses will include additional participants and measures relevant to the aims of this study.

112 **164.112** Specific Language Impairment in ASD: Exploring Language Phenotypes Beyond Standardized Testing

K. Wittke[1]*, A. M. Mastergeorge*[2]*, S. Ozonoff*[3]*, S. J. Rogers*[4] *and L. Naigles*[1]*, (1)University of Connecticut, Storrs, CT, (2)University of Arizona, Tucson, AZ, (3)UC Davis MIND Institute, Sacramento, CA, (4)University of California at Davis, Sacramento, CA*

Background: Although current diagnostic criteria for ASD do not include language impairment, children with autism present with a wide-range of language abilities and deficits. Language can vary independently of IQ in autism (Kjelgaard & Tager-Flusberg, 2001), and some children with ASD evidently meet criteria for specific language impairment (SLI), as they present with impaired language despite intact nonverbal cognitive abilities (Tager-Flusberg, 2006). However, it is currently unknown how common the SLI phenotype is, and which linguistic markers differentiate those children from other language phenotypes in this population. Therefore, spontaneous language samples are an ideal method for investigating more detailed and comprehensive linguistic profiles (Dunn et al., 1996).
Objectives: To assess standardized-test subtyping of children with ASD by analyzing children's language samples for SLI-relevant linguistic markers.
Methods: 98 participants (M= 68.63 months, *SD* = 12.06) from a large-scale study of autism phenotypes were classified into 4 groups based on standardized test scores (DAS or MSEL for Nonverbal, a composite of EOWPVT, PPVT, MSEL, DAS for Verbal). Groups included: Low (nonverbal/verbal <70), Low Normal (nonverbal/verbal between 70-85), Possible SLI (nonverbal >70, verbal more than 15 points below nonverbal), and Normal (nonverbal/verbal >85). Recordings from the ADOS were transcribed, targeting tasks that afforded unprompted, spontaneous language production. 49 children were eliminated from further analysis because of video recording errors (*n*=16) and/or insufficient spontaneous language to transcribe (*n*=30); only 3 children in the Low group presented with sufficient language to transcribe so this group was excluded from further analyses. Therefore, 49 children were included in the final sample (M= 67.8 months, *SD* = 11.5), across 3 of the groups: Low Normal (*n*=6), Possible SLI (*n*=8), and Normal (*n*=35). Language samples were analyzed for frequency of language types and tokens, as well as MLU, grammatical errors, and omissions.
Results: One-way ANOVAs revealed significant effects of group for MLU, frequency of grammatical errors, total word and verb types, and frequency of article errors *(Fs* >3.5, *p*s <.04). However, post-hoc Scheffe tests revealed that the Possible SLI group differed from the Normal Group only in frequency of total grammatical errors (*p*=.003) and frequency of article errors/omissions (*p*=.03). Interestingly, the Low Normal and Normal groups differed significantly in total word types (*p*=.02), total verb types (*p*=.04), and frequency of article errors. Surprisingly, significant group effects were not observed for error frequencies with pronouns, plurals, and tense/agreement, which are the grammatical structures most often impaired in SLI.
Conclusions: Standardized test results pointed to a possible subgroup of SLI in a large ASD sample; however, grammatical analyses of their speech samples did not fully support this subgrouping. Overall, frequency of grammatical errors was higher in the Possible SLI group, but specific error types did not consistently reflect an SLI designation. Further analyses will scrutinize the grammatical error patterns for each child, exploring different subgroup assignments based on these language samples. Our results suggest that including spontaneous language samples is critical for capturing the full extent of language impairments as well as designing targeted interventions for children with ASD.

113 **164.113** Speech Acts during Spontaneous Peer Conversation in ASD and Typical Development

N. Bauminger-Zviely[1] *and A. Golan Itschaky*[2]*, (1)Bar-Ilan University, Ramat Gan, Israel, (2)School of Education, Bar Ilan University, Ramat Gan, Israel*

Background: In typical development (TYP), early peer talk is crucial for pragmatic development. Speech acts – the primary illocutionary values conventionally conveyed by utterances as acts – are a crucial component of children's conversational capabilities. The pragmatic deficit, reflected in remarkably deficient conversational capabilities, is considered the hallmark of the language deficit in autism spectrum disorder (ASD) (Stefanatos & Baron, 2011). Despite its importance for understanding the pragmatic deficit in ASD, preschoolers' speech acts during spontaneous peer talk has not been explored.
Objectives: The current study's major aim was to close this knowledge gap about characteristics of the pragmatic deficit in ASD by examining the speech acts of high-functioning preschoolers with ASD (HFASD, IQ>75) versus preschoolers with TYP during spontaneous peer talk. We were also interested in learning about the role of the conversational partner's friendship and disability status as contributing to pragmatic capabilities. Prior studies reported higher mutual social engagement, responsiveness, and reciprocal verbal exchanges in interactions with friends versus non-friends (Newcomb & Bagwell, 1995). Aadditionally, in the HFASD group, prior research showed higher social complexity and level of play in interactions with a typical partner (mixed dyads) versus a partner with HFASD (non-mixed dyads) (Bauminger et al., 2008).
Methods: We conducted comparative assessment of speech acts during spontaneous peer talk along 10-minute free-play scenarios in preschoolers (ages 3-6 years) with HFASD (*n*=21) versus with TYP (*n*=30). Groups were matched on SES, verbal IQ (VIQ), nonverbal IQ (NVIQ), and CA. Children's conversations were videotaped and coded to tap speech act capabilities. Acts' coding included: *Assertive* (e.g., evaluation, declaration); *Requestive* (e.g., questions, requests); *Responsive* (e.g., answers to WH questions); *Organizational Devices* (e.g., request for attention) (Dore, 1979); and also *Stereotypic Speech.* Correlations with CA, VIQ, and NVIQ were examined. We compared the two groups' interactions with a friend versus non-friend partner; additionally, in the HFASD group, we compared interactions in mixed versus non-mixed dyads.
Results: As predicted, analysis of observed speech acts during spontaneous peer conversations revealed fewer speech acts in HFASD versus typical age-mates, mainly in assertive (declarative) acts and organizational devices. Moreover, the HFASD group used stereotypic talk more often than TYP peers. However, in both groups, more frequent and diverse uses of speech acts emerged during interaction with friends versus non-friends, including: assertive (declaration, evaluation); requestive (request); responsive (replies); and organizational devices. Thus, friendship may enable children to converse in a more socially complex way. The comparison of mixed versus non mixed friendship in HFASD did not yield significant differences. CA correlated positively with frequency and variety of speech acts only in the TYP group, whereas VIQ correlated with speech acts' frequency in the HFASD group while interacting with a non-friend.
Conclusions: Despite the poor performance of speech acts in ASD, involvement in friendship relationships and VIQ were linked to more intact pragmatic capacities. Clinically, emphasis on friendship in early intervention may help elicit more adequate pragmatic capabilities and presumably fuller peer relations in preschoolers with ASD.

114 **164.114** Spontaneous Expressive Language Impairments in Clinic Referred Children for a Possible ASD

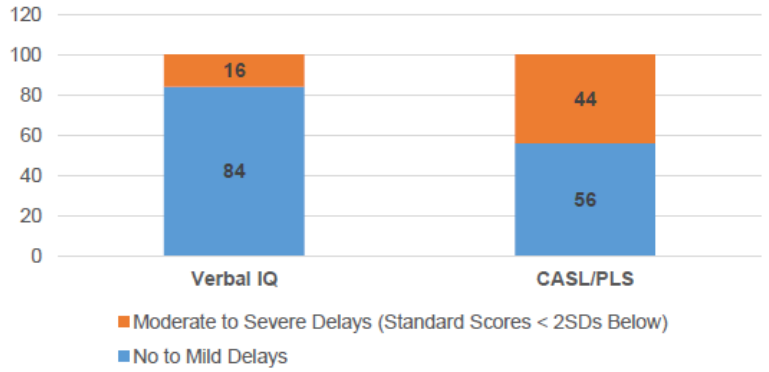
S. H. Kim[1] *and C. Lord*[2]*, (1)Yale Child Study Center, New Haven, CT, (2)Weill Cornell Medical College, White Plains, NY*

Background: Although impairments in spontaneous expressive language are prevalent in ASD and other communication disorders, standardized language measures currently available do not adequately capture these deficits, impeding our attempt to clearly quantify language profiles that are necessary for provisions of treatments. A newly developed language measure, the Observation of Spontaneous Expressive Language (OSEL) is a standardized, semi-structured clinician observation, which allows an assessment in children aged 2-12 years targeting: 1) Syntax, and 2) Pragmatic-Sematic skills under three domains: *Initiation of Reciprocal Communication*, *Narrative Skills*, and *Unusual Features* (**Table 1**).
Objectives: To examine spontaneous expressive language profiles during a standardized but natural, play-based setting targeting syntax (structure of language), semantics and pragmatics (social use of language) in clinic-referred children for a possible ASD.
Methods: Total of 66 children (57 ASD cases) were administered the OSEL (M*ean* Age=5, *SD*=2.3). The proportion of children showing delays were examined and the severity of delays were quantified based on language quotients ([age equivalent/chronological age]*100). The associations between the OSEL and autism symptom severity (Autism Diagnostic Observation Schedule [ADOS]) and standardized language scores (Comprehensive Assessment of Spoken Language [CASL] or Preschool Language Scale [PLS]) were examined using Pearson's Correlation.
Results: Out of 66 children, 38 (58%; 32 ASD cases) had their syntax language quotients less than 70. Out of 66 children, 55 (83%; 47 ASD) and 48 (72%; 41 ASD) had their language quotients less than 70 for *Initiation of Reciprocal Communication* and for *Narrative Skills* respectively. Notable gaps between chronological age and age equivalents (AE) were observed for all domains (e.g., mean Syntax AE=2.8 years (*SD*=0.7); mean chronological age=5.7 (*SD*=2.2); mean language quotient=53.6 [*SD*=16.6]). When verbal IQ and other language measures were examined, only 16-44% of all children who showed significant delays on the OSEL were identified as having delays (scores<2 *SD*s; **Figure 1**). A mild correlation was observed between the OSEL *Initiation of Reciprocal Communication* and ADOS *Social Affect* severity scores (*r*=-0.34, *p*<0.05). Moderate to strong correlations between OSEL and other language measures were observed (*r*'s 0.3-0.8; *p*'s<0.05).
Conclusions: Based on a measure of spontaneous expressive language, more than 80% of clinic-referred children for ASD showed significant delays in pragmatic language. Most children (90%) received a diagnosis of ASD, and their language scores were significantly associated with autism symptom severity. This may explain why these children demonstrated notable difficulties in initiating back-and-forth communication with a social partner and providing accounts of events, which is one of the hallmarks of ASD. About 60% of children also showed notable delays in syntax, suggesting that intervention may need to be tailored to target deficits in grammar in a subset of these children. The results also suggest that difficulties in spontaneous expressive language may be missed by other instruments measuring pre-determined answers that are highly tied to concepts. Moderate correlations between the OSEL and other measures also suggest that the assessment of language in a standardized but natural context has an additive value and should be used complementarily with other measures.

Table 1. OSEL Syntax, Pragmatic and Semantic Items

OSEL Syntax Items	OSEL Pragmatic and Semantic Items
Articles	**Initiation of Reciprocal Communication**
Regular Plurals	Verbal requests to get needs met
Irregular Plurals	Asks for information about thoughts, feelings, or experiences
Regular Past Verbs	Comments or offers information about thoughts, feelings, or experiences
Irregular Past Verbs	Maintains a conversation
Progressive Tense Verbs	(Absence of) Preoccupation with specific interests
Future Tense Verbs	
Copula Verbs	**Narrative Skills**
Modal Auxiliary Verbs	Repairs/Request clarification
Infinitive Phrases	Reports main ideas
Negation	Reports sequence of events/story
Prepositions	Comments on characters' emotional and/or mental states
Longest Sentence	Synthesizes cause-and-effect information
Subjective Pronouns	
Objective Pronouns	**Unusual Features**
Possessive Pronouns	Interrupts the examiner or dominates conversations
Subordination	Stereotyped/Idiosyncratic use of words or phrases
Coordination	Unspecific language and/or semantic errors
Adjectives	Immediate echolalia
Nouns	Impolite or inappropriate language
Verbs	
Responses to WH- questions	
Responses to Y/N questions	
Questions	

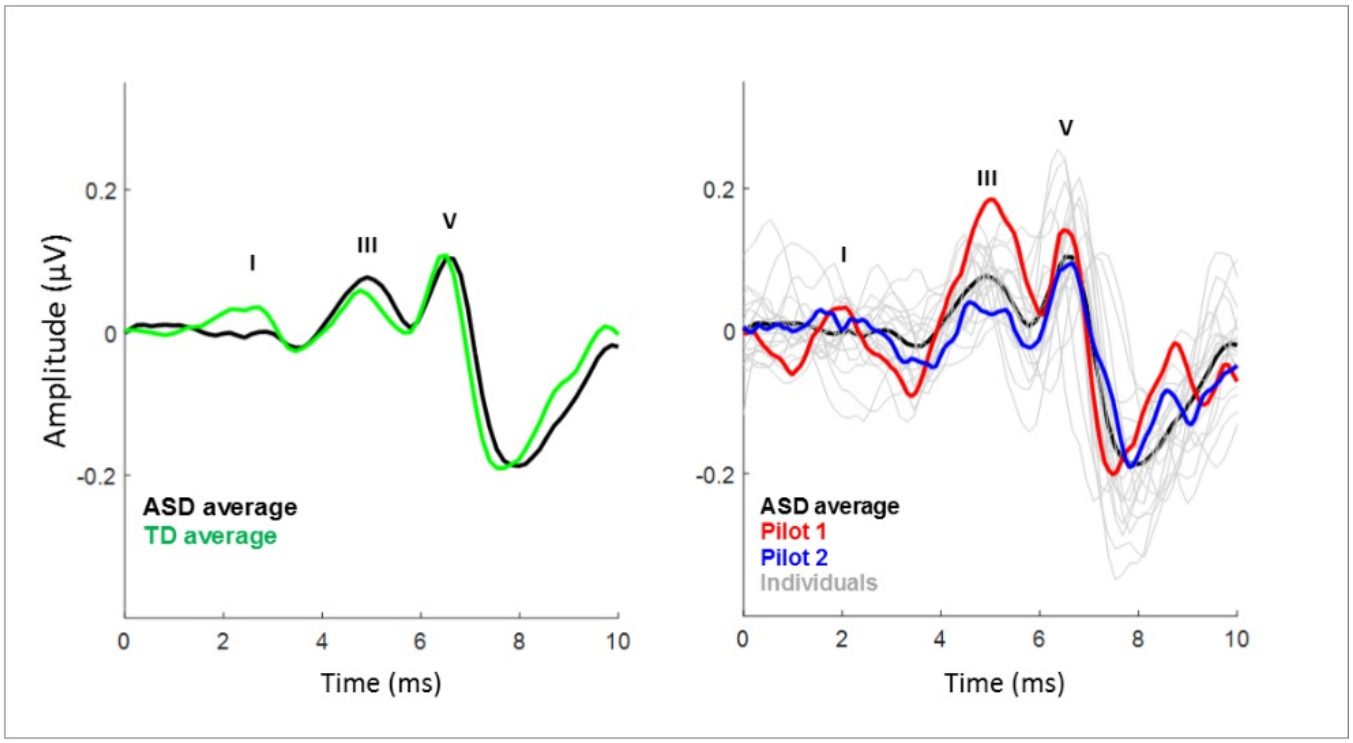
Figure 1. IQ and Language Profiles for Children with Moderate to Severe Delays on the OSEL



115 **164.115** Testing Auditory Brainstem Responses in Low-Functioning Children with ASD

Z. Johnson[1], *M. Spriegel*[2], *D. A. Fein*[3], *E. Skoe*[2] *and L. Naigles*[4], *(1)Psychological Sciences, University of Connecticut, Storrs, CT, (2)Speech Language Hearing Sciences, University of Connecticut, Storrs, CT, (3)Psychology, University of Connecticut, Storrs, CT, (4)University of Connecticut, Storrs, CT*

Background:
The neurological underpinnings of ASD language have long been sought, both to shed light on possible causes of the complex and multi-faceted behavioral presentation, and to identify targets for intervention. The purpose of our overall project is to explore whether abnormalities in language development can be attributed to breakdowns at an early stage of auditory processing, namely the auditory brainstem. Recent research with individuals with ASD has converged on the finding that abnormal neural conduction time, as revealed by prolonged latencies of auditory brainstem response (ABR), is a hallmark of the ASD central auditory system (Rosenhall et al., 2003; Roth et al., 2012; Russo et al., 2009). Most studies have involved high-functioning children tested in a lab setting; however, data collection from a wider range of children and in a home setting is desirable.
Objectives:
The purpose of the current study was to validate our ABR data collection protocol with low-functioning children tested at home.
Methods:
Two boys, aged 6 and 15 years, were tested. At their most recent assessment, their DAS NVIQs were 69 and 45 respectively, with TACL-Q standardized language scores of 57 and 61, respectively, and ADOS scores of 26 and 13, respectively. ABRs were recorded from scalp electrodes in response to a click stimulus (31.1/sec, 2000 trials) and a 40 millisecond "da" stimulus (10.9/sec, 6000 trials) presented at 80 dB SPL to the right ear. Wave V, the most robust peak within the ABR, serves as the primary dependent measure of sound encoding in this study.
Results:
Both boys were able to tolerate the electrode application and sound stimulation. Moreover, both provided useable ABR data, with minimal movement artifacts. In Figure 1, our pilot data is compared to the speech-evoked ABR waveforms of the TD and (high functioning) ASD groups from Russo et al., 2009. In our data, Wave V is clearly delineated; the latency and amplitude variability is also consistent with the ASD sample from Russo et al. (plotted as grey lines).
Conclusions:
Our procedures for collecting ABR data at home from two low-functioning boys with ASD proved successful, yielding waveforms that resembled those collected in lab settings, and demonstrating feasibility of collecting reliable ABR's in this setting and with this type of child. In the next 6 months we will collect ABR data from at least 8 more children with ASD, including both high- and low-functioning children, and assess the relationships between their ABRs and language abilities.



116 **164.116** The Discrepancy Between Receptive and Expressive Vocabulary in Preschoolers with ASD

P. J. Yoder[1], *L. R. Watson*[2] *and T. Woynaroski*[3], *(1)Vanderbilt University, Nashville, TN, (2)University of North Carolina at Chapel Hill, Chapel Hill, NC, (3)Vanderbilt University, Thompsons Stn, TN*

Background:
Some studies indicate receptive *age equivalencies* are lower than expressive age equivalencies in young children with autism spectrum disorder (ASD). In such children, the discrepancy between receptive - expressive vocabulary *size* should be atypically small, although this has not been shown. This could occur because children with autism attend less than other children to child-directed speech, which results in missing opportunities to learn to associate words with their referents. However, this association has not been tested.
Objectives:

1. Is there a lower receptive *age equivalency* than expressive age equivalency in preverbal children with ASD, and does this change over time?
2. Is there an atypically small receptive – expressive vocabulary *size* discrepancy?
3. Does early visual attention to speaker during child-directed speech predict the discrepancy between receptive – expressive vocabulary *size* 8 months later?

Methods:
Eighty-seven children with ASD participated in this study (see Table 1). Parent-reported (MacArthur-Bates Communication Development Inventory, MBCDI) receptive and expressive vocabulary was measured at four measurement periods, each separated by 4 months. The vocabulary size scores were transformed to age equivalencies using the median age or interpolated median age at which typically developing children achieved the raw score. The discrepancy between the mean receptive and the mean expressive vocabulary size in the typically-developing (TD) population was computed for four target ages. These ages were the rounded average of the mean receptive and mean expressive age equivalencies of the children with ASD at each measurement period (see Table 2). The visual attention to speaker during child-directed speech was quantified as the proportion of time that the child looked at the speaker out of the total time child-directed speech was presented at Time 2. The total duration of looking was coded from video records with inter-observer reliability > .9.
Results:
Children's receptive ages were significantly lower than their expressive ages at all four periods (within-subject Cohen's *d* values = .37, .34, .24, .24, respectively, all *p* values < .05). Table 2 indicates the atypically small discrepancy between receptive and expressive vocabulary size for the ASD sample. The difference between the normative gap for receptive versus expressive vocabulary size and that seen in the children with ASD grew over time. Time 2 visual attention to speaker during child-directed speech predicted the discrepancy between receptive and expressive vocabulary size at Time 4 (8 mos later), $r = .35$, $p = .01$. This association was significant, even after controlling for the receptive-expressive discrepancy at Time 1 ($p < .02$).
Conclusions:
Receptive vocabulary size was smaller than expected given the size of the expressive lexicon for this sample of young children with ASD, consistent with the finding that receptive vocabulary age equivalency was lower than expressive vocabulary age equivalency at each age point. Visual attention to the speaker during child-directed speech was associated with, and thus may have been one of the reasons for the atypically small discrepancy between, receptive and expressive vocabulary size. These findings suggest that enhancing attention to child-directed speech may be an important target of early language intervention.

Table 1.
Characteristics of Participants with ASD *at Time 1*

Variable	*Mean*	*Standard Deviation*
Chronological Age In Years	3.3 years	.6 years
MCDI Words Understood	115 words	110 words
MCDI Words Said	18 words	30 words

Table 2.

The Discrepancy Between Receptive and Expressive Raw Scores by Chronological Age in TD Children Comprising the MCDI Normative Sample and by Age Equivalency in ASD Children

Age group in mos of TD children in norming study	Average receptive-average expressive raw score difference for TD children at the target age	Rounded grand mean age equivalency in mos across modalities and participants at periods in ASD sample	Mean within-subject receptive-expressive raw score difference in ASD sample	TD – ASD difference in cross-modality discrepancy in vocabulary sizes
12	71	12	66	5
13	91	13	78	13
14	115	14	83	32
15	138	15	80	58

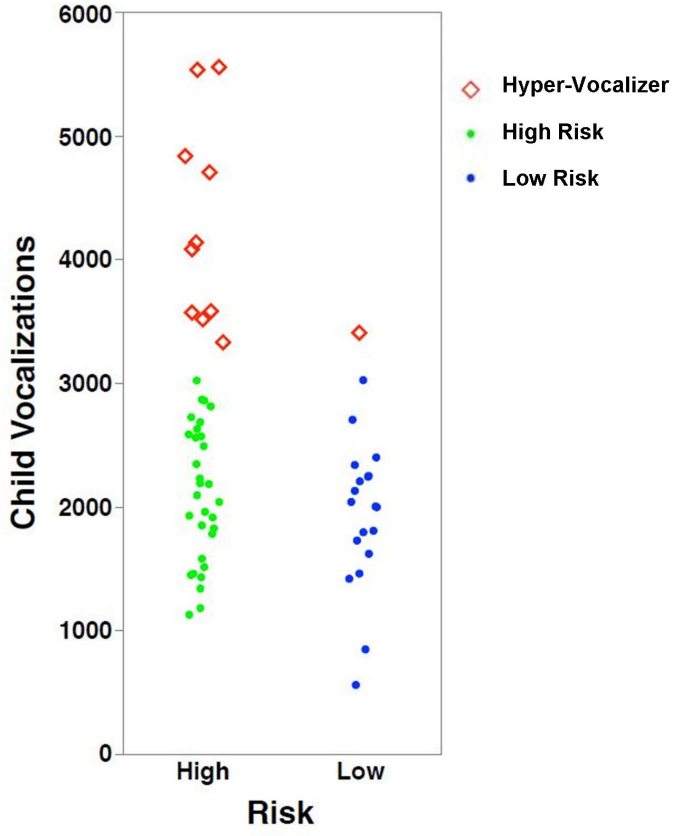
117 **164.117** The Early Language Environment and 9 Month “Hyper-Vocalizing” in Infants at Risk for Autism

M. R. Swanson[1], *B. Boyd*[1], *M. D. Shen*[1], *S. J. Paterson*[2], *J. C. Chappell*[1], *J. Pandey*[3], *J. Parish-Morris*[4], *R. Emerson*[1], *A. M. Estes*[5], *H. C. Hazlett*[6], *K. Botteron*[7], *R. T. Schultz*[8], *S. Dager*[9], *J. Piven*[1] *and .. The IBIS Network*[1], *(1)University of North Carolina at Chapel Hill, Chapel Hill, NC, (2)Department of psychology, Temple university, Philadelphia, PA, (3)Children's Hospital of Philadelphia, Philadelphia, PA, (4)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (5)University of Washington Autism Center, Seattle, WA, (6)Carolina Institute for Developmental Disabilities, University of North Carolina at Chapel Hill, Chapel Hill, NC, (7)Psychiatry and Radiology, Washington University School of Medicine, St. Louis, MO, (8)The Center for Autism Research, The Children’s Hospital of Philadelphia, Philadelphia, PA, (9)University of Washington School of Medicine, Seattle, WA*

Background: Studies on normative development have shown the substantial impact of the early language environment on a child’s later cognitive development (Hart & Risley, 1995; Ramirez-Esparza et al., 2014). Previous research on infants at-risk for ASD have been inconsistent with some reporting high-risk infants vocalizing less in the first year of life when compared to low-risk infants (Paul et al., 2010), while others report no group differences (Talbott et al., 2015; Northrup & Iverson, 2015). However, methodology has been limited to videotaped interactions of parents and infants playing.
Objectives: The goal of the current project is to extend prior literature by examining the early home language environment of 9 month old infants at high and low familial risk for ASD using naturalistic day-long in-home recordings.

Methods: This study includes data from 41 infants at high-risk (HR) for ASD (66% male), and 20 infants low-risk (LR) for ASD (50% male). As part of a larger ongoing longitudinal study, the Infant Brain Imaging Study, 9-month old infants wore LENA speech recorders for 2 full days in the home (yielding 32 hours of recording). The number of adult words, child vocalizations, and adult-child conversational turns were calculated. Infants and their families were also assessed during 4 clinic visits where infants were assessed using the Mullen: an intake assessment at 3 or 6-months, two randomly assigned follow-up assessments (6, 9, 12, or 15 months), and a 24-month outcome visit. Data collection is ongoing hence this analysis focused on the 12 and 15 month time-points.
Results: LR and HR infants did not differ on chronological age at 9-month LENA recording (Figure 1). The groups did significantly differ on Mullen early learning composite scores and receptive language scores at 12-15 months, but not on other Mullen subscales. LR and HR infants significantly differed on number of child vocalizations with HR infants vocalizing at a higher rate, $t(59)=2.76$, $p=.007$. The groups did not significantly differ in the number of adult words or conversational turns at 9 months. Given that previous studies have found maternal education and sex of the child to contribute to emerging language skills, additional analyses were run to control for these variables. We also controlled for Mullen composite. Results revealed a significant main effect of maternal education, $F(46)= 2.99$, $p=.05$, and group, $F(46)= 4.16$, $p=.04$, but not sex of the child or Mullen composite. This significant group difference in vocalization rate appears to be driven by a subgroup (25%) of HR "hyper-vocalizing" infants who vocalized at an extremely high rate (2 *SD*above the mean of LR infants, red diamonds in Figure 1).
Conclusions: We found that infants at HR and LR for ASD experience strikingly similar language environments in regards to adult words and adult-child conversational turns. However, we uncovered significant group differences in child vocalizations. This difference was driven by a subgroup of HR hyper-vocalizers who vocalized at a high rate. We will explore whether 9 month hyper-vocalizing is stereotypic in nature and if it is predictive of later ASD diagnosis.

	Low-Risk *M* (*SD*)	High-Risk *M* (*SD*)	*df*	*t*	*p*	Cohen's *d*
LENA at 9 months	*n* = 20	*n* = 41				
LENA Chronological age	9.45 (0.60)	9.41 (0.92)	59	-0.16	.88	.05
Adult Words	28,819 (12,806)	23,984 (11,673)	59	-1.47	.15	.39
Child Vocalizations	**1,995 (661)**	**2635 (1131)**	**59**	**2.76**	**.007**	**-.69**
Child non-speech vocalizations duration	1591 (762)	1724 (762)	59	0.64	.52	-.17
Conversational Turns	515 (197)	537 (220)	59	0.39	.71	-10
Mullen at 12-15 months	*n*= 17	*n*=40				
Mullen chronological age	13.68 (1.55)	13.59 (1.69)	55	-0.20	.84	.05
Mullen composite	107.00 (11.69)	100.20 (11.69)	55	-1.97	.05	.73
Expressive language	52.00 (7.03)	49.07 (11.13)	55	-1.00	.32	.31
Receptive language	48.47 (9.47)	41.50 (7.89)	55	-2.87	.005	.80
Visual reception subscale	54.71 (8.05)	53.72 (9.32)	55	-0.38	.71	.11
Gross motor	46.12 (14.12)	48.35 (10.00)	55	0.56	.57	-.18



118 **164.118** The Problems with “Look, Don't Touch”: Designing Robots to Maximally Benefit Young Children with ASD

L. Boccanfuso[1], *L. Chen*[2], *C. Torres*[3], *B. Hudik*[4], *J. C. Snider*[5], *M. Sanfilippo*[6], *P. E. Ventola*[7], *K. Chawarska*[1], *J. M. O'Kane*[8], *B. Scassellati*[4] *and F. Shic*[1], *(1)Yale Child Study Center, Yale University School of Medicine, New Haven, CT, (2)Mt. Holyoke College, South Hadley, MA, (3)Computer Science, Duke University, Durham, NC, (4)Yale University, New Haven, CT, (5)Yale Child Study Center, New Haven, CT, (6)University of California, Merced, Merced, CA, (7)Yale Child Study Center, Yale School of Medicine, New Haven, CT, (8)University of South Carolina, Columbia, SC*

Background:
Despite the fact that the first five years of a child’s life are foundational for their social, emotional, behavioral, cognitive and communicative development, a paucity of robots exist that can withstand the physical interactions and play through which very young children naturally learn about the world. A common approach has been to employ expensive off-the-shelf robots with numerous degrees of freedom and sensors, many of which may be functionally unnecessary to achieve the end goal for which they are employed. This is deleterious to productive human-robot interaction (HRI) in two ways. First, child-robot interactions are restricted because children are either physically separated from the robot or are instructed not to touch the robot. Second, robots with many moving parts and behaviors can add unnecessary complexity, particularly for highly-targeted interventions with children who have behavioral, social and cognitive difficulties. In this work, we present 3 low-cost ($100- $300USD), field-tested robots and their fundamental design features that may help inform development of other robust and minimalistic robots suitable for use with very young populations of children with autism spectrum disorder (ASD).
Objectives:

To identify typical physical interactions that lead to hardware failures, describe the evolution of key design features and resulting design modifications to each of three robots used with individual groups of young children. Further, to evaluate the efficacy of three low-cost, robot prototypes that may help inform the development of other robust and minimalistic robots suitable for use with young populations of children with ASD.

Figure 1. Robots: CHARLIE, L-E and Sphero

Methods:

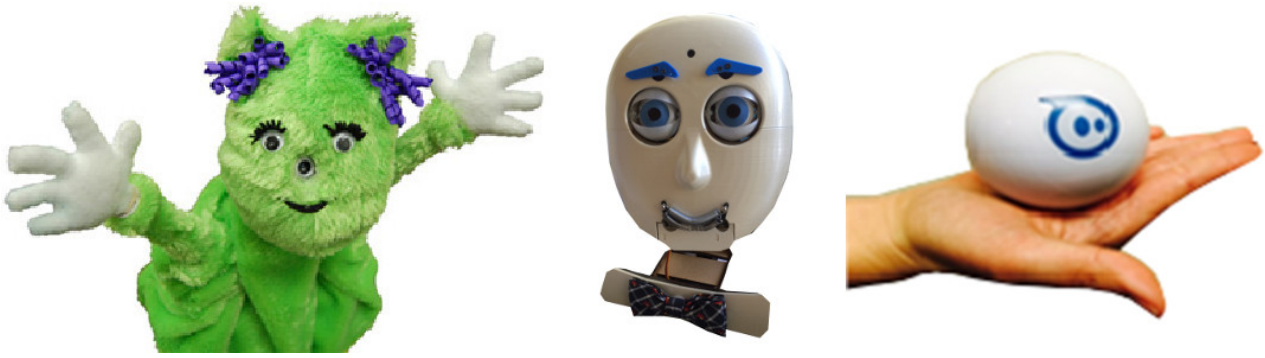
We analyzed child-robot interactions in each of three studies conducted with different subpopulations of children with ASD. Participant mean age for each study was 4.83 (CHARLIE, n_participants=8, n_sessions=96), 7.91 (L-E, n_participants=15, n_sessions=15) and 2.50 (Sphero, n_participants=12, n_sessions=12) years. Further, we summarized characteristics of interactions that lead to mechanical or hardware failure and identified specific design features that promoted maximal opportunities for unrestricted interactions and productive child-robot interaction. Finally, we evaluated the viability of low-cost robots with robust design features using empirical results obtained for each study.

Results:

Three generalizable, fundamental design features that directly contributed to promoting each study's aims resulted: (1) Simplified interface, with minimal DOF, and behaviors, (2) Securable base paired with break-away and/or compliant parts and, (3) Self-contained and impact-resistant. While low-cost and simple in design, these robot prototypes assisted in achieving significant improvements in speech (Mean Length Spontaneous Utterances), receptive language, interpersonal skills and play (Vineland Adaptive Behavior Scales – Parent/Caregiver Form). Additionally, one robot (Sphero) was used in unstructured scenarios to elicit and measure statistically significant differences in how typically developing children and a group of children with ASD play with a robot.

Conclusions:

Optimal HRI for young children requires robust robots. Simple, low cost design features can be easily integrated or added to robots employed to assist very young children with ASD while still contributing to significant improvements in several measures of communication and social skill proficiency.



119 **164.119** Looking and Language in Autism Spectrum Disorder: A Family Study

M. Lee[1], *N. M. Heckel*[1], *D. Hamburger*[2], *P. C. Gordon*[3], *G. E. Martin*[4] *and M. Losh*[5], *(1)Northwestern University, Evanston, IL, (2)Communication Sciences and Disorders, Northwestern University, Evanston, IL, (3)Pyschology, University of North Carolina-Chapel Hill, Chapel Hill, NC, (4)Communication Sciences and Disorders, St. John's University, Staten Island, NY, (5)Department of Communication Sciences and Disorders, Northwestern University, Evanston, IL*

Background: Converging evidence suggests that individuals with autism spectrum disorder (ASD) display atypical visual attention patterns that predict greater social impairment (Rice et al., 2012; Sasson et al., 2008; Klin et al., 2012). Unaffected relatives also demonstrate subtle differences in visual processing (Adolphs et al., 2008, Dalton et al., 2007). This study examines whether visual attention patterns relate to social language differences that characterize ASD, and which have been observed to express among unaffected relatives as well, though in milder form (e.g., Losh et al., 2008). Specifically, we examined visual attention during narration in ASD and first-degree relatives to investigate whether differences in perceptual strategies might relate to social communicative differences in ASD and subtler differences in social communication style in parents (i.e, the broad autism phenotype or BAP). Examining links between looking and speaking may inform how visual attention shapes the content and quality of social language.

Objectives: To examine relationships between visual attention and social language for individuals with ASD and their parents during two narrative tasks.

Methods: Thirty-four high functioning individuals with ASD (IQ>80) and 24 age-matched controls, as well as 147 parents of individuals with ASD and 61 control parents completed two narrative tasks presented on an eye-tracker: 1) a 24-page wordless picture book (PB), and 2) a series of six static images of emotionally ambiguous scenes drawn from the Thematic Apperception Test (TAT). During the PB task, participants narrated each page as it was presented on the eye-tracker. For the TAT task, individuals viewed six images from the TAT for eight seconds each. After each image was removed, participants were asked to tell a story about the image. Visual attention for narrative tasks was quantified as the proportion of fixations to different aspects of the images (e.g., social, background elements, white-space); Latent Semantic Analysis (LSA), a computational linguistic tool, measured narrative quality. Additionally, parents completed BAP assessments.

Results: Individuals with ASD demonstrated decreased attention to background elements during their narration of both tasks ($p < .05$). Whereas the ASD parent group did not differ from controls on the PB task, during the TAT BAP(+) parents looked significantly more at faces and significantly less at background elements of the scenes (ps < .05). Greater attention to non-social stimuli was positively correlated with semantic quality across narrative tasks in the ASD group and controls (rs > .4), as well as in parents (rs > .3).

Conclusions: This study is the first to assess the relationship between visual attention and narrative production in individuals with ASD and their parents. Results suggest that both individuals with ASD and their parents demonstrate different patterns of visual attention that may underlie differences in complex language use. In particular, reduced attention to the background of the scenes may result in narratives less rich in semantic content. Overall, this study provides further evidence of atypical visual processing as an index to genetic liability in ASD that may help explain the roots of differences in social language in ASD and the BAP.

120 **164.120** The Role of Parental Synchrony in the Language Abilities of Children with and without ASD

T. Ward[1], *T. Estrada*[1], *W. Mason*[1] *and B. Wilson*[2], *(1)Seattle Pacific University, Seattle, WA, (2)Clinical Psychology, Seattle Pacific University, Seattle, WA*

Background: Research suggests that up to 50% of children with autism spectrum disorder (ASD) have language impairments (Ganz, Lashley, & Rispoli, 2010). Parents play a critical role in the development of early language acquisition (Kamphaus, 1987; Mahoney, Kim, & Lin, 2007). Specifically, children with ASD whose parents demonstrated greater synchronous behaviors during a free play task had greater language gains longitudinally compared to parents with less synchrony (Siller & Sigman, 2002). These results have yet to be replicated using a typically developing (TD) control group.

Objectives: The aim of this study was to examine the moderating role of parental synchrony on the association between developmental status (ASD vs. TD) and verbal abilities.

Methods: Our sample consisted of 64 children, ages 3:0 to 6:11, and their parents. Thirty children were previously diagnosed with ASD and 30 children were TD. Parent-child dyads completed an eight-minute free-play task in a laboratory setting that was recorded for future coding. Parental synchrony was coded during the free-play task using a modification of Siller, Hutman, and Sigman's (2013) coding system. The *DAS-II*(Elliott, 2007) was also used to assess children's expressive and receptive language abilities.

Results: A multiple regression analysis was conducted using the SPSS macro add-on PROCESS (Hayes, 2008) to examine the moderating effect of parental synchrony on the association between developmental status and children's verbal abilities. Controlled variables included children's gender, age, and total number of parental phrases spoken. A significant main effect of status (B = -32.28, SE = 12.09, $p = .01$) and an insignificant main effect of parental synchrony (B = -.16, SE = .10 $p = .15$) on verbal abilities were detected. The interaction between status and parental synchrony was a significant predictor of verbal ability (B = .28, SE = .13 $p = .03$, $\Delta R^2 = .06$). When examining the significant interaction at the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles, the conditional effect of status on verbal ability scores were significant at the 10^{th} (B = -15.96, SE = 5.54, $p = .006$) and 25^{th} (B = -12.75, SE = 4.54, $p = .007$) percentiles and insignificant at the 50th, 75th, and 90th percentiles. This indicates children with ASD whose parents used mean and high levels of parental synchrony may have comparable verbal abilities to their TD peers.

Conclusions: Our findings support our hypothesis that parental synchrony moderates the relation between developmental status and language abilities in children with ASD when compared to TD children. Children with ASD who experienced mean and high levels of parental synchrony did not have verbal abilities that were significantly different from their TD peers. In contrast, children with ASD whose parents engaged in low levels of synchronous behavior had significantly lower verbal abilities than TD children. These results suggest that moderate to high levels of parental synchrony potentially buffer against language deficits in children with ASD. This supports previous literature suggesting responsive parenting practices contribute to the acquisition of language during early childhood.

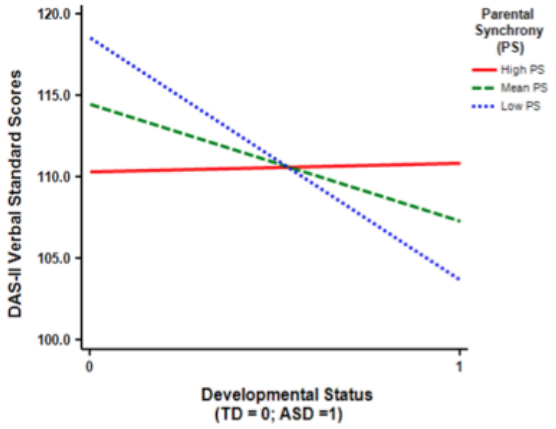


Figure 1. The interaction between developmental status and verbal ability at high, mean, and low levels of parental synchrony

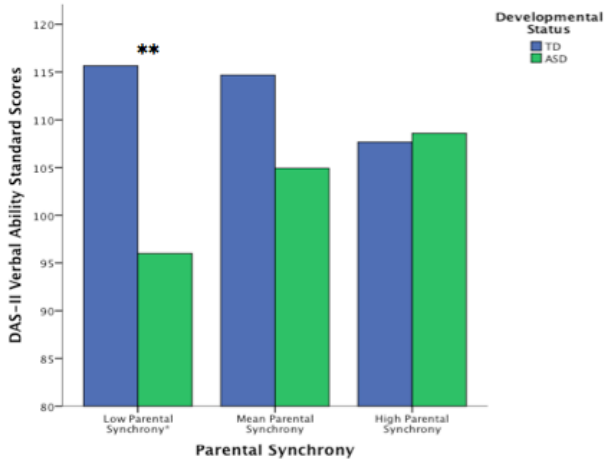
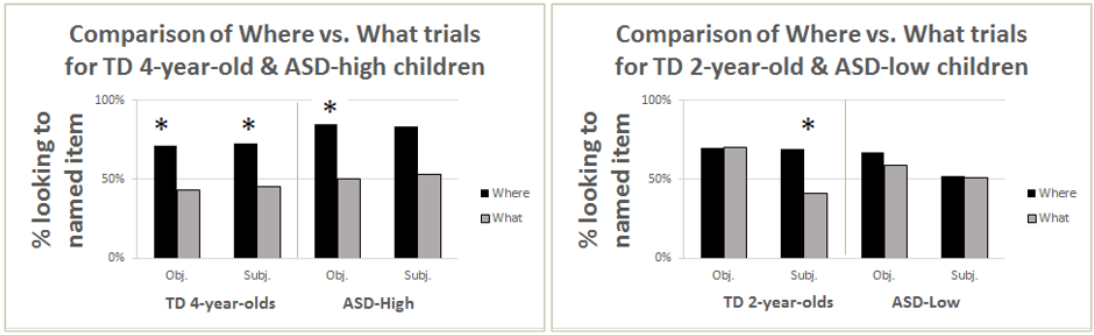


Figure 2. Bar graph displaying the association between low, mean, and high levels of parental synchrony and children's verbal abilities for children with ASD and TD
Note: ** indicates statistical significance at p < .01

121 **164.121** The Wh-Questions Comprehension in Korean Children with Autism Spectrum Disorders

J. Park[1], *M. Nam*[2], *S. W. Cho*[3], *S. J. Lee*[2], *J. W. Jeong*[4] *and L. Naigles*[1], *(1)University of Connecticut, Storrs, CT, (2)Seoul Metropolitan Eunpyeong Hospital, Seoul, South Korea, (3)Sogang University, Seoul, South Korea, (4)Korea Institute for Developmental Disabilities, Seoul, South Korea*

Background: Producing wh-questions is frequently problematic for English-learning children with ASD[1]; comprehension emerges earlier but is nonetheless delayed relative to overall language level[2]. Researchers disagree on whether these difficulties are attributable to pragmatic vs. grammatical sources. Pragmatically, the desire to communicate with others is impaired in autism; therefore, children may not know when and how to ask questions appropriately[3]. Grammatically, English wh-questions deviate from the standard SVO word order ('What did John eat?' is OSV); therefore, it is possible that children with ASD who have acquired declarative SVO sentences have difficulties learning another order for questions. Korean provides a test of the grammatical perspective, because in Korean wh-questions the canonical word order (SOV) does not change[4]('John-NOM what-ACC eat-did-CM?')
Objectives: The current study tests whether Korean-learning children with ASD have advantages in wh-question acquisition. If grammatical complexity contributes to English-learning children with ASD's delay in wh-question acquisition, Korean-learning children with ASD might demonstrate earlier comprehension. In contrast, if the pragmatics of questions is the key source of wh-question difficulties in ASD, children learning Korean should show a similar delay to children learning English.
Methods: Typically developing(TD) Korean 2-year-olds (n=15, *MA*=28.35 months), and 4-year-olds (n=15, *MA*=51.68 months) participated. Korean children diagnosed with ASD and matched with the TD 2- and 4-year-olds on raw NVIQ scores (Leiter-3) were also recruited: 11 children with ASD (M_{age}=56.72 months) matched the TD 2-year-olds (TD_{Mean}=26.73; ASD-low_{Mean}=23.92) and 9 children with ASD (M_{age}=70.47 months) matched TD 4-year-olds (TD_{Mean}=45.88, ASD-$high_{Mean}$=45.85). Language levels were also comparable by group: (TD 2-year-olds M=267 words, ASD-low M=211.50 words; TD 4-year-olds $M_{expressivelanguageage}$=54.9 months, ASD-high $M_{expressivelanguageage}$=54.9 months). Children viewed a wh-questions video[2, 6] in which pairs of familiar items (apple, flower) appeared side-by-side in the baseline trial. Then the items appeared in transitive events (apple hitting flower); finally, they were again shown side-by-side, paired with object-what-questions, subject what-questions, or where questions: (1) (Sa-gwa-ga-Mu-eos-eul-Chyeo-seo "What did the apple hit?") (2) (Mueosi-Kko-cheul-Chyeo-seo "What hit the flower?") (3) (Eo-di-e-Kko-chi-I-seo "Where is the apple/flower?"). Children's eyegaze was coded offline. Percent looking to the named item ('apple' in (1)), were analyzed; children who understand the audio were expected to look longer to the correct items (compared to the named items).
Results: TD 4-year-olds demonstrated significant wh-question comprehension for both subject and object what-questions (*ts*>4.43, *ps*<.001); these children correctly looked at the named item *less* during the 'what' than 'where' trials. TD 2-year-olds only demonstrated this comprehension for the subject what-questions (*t*=3.78, *p*<.001). The ASD-high group demonstrated significant wh-question comprehension for the object what-questions (*t*= 2.43, *p*=0.02), but not for subject what-questions (*t*= 1.08, *p*>.05), while the ASD-low group did not demonstrate significant comprehension for either question type.
Conclusions: TD Korean 4-year-olds showed robust comprehension of wh-questions; however, the other groups all demonstrated some difficulties, with TD 2-year-olds succeeding only on subject wh-questions, ASD-high children succeeding only with object-wh-questions, and ASD-low children not succeeding on either. Therefore, the grammatically simpler form of Korean wh-questions do not appear to facilitate earlier acquisition of these forms, leaving open a role for pragmatics.



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122 **164.122** Therapist Role-Reversals in an Autism Spectrum Pilot Study: Robot Malfunctions Prompt Enhanced Social Speech Performance

S. M. Walsh Matthews *and J. Pelkey, Languages, Literatures, and Cultures, Ryerson University, Toronto, ON, Canada*

Background: Recent studies (e.g., Kim et al. 2015) show increased social communicative behavior by children with Autism Spectrum Disorder (ASD) following human robot interaction (HRI). To test these results with a specific focus on social speech development, we designed and implemented a multi-month pilot study using HRI, hypothesizing that children with ASD would show improved linguistic and pragmatic communication skills through time. Tanaka and Matsuzoe (2013) find that using HRI in standard primary school settings enhances vocabulary, suggesting this may be due to role-reversal opportunities afforded by HRI, allowing children to serve as robot care-givers. This effect holds relevance for our findings.
Objectives: To use native NAO robot programming behaviors to elicit and observe social speech performance in three children with ASD through a pilot study hosted by an equal care (ABA, Therapy directed learning) center, allowing participants to interact with the small humanoid robot by playing semantic-domain card games, spontaneous dialogues and other routines.
Methods: The study used a grounded-theory, mixed-methods approach, combining ethnographic observation, with first language acquisition metrics, cognitive linguistic analyses and speech pragmatic analyses. Three investigators were required to facilitate each field data collection session, including an interface technician and two participant observers. Session programming was standardized across participants. Ethnographic field notes were rendered into project reports and compared with WAV audio recordings of HRI sessions to produce detailed transcripts coded to CHILDES CHAT standards (MacWhinney 2000). At least two investigators coded each transcript for multiple layers analysis, including Mean Length of Utterance (MLU) analysis, structural discourse analysis, content analysis of discourse pragmatics (with a focus on implicature), and cognitive semantic analysis of conceptual blends and script-frame dynamics.
Results: Relative levels of speech performance were operationalized after two visits to define varying degrees of proficiency per child: high [H], medium [M] and low-functioning [L], corresponding with preliminary MLU counts of 1.8[H], 1.0[M] and 0[L], further operationalized via successive layers of analysis. Modest net increases in MLU were apparent by the third visit (MLU=2.1[H] and 1.2[M]), and utterance counts increased substantially (n=82[H], n=69[M]). Speech pragmatic analyses indicated concrete instances of increased linguistic performance for social ends by participants H and M, including (1) increased usage of spontaneous vocatives, (2) increased verbal strategies to initiate conversation and (3) increased response rate to content questions. Linguistic strategies for the expression of concern, humor, empathy and care-giving also emerged following unplanned instances of robot malfunction, including unprompted assumption of overt role reversal by participant H, who offered a behavioral modification reward to the robot following technical correction of a software malfunction by investigators. Using insights from Cognitive Linguistics, such behavior is analyzed as a conceptual blend or interchange between Idealized Cognitive Models.
Conclusions: Using a range of fresh linguistic evidence, including first language acquisition metrics, cognitive linguistic analyses and speech pragmatic analyses, our study confirms that children with ASD who interact with robots demonstrate increased social communicative behaviors. We further find that robot malfunctions can give rise to care-giving role-reversals. Children assuming such roles improved in linguistic performance.

123 **164.123** Treatments Priorities of Saudi Parents for Their Children with ASD

F. Alnemary[1]*, H. M. Al Dhalaan*[2] *and F. Alnemary*[1]*, (1)UCLA, Los Angeles, CA, (2)King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia*

Background:
Identifying parents' treatment priorities prior to treatment planning is critical. No information about parents' treatment priorities for their children with ASD in the Arab World.
Objectives:
To identify the treatment priorities that parents in the KSA have for their children with ASD. A second aim of the study was to determine whether child characteristics reflect on parent priorities.
Methods:
Data were collected from 156 caregivers of children with ASD who participated in a project aim to evaluate ASD in the KSA. The percentages of priorities were calculated identify the highest area of need. Chi-Square was used to examine the association between parent priorities and child characteristics.
Results:
The top treatment priorities were toileting and communication, followed by safety, school achievement, relationship with peers, sensory needs, problem behaviors, adaptive skills, relationship with siblings, feeding, community outings, compliance, sleeping issues, repetitive behaviors, parent-child interaction, and greeting. Parents' treatment priorities differed by child characteristics such age, gender, and severity of the ASD symptoms.
Conclusions:
Parent priorities tended to be higher in areas where children have the greatest deficits or show emerging skills, thus emphasizing on the importance on targeting the assessment of children's deficits and emergent skills for treatment planning.

124 **164.124** Understanding How Parent Pragmatics Influence Child Language

Y. S. Stern *and M. Y. Roberts, Communication Sciences and Disorders, Northwestern University, Evanston, IL*

Background: Quantity and quality of parents' child-directed language influence children's language development. Previous work has demonstrated that early language development is boosted by parents' use of certain strategies related to responsiveness. The delivery of verbal responses that are both temporally and topically contingent to a child's utterances facilitates language development. Since these response strategies are functionally similar to typical adult pragmatic norms, it is important to examine whether differences in parent pragmatic styles may affect the language input a child receives. As pragmatic differences have been identified in unaffected family members of individuals with autism, it is critical to understand how parental pragmatic differences might influence language learning in young children with ASD.
Objectives: The focus of this project was to determine how parent pragmatic profiles relate to early child language profiles of children with ASD. This project also aimed to

assess whether pragmatic profiles of parents predict parent use of language support strategies prior to participation in a parent-implemented language intervention. We explore the hypothesis that for parents of children with ASD, pragmatic profiles characterized by higher rates of pragmatic violations are negatively associated both with child language standard scores and parental use of language support strategies.
Methods: We adapted the Pragmatic Rating Scale (PRS; Landa et al., 1992) to assess the pragmatic quality of parent language during a semi-structured interview that was conducted prior to initiation of a parent-mediated language intervention. These conversations were coded for frequency and severity of pragmatic violations. A total of 20 parents of children between 24-42 months, were included in analyses (10 parents of children with ASD, 10 parents of children with a non-ASD language delay). The Preschool Language Scales (PLS-4) was conducted with each child to assess pre-treatment receptive and expressive language levels.
Results: An independent samples t-test revealed that parents of children with ASD scored significantly higher on the PRS (indicating more pragmatic violations), as compared to parents of children with a non-ASD language delay, $t(18) = -2.301$, $p < .001$. Partial correlations revealed that within the group of parents of children with ASD, PRS Totals were negatively correlated with child expressive language level, as measured by PLS-4 expressive language Standard scores, $r(7) = -.66$, $p < .05$. Additionally, within this group, PRS Totals were also negatively correlated with parent use of the expansions strategy in a pre-treatment play interaction, $r(7) = -.68$, $p < .05$.
Conclusions: Parent pragmatic style may contribute to difficulty with language learning in children with ASD. It may be challenging for parents with different pragmatic styles to naturally respond to child utterances in a topically contingent manner and implement the expansions strategy. This may indirectly influence child language development. The project highlights the responsibility of researchers and clinicians to consider parent language factors during design and implementation of parent-mediated language interventions for children with autism. Consideration of parent language may increase the likelihood that a parent-mediated language intervention will address both the needs of the child with ASD, as well as the parent's capacities.

125 **164.125** Uneven Language Acquisition in Mandarin-Learning Preschool Children with ASD: Comparing Vocabulary, Grammar, and Pragmatic Use Via the PCDI-Toddler Form

Y. E. Su[1], *L. Naigles*[2] *and L. Y. Su*[3], *(1)Institute for Applied Linguistics, School of Foreign Languages, Central South University, Changsha, China, (2)University of Connecticut, Storrs, CT, (3)Mental Health Institute, The Second Xiangya Hospital of Central South University, Changsha, China*

Background:
English-speaking children with autism spectrum disorders (ASD) have often been reported to demonstrate an uneven language profile, with strengths in vocabulary and grammar in contrast to the pragmatic deficits (Tager-Flusberg et al. 2005; Boucher 2012). Recent research has begun to delineate language profiles in non-English speaking children with ASD, to characterize the general language acquisition process of children with ASD across countries (Su et al. 2014; Terzi et al. 2014).
Objectives:
Using the Putonghua Communicative Development Inventory: Words and Sentences (PCDI-Toddler Form; Tardif et al., 2008), this study attempts to characterize expressive language profiles in Chinese preschool children with ASD, especially to compare vocabulary, grammar and pragmatic use.
Methods:
Parents of 110 2-6-year-old children with ASD (97 boys and 13 girls, mean age = 51.57 ± 15.34 months) completed the PCDI-Toddler Form. Children were divided into 3 subgroups - Low Verbal (LV, n=62), Middle Verbal (MV, n=30) and High Verbal (HV, n=18), based on a trimodal histogram of total vocabulary production scores (LV: 0–200 words; MV: 201 – 499 words; HV: 500+ words). Language abilities were compared among the subgroups and with the published norms of typically-developing (TD) children.
Results:
The LV, MV and HV subgroups were each significantly different in total vocabulary production as well as all five subcategories (nouns, verbs, pronouns, quantifiers and question words; ps < .01). The 3 subgroups also differed significantly in the four grammatical subcategories of serial verb construction, possessive, quantifier, and past tense marker (ps <.05 for 9/12 comparisons) and in the 5 pragmatic subcategories of abstract objects, possession, absent toys/animals, past events/people, and future events (ps <.05 for 12/15 comparisons). When matched on total vocabulary production scores with TD children aged 16 months, 20 months and 27 months, the three ASD subgroups didn't generally differ from the TD children on lexical subcategory scores (ps=.07-.75 for 13/15 comparisons), nor on grammatical subcategory scores (ps = .20 -.91 for 9/12 comparisons). In contrast, the vocabulary-matched groups did consistently differ on the subcategories of the pragmatic uses of language (ps <.05 for 12/15 comparisons), with the ASD groups showing lower scores. Correlations between the total grammatical and total pragmatic scores were not significant once vocabulary was partialled out, for the whole ASD group, nor for the three ASD subgroups (ps = .25 - .65).
Conclusions:
LV, MV and HV subgroups of Mandarin-speaking children with ASD differ on grammatical and pragmatic as well as vocabulary skills. However, compared to vocabulary-matched TD children, children with ASD seemed to have more difficulties in the pragmatic than in the grammatical uses of language. Furthermore, the grammatical and pragmatic uses of language were not significantly related, even in this large dataset of Mandarin-learning preschool children with ASD. These findings thus corroborate the uneven language profile reported in English-learning children with ASD.

126 **164.126** Validity Testing of a Social Communication Classification System of Functioning for Preschool Children with Autism Spectrum Disorder (ASD)

B. M. Di Rezze[1,2], *P. Stratford*[1], *P. Rosenbaum*[2], *L. Zwaigenbaum*[3], *M. J. C. Hidecker*[4], *H. Viveiros*[2] *and M. Law*[1], *(1)School of Rehabilitation Science, McMaster University, Hamilton, ON, Canada, (2)CanChild Centre for Childhood Disability Research, McMaster University, Hamilton, ON, Canada, (3)University of Alberta, Edmonton, AB, Canada, (4)Communication Disorders, University of Wyoming, Laramie, WY*

Background: We have created an ASD functional classification system based on the WHO's International Classification of Functioning, Health and Disability (ICF). The Autism Classification System of Functioning: Social Communication (ACSF:SC) is a novel 5-level descriptive system with demonstrated consistency in ratings of both capacity (i.e., best) and typical performance by parents and professionals of preschool children with ASD.
Objectives: To examine the construct validity of the ACSF:SC across settings (i.e., home and clinic) and the spectrum of abilities of preschool children with ASD.
Methods: Support for ACSF:SC construct validation was proposed with a priori hypotheses by the research team based on Pearson correlation coefficients between ACSF:SC ratings (parents or professionals) and sub-domains of other measures. Construct validity was examined using concurrent ratings of the ACSF:SC with prominent ASD measures that evaluate function and/or social communication to assess: (1) convergent validity: how well the ACSF:SC correlates with measures possessing domains related to social communication; and (2) discriminant validity: weak correlations with unrelated functional domains. Professionals and parents completed the ACSF:SC ratings, and a concurrent self-report measure (Social Responsiveness Scale 2nd edition [SRS-2]). Parents also completed two interview-based measures: the Vineland Adaptive Behavior Scale-2 (VABS-2) and the Autism Diagnostic Interview-Revised (ADI-R) algorithm. For the ADI-R algorithm, only Social Interactions (section A) and Communication (section B) were completed.
Results: The sample included 36 children whose ACSF:SC and SRS-2 were completed by their parents. The mean age (SD) was 4.3 (0.9) years (85% male). 27 (75%) parents completed an interview to collect data for the VABS-2 and ADI-R algorithm. 33 professionals completed ACSF:SC and SRS-2 ratings. Descriptive data showed that children categorized as either verbal or non-verbal based on the ADI-R algorithm had an ACSF:SC across most of the 5 ability levels (Table 1). Mean composite scores for parent scores on the SRS-2 and VABS2 were generally increasing across improved functioning on the 5 ACSF:SC levels (i.e., ACSF:SC rating of 1 = highest ability) (Table 2). Convergent validity testing between the SRS-2 subdomain (Social Communication and Interaction [SCI]) and ACSF:SC showed statistically significant correlations for capacity (95% confidence interval[CI]), for parents: 0.52 (0.23,0.73) and for professionals: 0.63 (0.36,0.80), respectively. Discriminant validity comparing the ACFS:SC tool with an unrelated sub-domain of function on the VABS-2 (i.e., Motor Skills) demonstrated no significant correlations for capacity, -0.34 (-.64,0.04).
Conclusions: Without a gold standard, testing validity of a novel tool is challenging, requiring other measures that may be only partly related to its core construct (i.e., social communication functioning). These data demonstrated that ACSF:SC ratings by both parents and professionals were related to SRS-2-defined social communication. Parent ratings of children identified as having both verbal and non-verbal abilities also demonstrated abilities across most of the five ACSF:SC levels, indicating that social communication ability is not contingent on verbal ability. These data are promising starting point for an ongoing validation process of the ACSF:SC.

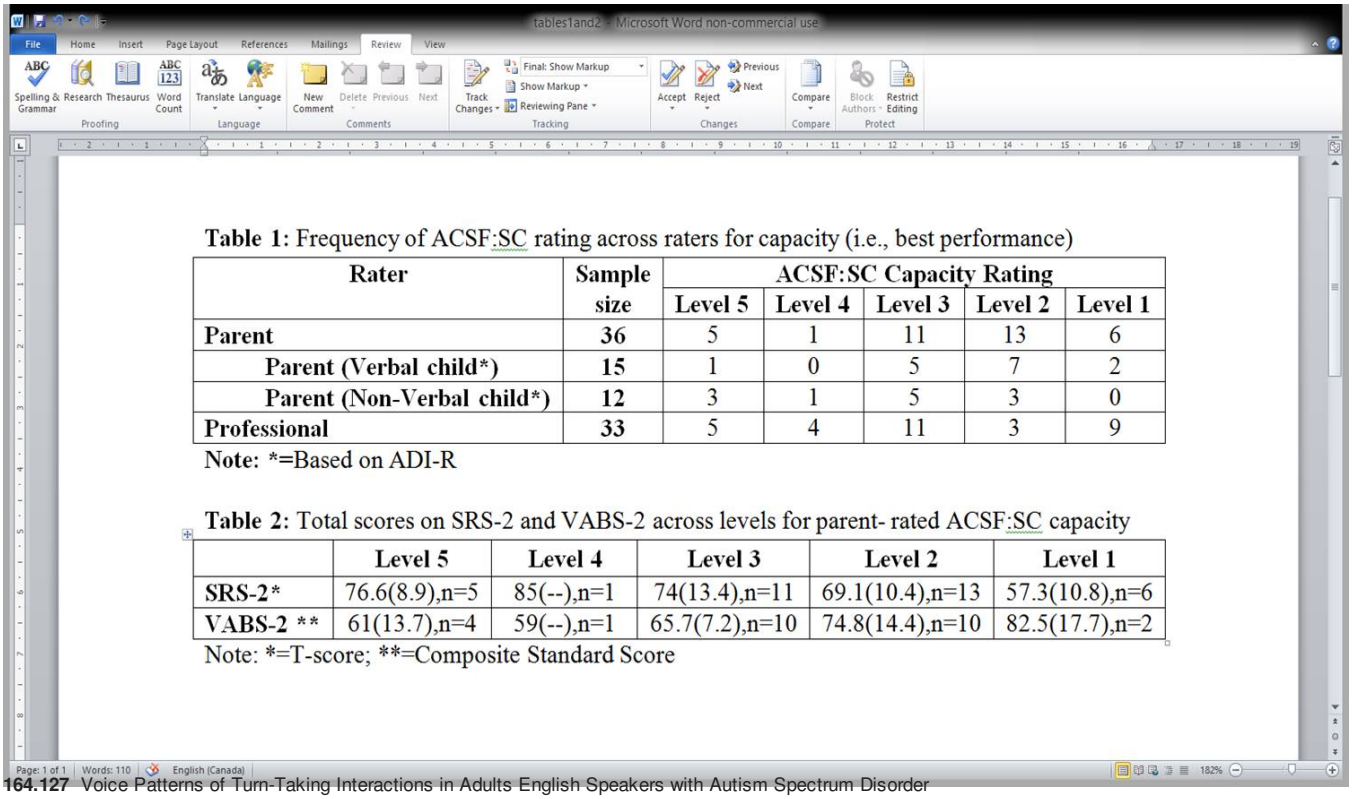

Table 1: Frequency of ACSF:SC rating across raters for capacity (i.e., best performance)

Rater	Sample size	ACSF:SC Capacity Rating				
		Level 5	Level 4	Level 3	Level 2	Level 1
Parent	**36**	5	1	11	13	6
Parent (Verbal child*)	**15**	1	0	5	7	2
Parent (Non-Verbal child*)	**12**	3	1	5	3	0
Professional	**33**	5	4	11	3	9

Note: *=Based on ADI-R

Table 2: Total scores on SRS-2 and VABS-2 across levels for parent- rated ACSF:SC capacity

	Level 5	Level 4	Level 3	Level 2	Level 1
SRS-2*	76.6(8.9),n=5	85(--),n=1	74(13.4),n=11	69.1(10.4),n=13	57.3(10.8),n=6
VABS-2 **	61(13.7),n=4	59(--),n=1	65.7(7.2),n=10	74.8(14.4),n=10	82.5(17.7),n=2

Note: *=T-score; **=Composite Standard Score

127 **164.127** Voice Patterns of Turn-Taking Interactions in Adults English Speakers with Autism Spectrum Disorder

R. Fusaroli[1,2], *A. Lambrechts*[3] *and K. L. Maras*[4], *(1)Interacting Minds, Aarhus University, Aarhus, Denmark, (2)Center for Semiotics, Aarhus University, Aarhus, Denmark, (3)City University London, Ruislip, England, United Kingdom, (4)University of Bath, Bath, United Kingdom*

Background: Individuals with Autism Spectrum Disorder (ASD) reportedly display atypical modulation of speech described as awkward, monotone, or sing-songy (Shriberg et al., 2001). These patterns are robust indicators of social communication deficit (Paul et al., 2005) and contribute to reaching a diagnosis of ASD. Fusaroli et al. (2013 ; IMFAR 2014 ; IMFAR 2015) showed that Recurrence Quantification analysis of acoustic features could be used to successfully identify voice patterns characteristic of adults with ASD and train machine learning algorithms to accurately (80-86%) discriminate autistic from non-autistic speakers in directed speech recordings.
Objectives: Our aim was to replicate and extend the results obtained by Fusaroli et al. (2013, 2014, 2015) in a turn-taking interaction, i.e. (1) characterise the speech patterns of adults with ASD in a Q&A setting, (2) characterise the corresponding changes in the interlocutor's speech patterns, and (3) employ the results in a supervised machine-learning process to determine whether acoustic features predict diagnosis and severity of the symptoms. We were also interested to evaluate how valid the model built based on directed speech data would be on turn-taking data
Methods: The context of a previously published study of memory in ASD (Maras et al., 2013) provided audio recordings of 17 ASD and 17 matched Typically Developing (TD) adults recalling details of a standardised event they had participated in. Part of the recording consisted in a Q&A between experimenter and participant, i.e. a turn-taking interaction. Transcripts were time-coded, and pitch (F0), speech-pause sequences and speech rate were automatically extracted. We conducted traditional statistical analysis on each prosodic feature. We then extracted non-linear measure of recurrence: treating voice as a dynamical system, we reconstructed its phase space and measured the number, duration and structure of repeated trajectories in that space (Marwan et al., 2007). The results were injected to train a linear discriminant function algorithm to classify the descriptions as belonging either to the ASD or TD group. The model was developed and tested using 1000 iterations of 10-fold cross-validation (to test the generalizability of the accuracy) and variational Bayesian mixed-effects inferences (to compensate for biases in sample sizes).
Results: Preliminary analysis of a subset of recordings suggest similar results to those obtained with directed speech: ASD individuals ASD produce highly regular speech patterns organized in frequently repeated short sequences (200-400 ms), supporting clinical reports of monotony. While features are similar across modes of communication, the coefficients discriminating individuals with ASD and controls need to be re-trained in the context of a turn-taking interaction. Interestingly, the interlocutor's speech patterns are as informative about diagnosis as the participants'.
Conclusions: The current data suggest than ASD adults produce highly regular patterns of speech in turn-taking interaction. Importantly this measurement captures some aspects of the clinical reports, which contribute to reaching a diagnosis of autism. Further analysis will establish whether voice patterns in turn-taking interaction are particularly distinct in ASD compared to directed speech, indicating whether interactive conversation exacerbates voice pattern atypicalities, reflecting the reported "awkwardness" in the interaction with ASD individuals ASD.

128 **164.128** Word Order Understanding Guides Wh-Question Comprehension

M. Jyotishi *and L. Naigles, University of Connecticut, Storrs, CT*

Background:
Wh-questions are challenging for children with ASD. Prior research has shown delays in both production and comprehension of questions like "What did the apple hit?" and "Who pushed the doggy?" in ASD compared with TD groups (1, 2). Some researchers have argued that children with ASD have particular difficulties with complex grammatical structures (3) while others have proposed that the impairments are related to pragmatics (4). We investigate the former possibility by examining whether early grammatical competence predicts later wh-question comprehension. One index of early grammar is word order; children who successfully process wh-questions must have abstracted the subject-verb-object (SVO) frame. Therefore, children's ability to successfully process SVO sentences could help them learn wh-question structures.
Objectives:
We investigated the degree to which comprehension of SVO word order at 2 years predicted wh-question comprehension at 3-4 years in a large sample of children.
Methods: Language comprehension of 35 TD children (MA_{visit1} =20.20 months) and 29 children with ASD (MA_{visit1}=33.16 months) was assessed via intermodal preferential looking every four months for two years in this longitudinal study. At visits 1-2, children viewed the word order video, in which they were shown side-by-side reversible actions involving a costumed horse and bird, paired with Baseline trials ("we can see both") and test trials ("The horse is washing the bird" vs. "the bird is washing the horse") (3,4). At visits 3-6, children watched the Wh-Question video, in which each horse-and-bird action was followed by trials in which the horse and bird appeared side by side. The test audios were e.g., "Where is the bird/horse?" for Where/Baseline trials, "What washed the horse?" for Subject wh-questions and "What did the bird wash?" for Object wh-questions. Children's eye movements were coded off-line. The dependent measures were difference scores of proportion looking to the target during the test minus baseline trials; larger differences indicated stronger comprehension. Word order scores were combined across visits 1 – 2; wh-question scores were analyzed for each visit.
Results:
In the TD group, a significant correlation was obtained between early word order and subject-wh-question at visit 5, $r = .359$, $p < .05$. In the ASD group, a significant correlation was obtained between early word order comprehension and object-wh-comprehension at visit 6, $r = .381$, $p < .05$. Stepwise regressions in which NVIQ (Mullen VR) and vocabulary (CDI:Communicative Development Inventory) were entered first revealed that word order was the only significant predictor of subject-question comprehension for the TD group, $F(1,30) = 4.43$, $p = .044$ ($R^2 = .129$). For the ASD group, NVIQ and early word order (but not vocabulary) jointly accounted for a significant amount of variance in object wh-question comprehension ($R^2 = .272$).
Conclusions:
Early performance on SVO word order predicted later wh-question comprehension in both group; thus, children's understanding of wh-questions seems to be emerging from their knowledge of English sentence frames. These findings lend support to the hypothesis that the sparse and delayed wh-question use of children with ASD has grammatical roots, perhaps in combination with pragmatic roots.

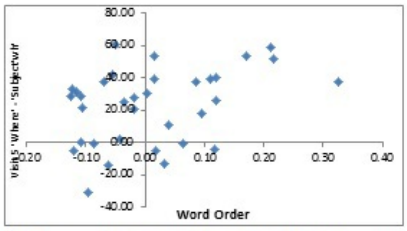

Figure 1. Word order significantly predicted Visit 5 'Where' – 'Subject-wh' in TD group.

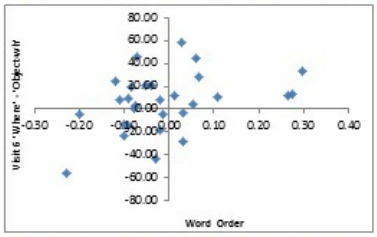

Figure 2. Word order significantly predicted Visit 6 'Where' – 'Object-wh' in ASD group.

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129 **164.129** Writing Development in Higher-Functioning Children with Autism Spectrum Disorder with and without ADHD Comorbidity

M. C. Zajic[1], *N. S. McIntyre*[1], *L. E. Swain-Lerro*[1], *J. B. McCauley*[2], *H. K. Schiltz*[3], *T. Oswald*[2] *and P. C. Mundy*[4], *(1)University of California at Davis MIND Institute, Davis, CA, (2)University of California at Davis MIND Institute, Sacramento, CA, (3)Human Development, University of California at Davis, Davis, CA, (4)Education and Psychiatry, University of California at Davis, Sacramento, CA*

Background: Higher-functioning children with ASD (HFASD) often experience difficulty with writing. However, this problem also occurs for children with ADHD. Few studies have examined the effect of the co-occurrence of symptoms of ASD and ADHD on writing, and few studies have addressed the question of how well children with HFASD develop writing abilities across time in longitudinal research.

Objectives: To address these gaps in the literature, this longitudinal study examined writing ability in 8–16 year-old school-age children with HFASD compared to children with ADHD and typical development (TD). This study also examined the hypothesis that children with HFASD with comorbid elevations of ADHD would display poorer writing development than children with HFASD without comorbid ADHD.

Methods: The participants were 17 children with HFASD without ADHD symptoms (HFASD-L), 39 with HFASD and ADHD symptoms (HFASD-H), 24 children with only ADHD symptoms, and 25 children with TD. ASD symptoms were confirmed with the ADOS–2. ADHD symptoms (T-scores > 70) were confirmed with parent reports on the Conners-3. All groups were age matched at the first visit (T1) and re-assessed 15 months later (T2). IQ was assessed with the WASI-II, and FIQ was included as a covariate in all analyses due to group differences (Table 1). Writing was assessed with the Wechsler Individual Achievement Test–3 (WIAT-III). At T1, all children handwrote their responses; at T2, children were given the choice (their preference) to handwrite or type their responses.

Results: A mixed-design MANCOVA yielded a significant effect for time point on overall writing scores for all groups, $F(1,100)=7.0$, $p=.009$, $eta^2=.07$. Significant time point effects across groups were also observed on the WIAT-III word count and thematic content scores ($p=.027$ and $.009$, respectively; see Figure 1). Main effects for diagnostic group were observed for overall writing score, $F(3,100)=3.14$, $p=.03$, and word count, $F(3,100)=3.38$, $p=.03$, both $eta^2=.09$ (see Figure 1), but not for thematic content, $p=.15$. Children with HFASD-H performed poorest of all groups for overall writing score and word count (see Figure 1) but planned comparison revealed this difference was significant only versus the children with TD. Children with HFASD-H also performed poorly on thematic content at T1, but this effect was not apparent at T2 (see Figure 1).

Conclusions: This study provided evidence that many children with HFASD may be at risk for poor academic writing development, especially children with HFASD and comorbid ADHD symptoms. It was not clear if the writing risk of children with HFASD-H was appreciably greater than children with HFASD-L or ADHD; sample sizes may have limited the power of these comparisons. Alternatively, the results also provided evidence of improvement in writing across groups, suggesting that specific writing instruction may be a useful modality for communication intervention among children with HFASD or ADHD. Future research on measurement issues, such as handwriting versus typing and comparing the WIAT-III versus other writing assessments, will sharpen our understanding of writing development in children with HFASD and ADHD.

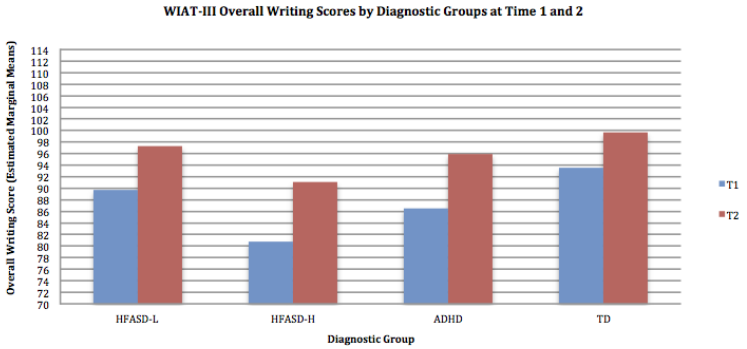
Table 1

Descriptive Statistics by Diagnostic Groups for Age, IQ, and Diagnostic Measures with One-Way Analysis of Variance (ANOVA) Comparisons

	TD		ADHD		HFASD-L		HFASD-H		ANOVA Comparisons	
N	25		24		17		39			
Measures	M	SD	M	SD	M	SD	M	SD	F	p value
Demographics										
Age, Time 1	11.57	2.39	11.88	2.39	10.97	1.72	11.52	2.18	0.567	0.64
Age, Time 2	12.85	2.38	13.19	2.37	12.33	1.70	12.78	2.17	0.51	0.68
IQ										
FIQ	116.60	13.91	99.63	16.75	99.53	14.31	97.67	15.38	8.95	<.001
ASD Diagnostics										
ADOS-2	#	#	3.67	3.34	9.71	2.37	11.08	3.72	33.896	<.001
SCQ	2.20	1.76	7.54	6.69	21.53	8.40	21.62	7.02	63.157	<.001
SRS	43.48	7.94	62.63	15.58	77.06	11.71	83.87	8.54	75.221	<.001
ADHD Diagnostics										
Conners-3 Inatten	47.32	11.23	78.75	9.65	66.76	8.08	80.21	7.89	74.286	<.001
Conners-3 Hyper/Imp	46.68	8.86	72.67	17.20	56.29	8.92	81.79	9.11	55.364	<.001
Conners-3 Overall Average	47.28	9.16	75.96	10.74	61.94	6.17	81.44	6.74	95.354	<.001

Note. IQ, ASD diagnostics, and ADHD diagnostics were collected at time one. TD = typical developing. ADHD = attention-deficit/hyperactivity disorder. HFASD-L = high-functioning autism spectrum disorder with low ADHD symptomatology. HFASD-H = high-functioning autism spectrum disorder with high ADHD symptomatology. FIQ = full-scale intelligence quotient. ADOS-2 = Autism Diagnostic Observation Schedule (Second Edition). SCQ = Social Communication Questionnaire. SRS = Social Responsiveness Scale. Conners-3 Inatten = Conners-3 Parent Report Scale of Inattention Symptoms. Conners-3 Hyper/Imp = Conners-3 Parent Report Scale of Hyperactive/Impulsive Symptoms. [#]ADOS-2 was not administered to children with TD.

A



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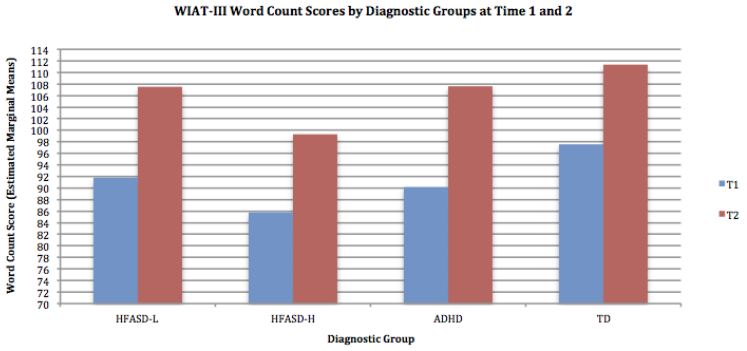

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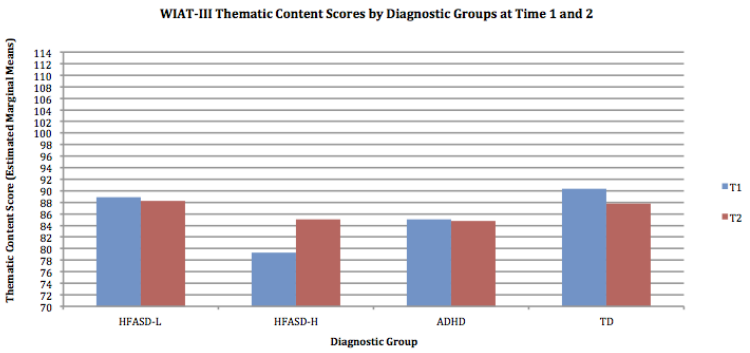


Figure 1. Age-based standardized WIAT-III writing scores for overall writing (A), word count (B), and thematic content (C) across the four-diagnostic group split across time points one and two. All estimated marginal means covary for FIQ = 102.92.

N. M. Heckel[1], *J. Barstein*[2], *G. E. Martin*[3] *and M. Losh*[1], *(1)Department of Communication Sciences and Disorders, Northwestern University, Evanston, IL, (2)Northwestern University Feinberg School of Medicine, Chicago, IL, (3)Communication Sciences and Disorders, St. John's University, Staten Island, NY*

Background: Pragmatic language is universally impaired in individuals with ASD, and sub-clinical pragmatic language differences have been observed in a subgroup of first-degree relatives. Believed to constitute an endophenotype indicative of genetic risk to ASD, pragmatic language differences among relatives have been described as part of the broad autism phenotype (BAP). Prior investigations of pragmatic language in unaffected relatives revealed global differences in contingency and content in both narrative and conversational tasks (Landa et al., 1991, 1992; Losh et al., 2008, 2012). This study attempted to build on this work by applying a fine-grained discourse analysis to transcripts of conversational interactions from parents of individuals with ASD. In particular, we examined the use of conversational markers essential for cohering messages and maintaining the conversational floor, as well as the relevance and repetition of thematic content, which influences conversational reciprocity.
Objectives: To examine the patterns of discourse marker use and thematic content of conversational samples from parents of individuals with ASD and age- and IQ-matched controls.
Methods: Participants included 30 parents of individuals with ASD and 36 parents of typically-developing controls. A detailed coding scheme (adapted from Martin et al., 2012) was used to assess discourse marker use, thematic content, and topic repetition during a semi-structured conversation. Discourse markers included Back-Channeling (i.e., listener responses, 'okay', 'yeah') and Filled Pauses (e.g., 'uh', 'um'). Thematic content was evaluated by how related a topic was to ongoing discourse (i.e., Contingent vs Noncontingent). Topic repetition was derived by the proportion of topics that were spontaneously re-introduced by participants >2 times. BAP status (positive + or negative -) was determined using the Modified Personality Assessment Scale (MPAS; Tyrer, 1988) and global pragmatic language was assessed using the Pragmatic Rating Scale (PRS; Landa, 1992).
Results: Family diagnostic groups differed in their use of discourse markers. Specifically, the ASD parent group overall used Filled Pauses less than Control parents $F(1, 79) = 6.44$, $ps < .05$. When broken down by BAP status, however, the BAP (+) parents used Back-Channeling significantly less than control parents $F(2, 57) = 4.45$, ($p < .01$) and BAP (-) parents ($p < .02$). BAP (+) parents also demonstrated increased discussion of Noncontingent topics $F(2, 66) = 6.95$, $ps < .01$ relative to both groups. Greater discussion of Noncontingent topics was significantly related to a pragmatic language domain associated with talkativeness and overly detailed language ($r = .63$) in BAP (+) parents. Higher rates of repetitive topic introduction were observed in the BAP (+) group $F(2, 67) = 2.40$, $ps < .05$.
Conclusions: Differences in discourse marker use and thematic content in conversation were associated with subclinical features of genetic risk in parents of individuals with ASD. In particular, BAP (+) parents demonstrated word use patterns indicative of *reduced* reciprocity. Such discourse patterns may significantly, albeit subtly, influence communication styles relevant to interpersonal relationships. These findings underscore the subtle manifestation of pragmatic language differences as a possible endophenotype of ASD.

Poster Session
165 - Diagnostic, Behavioral & Intellectual Assessment II
5:30 PM - 7:00 PM - Hall A

131 **165.131** ABAS-II Adaptive Profiles and Correlates in Samples of Children with HFASD or LFASD

C. A. McDonald[1], ***B. C. Nasca***[2], *C. Lopata*[1], *J. P. Donnelly*[1], *M. L. Thomeer*[1] *and J. D. Rodgers*[1], *(1)Institute for Autism Research, Canisius College, Buffalo, NY, (2)Counseling, School, And Educational Psychology, SUNY at Buffalo, Buffalo, NY*

Background: There have been few studies that have used the ABAS-II to document adaptive profiles in homogeneous samples of high-functioning children with autism spectrum disorder (HFASD) and children with ASD and co-occurring intellectual disability (LFASD). Further, prior studies of predictors of adaptive functioning using either the VABS or ABAS-II have yielded mixed results (Lopata et al., 2012; McDonald et al., 2014).
Objectives: This study (a) examined the ABAS-II adaptive profile within each sample, (b) compared adaptive functioning and cognitive ability, and (c) assessed predictors (i.e., age, IQ) of adaptive skills.
Methods: Participants included 110 children (i.e., 55 with HFASD and 55 with LFASD), ages 6 to 12 years. The LFASD sample was recruited from a center-based school serving students with ASD and co-occurring cognitive and language deficits. Inclusion criteria included an independent diagnosis of an ASD and/or educational classification of autism and estimated IQ < 70. The second sample consisted of 55 children with HFASD recruited from prior clinical trials with an independent diagnosis of ASD and WISC-IV short-form IQ ≥ 85. The dependent measure used was the parent rating form of the Adaptive Behavior Assessment System - Second Edition (ABAS-II).
Results: Examination of the adaptive profile for the HFASD sample indicated a relative strength in the Conceptual domain (CON), followed by Practical (PRAC), and lastly Social (SOC) domains. Comparisons of cognitive and adaptive abilities within the sample indicated significantly lower scores on the GAC, $t(54) = 12.50$, $p < .001$, $d = 2.49$, and all of the adaptive domains [CON, $t(54) = 10.48$, $p < .001$, $d = 1.93$; PRAC, $t(54) = 9.64$, $p < .001$, $d = 1.95$; SOC $t(54) = 13.75$, $p < .001$, $d = 2.78$]. The majority of correlations between adaptive ability and cognitive ability and age were nonsignificant, with the exception of the relationship between age and SOC ($r = -.27$, $p < .05$), which was negative and significant. For the LFASD sample, no significant difference was found between cognitive ability and overall adaptive performance, GAC, $t(54) = 1.83$, $p = .073$, $d = 0.08$, or PRAC $t(54) = .54$, $p = .593$, $d = -1.00$. However, this sample performed significantly higher than expected on CON, $t(54) = -2.91$, $p < .005$, $d = -1.17$, and SOC, $t(54) = -6.35$, $p < .001$, $d = -1.33$, given their estimated cognitive ability. All correlations between age and adaptive abilities were nonsignificant ($p > .05$), while relationships between estimated cognitive ability and all adaptive areas for the LFASD sample were positive and significant ($p < .01$), with rs ranging from .35-.46.
Conclusions: The measurement of adaptive behavior is important both in diagnostic and psychological assessment. While individuals with LFASD displayed a relative strength in adaptive behavior in comparison to their estimated cognitive ability, individuals with HFASD displayed an overall cognitive strength with relative adaptive deficits. Results highlighted a need for intervention in the area of adaptive skills for children with ASDs, especially in the area of social skills for those with HFASD.

132 **165.132** Adaptive Behavior in Children with ASD with Monolingual and Bilingual Language Experience

S. B. Vanegas*, K. Acharya and L. Sandman, University of Illinois at Chicago, Chicago, IL*

Background:
Children with ASD typically present challenges across multiple areas of functioning. Adaptive behavior skills can yield practical information on the everyday functioning of children with ASD. The Vineland Adaptive Behavior Scales (Sparrow et al., 1984, 2005) has been developed as a parent interview to capture skills in communication, daily living, socialization, and motor domains and has been widely used in ASD research (e.g., McDonald et al., 2015). However, there is limited research on adaptive behavior skills among racial/ethnically diverse children with ASD. Evaluating adaptive behavior skills of children from diverse backgrounds can be a critical step in developing effective treatment goals.
Objectives:
The current study intends to fill a gap in empirical data on adaptive behavior skills in a diverse sample of children with ASD with monolingual and bilingual language experience.
Methods:
Clinical records for children with ASD between 3 and 12 years of age were reviewed from a developmental disabilities clinic located in a large diverse city in the United States. Data was extracted from the clinical record including demographics, language experiences, and scores for the Vineland Adaptive Behavior Scales and nonverbal IQ. Children were eligible for inclusion if they were verbal and had a nonverbal IQ score greater than 70. Children's language status was determined by review of clinician observations, parent-report of language use in the home/school, and language use reported in IEP reports. The preliminary sample included 57 children, with a mean age of 6.20 years. The monolingual group included 15 children (53% White, 47% African-American; 100% male) and the bilingual group included 42 children (100% Latino; 93% male, 7% female).
Results:
Preliminary analyses demonstrated that the bilingual group was older than the monolingual group and no differences were found in nonverbal IQ between groups. A MANOVA was then conducted on the standard scores for the Communication, Daily Living Skills, and Socialization subscales of the Vineland across child language groups, with age as a covariate. These analyses found that parent-reported communication skills did not differ between monolingual and bilingual children with ASD, $F(1, 54) = 1.30$, $p = .260$. Analyses also showed that bilingual children with ASD had more intact daily living skills, $F(1, 54) = 6.80$, $p = .012$, partial $\eta^2 = .11$, and more intact socialization skills, $F(1, 54) = 5.97$, $p = .018$, partial $\eta^2 = .10$, than monolingual children with ASD.
Conclusions:
The preliminary results finds that within a diverse sample of children with ASD, children with bilingual language experience had greater daily living and socialization skills when compared to children with monolingual language experience. These results are supported by one study comparing simultaneous and sequential bilingual children with ASD (Hambly & Fombonne, 2012). These results suggest that bilingual language experience may afford children with ASD additional opportunities for developing adaptive behavior skills. Additional data is needed to determine if adaptive behavior skills vary due to language experience or cultural values. These results contribute to the field by providing empirical evidence on diverse language experiences and adaptive behavior in children with ASD.

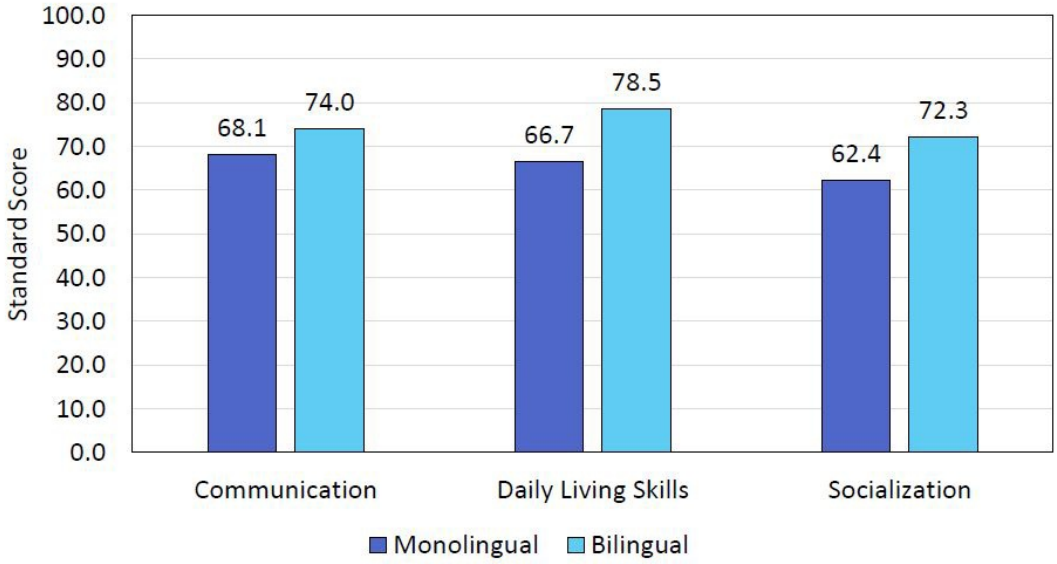


Figure 1. Standard Scores for subscales of the Vineland Adaptive Behavior by language group

133 **165.133** An Initial Evaluation of the Validity of the Gilliam Autism Rating Scale-Third Edition (GARS-3) in a Clinical Sample

*K. A. Hastings and **J. M. Campbell**, University of Kentucky, Lexington, KY*

Background: Third party rating scales are often used to support diagnostic decision making in Autism Spectrum Disorder (ASD) diagnostic evaluations. One such measure is the Gilliam Autism Rating Scale-Third Edition (GARS-3; Gilliam, 2014). The GARS-3 is a standardized norm-referenced instrument designed to assist in the diagnosis of ASD. The GARS-3 is keyed to correspond with DSM-5 diagnostic criteria and was standardized with a sample of 1,859 individuals with ASD 3 to 22 years of age. Gilliam (2014) provides psychometric support for the GARS-3 as evidenced by internal consistency of .79 - .94 for GARS-3 subscales and .93 - .94 for GARS-3 Autism Index scores. Gilliam also reports criterion-related validity in support of the GARS-3 as evidenced by significant correlations between the GARS-3 Autism Index and (a) the Childhood Autism Rating Scale, Second Edition (CARS-2) and (b) Autism Diagnostic Observation Schedule.
Objectives: The authors conducted an initial evaluation of the validity of the GARS-3 by correlating scores with well-established measures of autism symptomatology. Investigators also contrasted GARS-3 scores between individuals who met DSM-5 diagnostic criteria for ASD and those individuals who did not.
Methods: Participants were 20 individuals (*M* age = 8.23 yr; 80% Male; 80% Caucasian; 12 diagnosed with ASD, 8 diagnosed with another DSM-5 disorder) who participated in comprehensive diagnostic evaluation at a training clinic at a land grant university in the Southeast U.S. Diagnostic evaluation was established using results from the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) and CARS-2. Caregivers completed the GARS-3 as part of the diagnostic evaluation; GARS-3 ratings were collected for the purposes of research and were not used in diagnostic decision making.
Results: Preliminary results indicate significant relationship between ADOS-2 Module 3 Total Scores and CARS-2 T Score, $r(3) = .87$, $p < .05$. ADOS-2 Module 2 Total Score also correlated highly with the CARS-2 T Scores, $r(5) = .74$, $p < .05$. ADOS-2 Module 3 Total Score and the GARS-3 Autism Index were not correlated, $r(3) = -.04$, *ns*. CARS-2 T Score and the GARS-3 Autism Index were also uncorrelated, $r(18) = .06$, *ns*. CARS-2 T Scores differed across ASD and non-ASD groups, $t(18) = 3.42$, $p < .05$. Individuals with ASD diagnosis ($n = 12$) earned similar GARS-3 Autism Index scores ($M = 79.92$; $SD = 18.62$) to individuals without ASD diagnosis ($n = 8$; $M = 93.75$; $SD = 10.63$); $t(18) = -1.90$, *ns*.
Conclusions: Preliminary results suggest weak relationships between the GARS-3 Autism Index Score and the ADOS-2, and the GARS-3 Autism Index Score and CARS-2 T Score. ADOS-2 and CARS-2 T scores differed across diagnostic groups, with individuals with ASD earning significantly higher scores. GARS-3 Autism Index scores, however, did not differ between groups with ASD and those without ASD. Initial findings warrant caution in using the GARS-3; however, larger samples are needed to fully document the utility of the GARS-3 in diagnostic evaluation.

134 **165.134** Besides Normal Children, Can the Children and Adolescent Versions of Autism-Spectrum Quotient (AQ) Also Differentiate ASD from ADHD Children? a Validation Study of AQ in Hong Kong

P. W. Leung[1], *R. Chan*[2], *V. Wai*[1] *and P. Wong*[1], *(1)Dept of Psychology, The Chinese University of Hong Kong, Hong Kong, China, (2)Kwai Chung Hospital, Hospital Authority, Hong Kong, China*

Background:
The Children and Adolescent versions of Autism-Spectrum Quotient (AQ-Child and AQ-Adol) are respectively 50-item, parent-report questionnaires. They had been validated for assessing autism spectrum disorder (ASD), differentiating children with ASD from normal children. However, so far, few study reported on their ability to differentiate ASD from ADHD (attention-deficit hyperactivity disorder). Both neurodevelopmental disorders were common referrals to and presentation in child psychiatric clinics. It was important to test for practical reasons if AQ could aid clinicians in making differential diagnosis between ASD and ADHD.
Objectives:
This study aimed at testing whether the AQ-Child and AQ-Adol were not only capable in differentiating ASD children/adolescents from normal control, but also from ADHD children/adolescents.
Methods:
Two Chinese-speaking samples were recruited from child psychiatric clinics and mainstream schools to examine the psychometric properties of AQ-Child and AQ-Adol respectively in Hong Kong. They were translated into Chinese via the standard procedure of translation and back-translation. The first sample included three groups of children of 4 to 11 years for validating AQ-Child: (1) community control (N=1,196), (2) ASD children (N=124), and (3) ADHD children (N=82). A second sample included adolescents of 12 to 18 years for validating AQ-Adol: (1) community control (N=809), (2) ASD adolescents (N=78), and (3) ADHD adolescents (N=51). The AQ-Child and AQ-Adol were filled in by parents of the recruited samples.
Results:
The psychometric results found for AQ-Child and AQ-Adol were largely similar. Both did not find age and gender effects in their total scores. Factor analysis was able to replicate three of AQ-Child's five subscales, namely, Social Skills, Attention to Detail, and Communication, and four of AQ-Adol's five subscales, adding Imagination. The remaining subscale, Attention Switching, failed to be replicated in both AQ versions. The internal consistency of the total scores of AQ-Child and AQ-Adol were respectively 0.80 and 0.87, while test-retest reliability 0.80 and 0.95. There were significant group differences in the total scores of both AQ-Child and AQ-Adol across the three groups of participants with large effect sizes (>1.3) between ASD vs Control and ASD vs ADHD, but only small-to-moderate effect sizes (≤0.5) between ADHD vs Control. The AUCs for AQ-Child between ASD vs Control and ASD vs ADHD were respectively 0.91 and 0.87, while for AQ-Adol, the corresponding figures were 0.91 and 0.81. The performance of the five subscale scores of both AQ versions in the above psychometric indices varied. Instead, the total scores appeared to be the consistent good performers in them.
Conclusions:

The psychometric properties of AQ-Child and AQ-Adol in Hong Kong would be comfortably regarded as good to excellent. They were highly compatible to those of the original and other previous studies in AQ. Particularly, the added contribution of this study was to indicate that both AQ-Child and AQ-Adol were able to differentiate competently ASD from ADHD, underscoring the specificity of the AQ for ASD.

135 **165.135** Caregiver Concerns Prior to a Diagnostic Evaluation: Differences Between Children with and without Autism Spectrum Disorder

L. Little[1], *A. Wallisch*[2] *and B. Salley*[3,4], *(1)University of Kansas Medical Center, Kansas City, MO, (2)University of Kansas Medical Center, Kansas Clty, KS, (3)University of Kansas, Overland Park, KS, (4)Pediatrics, University of Kansas Medical Center, Kansas City, KS*

Background:
Research suggests that parental concerns precede an Autism Spectrum Disorder (ASD) diagnosis; it is unclear if specific types of concerns may be specific to children with ASD versus another developmental condition. While previous studies have gathered parent-report data from high-risk samples (Ozonoff et al., 2009) or used retrospective reports, caregiver concerns preceding a diagnosis of ASD in a large community based sample remain unexamined.
Objectives:
This study examined the extent to which parent concerns differentiate children with an eventual diagnosis of ASD versus those without in a community based sample aged 12 months-9 years.
Methods:
This secondary data analysis of caregiver report data gathered prior to a child's diagnostic evaluation resulting in a diagnosis of ASD (n=271) or non-ASD (including global developmental delay; n=314). We examined 3 groups of participants: (ages 0-3yrs; 3-6yrs; 6-9yrs; total of n=585 children). Concerns were coded from an intake form prior to diagnostic evaluations. Coding was adapted from Ozonoff et al. (2009), and included: 1) Externalizing; 2) Cognitive development; 3) Medical; 4) Motor; 5) Speech/communication; 6) Social interaction; 7) Stereotyped behavior; 8) Sensory aversions/preferences; 9) Unspecified autism; 10) Internalizing. We used binary logistic regression to determine the extent to which categories of caregiver concerns predicted diagnostic group (ASD/non-ASD) in 3 age groups of children.
Results:
In the youngest group, increased Externalizing (p<.05; OR=.334) and Cognitive development (p<.05; OR=.221) differentiated children in the non-ASD group. In children 3-6 yrs, increased Speech (p<.05; OR=1.640) and Social concerns (p<.01; OR=2.156) differentiated children with ASD. In the oldest group, increased Social concerns differentiated children with ASD (p<.05; OR=2.433). These four concerns correctly classified 74.5% of children 0-3yrs; 62.5% 3-6yrs; and 73.1% of children 6-9yrs.
Conclusions:
Results suggest that parental concerns may help predict a diagnosis of ASD, but distinct concerns differentiate ASD across age groups. Children that do not receive an ASD diagnosis in the 0-3yr group have a higher likelihood of Cognitive development and Externalizing concerns potentially due to the emphasis of reaching developmental milestones at this age. Among children aged 3-6 years that received an ASD diagnosis, the likelihood of Speech and Social concerns was increased. This may be due to the changing social demands on the child (e.g., preschool). At 3 years, many children are increasingly demonstrating complex language and social play, and this may be a potential differentiating factor and concern for parents of children with ASD. In children with a diagnosis of ASD aged 6-9 years, speech concerns diminish, and the likelihood of Social concerns is very high. By understanding the parental concerns that best differentiate those with an eventual ASD diagnosis, we can better monitor children at risk of a diagnosis and identify children more acuurately across development.

136 **165.136** Characteristics of Autism Spectrum Disorder Across Time: Comparing Cohorts of Birth Date and Time of Assessment

T. White*, T. E. Regan, K. Williams and M. R. Klinger, University of North Carolina at Chapel Hill, Chapel Hill, NC*

Background: Over the course of this century, the diagnosis of autism spectrum disorder (ASD) has drastically increased. In 2000, the rate of diagnosis was 1 in 150, and recent reports indicate the prevalence as 1 in 68 (Center for Disease Control, 2014). In addition to growing numbers in the population, the autism profile has changed. There has been an increase in the number of individuals diagnosed with normal to high intellectual functioning and adaptive behavior functioning (Freeman, Homme, Guthrie, & Zhang, 2009). There is a need to evaluate these changes across the ASD population over time.
Objectives: This study examined associations of autism diagnostic characteristics with date of birth and date of evaluation within a large clinical sample. Three diagnostic characteristics were included in analysis: autism symptom severity, adaptive functioning, and cognitive functioning. The goals were to (1) determine if changes in diagnostic profile appearance were tied to date of birth, indicating a birth cohort effect, and (2) determine if changes in diagnostic profile appearance were tied to date of evaluation, indicating changing diagnostic criteria across time.
Methods: This study used secondary data analysis of assessment data collected from the statewide UNC TEACCH Autism Program registry. A records review was conducted to compare profiles of individuals evaluated in clinics. The sample includes evaluations starting in 2000 through 2015. Data from nearly 3000 individuals were used in this study. A preliminary hierarchical multiple regression analysis was performed in order to investigate the ability to predict three facets of the autism profile (symptom severity, cognitive functioning, and adaptive functioning) based on date of diagnosis compared to date of birth, after controlling for both parent's date of birth and the child's gender.
Results: Data were analyzed separately for symptom severity (ADOS, N=1746 and CARS, N=1333), cognitive functioning (IQ, N=2929), and adaptive functioning (Vineland, N=2790). Hierarchical regression analyses were run for each variable with covariates (Parent 1 Date of Birth, Parent 2 Date of Birth, and Gender) entered first followed by predictor variables (Date of Evaluation and Child Date of Birth). Regression analyses found that both predictor variables contributed significant variance in the model for all four variables (ADOS: *Child Date of Birth*: beta = 0.315; p < .001; *Evaluation Date* beta= 0.265; p<.001) (CARS: *CDoB* beta= 0.237; p<.001; *ED* beta=0.117; p<.001) IQ: CDoB beta = .086; p < .001; ED beta = .357; p<.001) (Vineland: *CDoB* beta = .086; p < .001; *ED* beta = .357; p<.001).
Conclusions: Preliminary results indicate a relatively consistent pattern for both date of evaluation and date of birth cohorts influencing the characteristics of individuals seen in a large network of community clinics. Across the three domains (symptom severity, cognitive functioning, and adaptive behavior) all showed higher functioning for individuals diagnosed more recently and more adults. Part of this change may be due to changes in criteria (as indicated by evaluation date effects) and changes across birth cohorts (as indicated by child date of birth effects).

137 **165.137** Clincal Validation of a Test for Maternal Antibody Related (MAR) Autism

J. W. Amshey[1], *S. Hilt*[2], *J. Bue*[1], *A. Domingo*[1], *G. Landau*[1], *G. Korzus*[1] *and J. Van de Water*[3], *(1)Pediatric Bioscience, Inc., San Diego, CA, (2)University of California at Davis, Davis, CA, (3)University of California at Davis MIND Institute, Davis, CA*

Background: It has been reported based on Western Blot analysis (Braunschweig, et al., 2013), that approximately 23% of mothers of children with ASD have specific patterns of autoantibodies to brain proteins. These patterns are found in less than 1% of mothers of typically developing children. Thus, these autoantibodies are potential biomarkers for a newly identified subtype of autism, Maternal Antibody Related (MAR) autism, and may be risk factors for ASD. Validated biomarkers for ASD can potentially contribute to earlier diagnosis and intervention. We have converted the Western Blot to an ELISA method that is more suitable for clinical laboratory use.
Objectives: We set out to confirm that the ELISA method replicates the Western Blot findings and to determine the potential value of the test based on its sensitivity, specificity, and Positive Predictive Value [PPV]) in a large prospective-retrospective clinical study.
Methods: This study includes over 450 mothers enrolled in the CHARGE (Childhood Autism Risk from Genetics and the Environment) Study whose children (2-5 years old) have had a diagnosis of ASD confirmed on both ADI-R and ADOS, as well as case controls from mothers of typically developing children. Maternal plasma specimens collected at study enrollment were analyzed for the presence of multiple autoantibodies on a quantitative, high-throughput ELISA platform. These results are evaluated to provide a qualitative result for the presence or absence of the MAR autism subtype.
Results: The study is ongoing and results from the full study will be presented. Preliminary results on 123 samples with 6 of 7 known antigens show that the transfer of the MAR Autism Test to a high-throughput ELISA platform has been successful. We observed a 15% sensitivity (percent of ASD samples that tested positive) with 98% specificity (percent of TD samples that tested negative), consistent with previous results reported using the Western blot method. We will present the results of the decision algorithm training study of about 250 samples and a blinded validation study on about 200 samples, each set containing approximately 63% samples from mothers who have children with ASD, and 37% mothers of typically developing children.
Conclusions: These preliminary results suggest that the presence of MAR antibodies can be used to identify a substantial subtype of children with ASD with an actionable positive predictive value due to a low false positive rate. A positive result in a mother of a child where developmental delay is observed indicates a high probability of a future ASD diagnosis based on behavioral criteria. In such a case, behavioral therapy could be started immediately for the most effective outcome for the child. Samples from pregnant women are not included in the study, and the test is not validated for use during pregnancy.

138 **165.138** Clinical Characteristics of Children with Dup15q Syndrome and Comorbid ASD

C. DiStefano[1], *C. Kasari*[2], *S. Huberty*[3] *and S. S. Jeste*[4], *(1)Psychiatry and Biobehavioral Sciences, University of California, Los Angeles, Los Angeles, CA, (2)University of California Los Angeles, Los Angeles, CA, (3)Psychiatry and Biobehavioral Sciences, UCLA Center for Autism Research and Treatment, Los Angeles, CA, (4)Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA*

Background:
Duplication 15q syndrome (Dup15q), one of the most common genetic variants associated with Autism Spectrum Disorders (ASD) (Hogart et al., 2010), is characterized by intellectual disability (ID), hypotonia, motor delays, and social communication impairment (Battaglia et al., 2010). Because most research has consisted of retrospective chart

reviews or case studes, we lack in-depth information about clinical profiles of children with Dup15q syndrome, notably in comparison to children with non-syndromic ASD. Improved characterization of genetic syndromes associated with ID and ASD can inform not only prognosis, but also treatment, leading to the discovery of targeted, mechanism-based interventions that may improve individual outcomes.

Objectives:

Examine social-communication, adaptive and cognitive skills in children with Dup15q syndrome and compare these domains to chronological and mental age matched children with non-syndromic ASD.

Methods:

Participants included 13 children with Dup15q syndrome (22 months – 12 years) and 13 children with non-syndromic ASD, matched on chronological and mental age. In the Dup15q group, 10 participants had isodicentric duplications and 4 had active epilepsy. Participants were assessed for verbal and non-verbal developmental quotient, ASD characteristics and adaptive behavior. Group comparisons were performed between Dup15q and ASD participants, as well as within the Dup15q group (by duplication type and epilepsy status).

Results:

All Dup15q participants met criteria for ASD, but had significantly lower ASD severity scores (specifically on certain reciprocal social interaction items) than children in the ASD group (t=2.26, p=0.03). Dup15q participants demonstrated significantly more impaired motor (t=5.9, p<0.001) and daily living skills (t=2.41, p=0.03), and with significantly correlated scores across domains. In contrast, the ASD group showed scores that were largely independent of each other. Within the Dup15q group, there were no significant differences by duplication type. Participants with epilepsy were significantly more impaired than those without across all domains other than ASD severity (p-value range: <.001 - .03).

Conclusions:

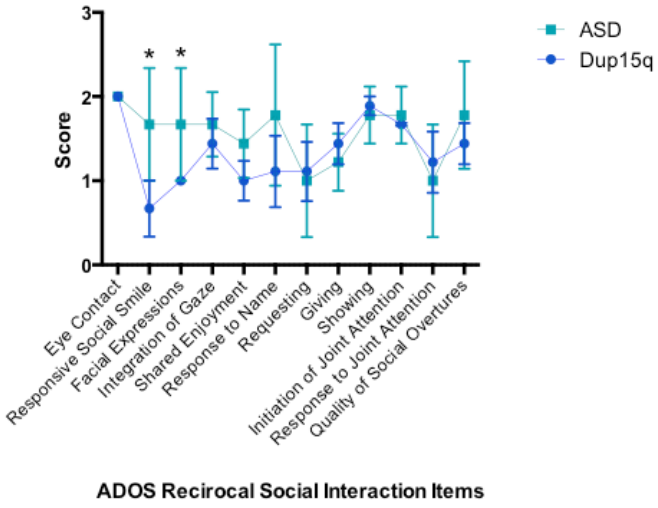
All children with Dup15q syndrome met ADOS criteria for ASD, but showed relative strength in social interest with marked impairment in motor and daily living skills. Research is currently underway using electroencephalography (EEG) to examine neural correlates of social interest and language processing in Dup15q syndome in order to inform our understanding of how these processes interact with ASD symptoms. In the Dup15q group, motor skills were closely related to abiities across domains. Although children with ASD often show relative strengths in motor ability compared with other deveopmental domains (Yang et al., 015), recent studies have demonstrated the importance of early motor ability in predicting outcomes in children later diagnosed with ASD (Gernsbacher et al., 2008; Estes et al., 2015). Dup15q syndrome presents an ideal opportunity to examine developmental relationships between motor impairment and emerging ASD symptoms. Intervention recommendations for children with Dup15q syndrome include aggressive epilepsy treatment, focus on motor skills, and engagement based therapy building on social interest to further develop social communication abilities. Longitudinal research from early development is necessary to understand the temporal relationships between developmental domains, and multi-site studies will allow for larger sample sizes to examine subgroups with Dup15q syndrome.

Table 1: Relationships Across Skill Domains by Group

	ASD						Dup15q					
Skill Domain	1	2	3	4	5	6	1	2	3	4	5	6
1. VDQ	--						--					
2. NVDQ	0.62*	--					0.97**	--				
3. ADOS CSS	0.72**	0.35	--				-0.46	-0.34	--			
VABS-II												
4. Communication	0.65*	0.44	0.26	--			0.96**	0.91**	0.25	--		
5. DLS	0.12	0.27	0.27	0.24	--		0.90**	0.82**	0.27	0.86**	--	
6. Socialization	0.32	0.28	0.41	0.58*	0.71*	--	0.78**	0.63*	0.08	0.72**	0.89**	--
7. Motor	-0.29	0.17	0.33	0.25	0.89**	0.60	0.85**	0.78**	0.56	0.77**	0.80**	0.66*

* $p<.05$ ** $p<.01$

Figure 1: ADOS Reciprocal Social Interaction Item Scores by Group



Average ADOS RSI item scores by group, showing significant differences for two items: "Responsive Social Smile" (ASD *M*=1.67, Dup15q *M*=0.67; *t*=2.27, *p*=.04) and "Directs Facial Expressions to Others" (ASD *M*=1.67, Dup15q *M*=1; *t*=2.31, *p*=.04).

139 **165.139** Clinical Evaluation of Children with Autism at a Multidisciplinary Intervention Centre in India

D. R. Kanade, *A. Bondre and S. H. Dalwai, New Horizons Health and Research Foundation, Mumbai, India*

Background:
About 10 million individuals in India have Autism. The burden of disability is compounded by limited interventions and even fewer multidisciplinary approaches, targeting children in early life. Few studies in India have mapped clinical profiles of children with Autism.
Objectives:
This analysis aims to present results of clinical evaluations of children with features of Autism reporting to a multidisciplinary child development centre in Mumbai.
Methods:
Sample was derived from a published study (n = 1301) that obtained data on assessment and intervention for neurodevelopmental disorders at the aforesaid centre from 2009 to 2012. Children were trans-departmentally assessed across various clinical (developmental paediatric and paramedical) disciplines. Fourth edition of Diagnostic and Statistical Manual of Mental Disorders was referred. Data were descriptively analyzed using Microsoft Excel 2007 and Stata-10.
Results:
Out of 1301 children, 145 children (11.1%) were identified with features of Autism. Most children were referred by physicians and paediatricians (70.9%). Mean age at referral was 4.5 years. Only 3 children were referred at less than 2 years. The multidisciplinary centre was the first point of therapy for 60% of families. These findings indicate the delay by parents to seek care. Salient presenting concerns reported by parents were speech delay (88.1%), behavioural concerns (61.8%), and atypical socialization (36.1%) . About 69% of children attended school and most of them attended regular schools (94.5%) with English as medium of instruction (94.1%). However, English was spoken at only 35.4% of homes.
In developmental assessment (n = 134), solitary and destructive play was observed in 99.2% and 26.8% respectively. Thus, most children had not developed parallel play. Hypotonicity was observed in 63.4% of children. Hypersensitivity to tactile and auditory input was noted in 57.8% and 36.3% of children respectively. Hyposensitivity to vestibular and proprioceptive input was noted in 86.4% and 67.1% of children respectively. Toe-walking was present in 23.8% and mouthing of objects in 32% of children. Only 15.6% of children maintained eye-contact. Inability to perform activities of daily living was noted in 92.5% of children. In speech assessment (n = 96), sub-optimal oral-motor and vegetative functioning was present in 64.2% and 76% of children respectively. On assessment, non-verbal communication was noted in 75.6% of children. In speech milestones, delays in uttering one and two meaningful words were seen in 95.7% and 98.9% of children respectively. Receptive and expressive language ages were 16.2 and 14.8 months respectively and unpaired t tests provided statistically significant differences between these ages and the mean chronological age of 48 months. Thus, inability to communicate verbally was the most important reason for care-seeking. Comprehending single, dual and multi-step instructions (on 3rd edition of Reynell scale) was observed in 12.5%, 2% and 1% of children respectively.

Conclusions: Initial comprehensive evaluations allow developmental therapists to focus on multiple developmental domains, set feasible and individualized therapeutic goals and monitor functional changes, particularly in a multidisciplinary intervention model. Further research is needed to test the impact of these models in developing countries like India.Background:
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Conclusions: Initial comprehensive evaluations allow developmental therapists to focus on multiple developmental domains, set feasible and individualized therapeutic goals and monitor functional changes, particularly in a multidisciplinary intervention model. Further research is needed to test the impact of these models in developing countries like India.

140 **165.140** Cognitive and Adaptive Profile Differences Between Diagnostically Concordant and Nonconcordant Twins with ASD

J. Cash[1], *J. Mendelson*[2], *C. Hall*[3], *S. Hoffenberg*[3] *and T. Aronson*[1], *(1)Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, GA, (2)Marcus Autism Center, Children's Healthcare of Atlanta, Emory University School of Medicine, Atlanta, GA and The University of North Carolina at Greensboro, Greensboro, NC, (3)Marcus Autism Center, Children's Healthcare of Atlanta, and Emory University School of Medicine, Atlanta, GA*

Background: Research on twins has demonstrated a strong genetic contribution to autism spectrum disorder (ASD), with monozygotic (MZ) twin ASD concordance rates ranging from 60 to 90% and dizygotic (DZ) ASD concordance rates ranging from 5 up to 20% (Bohm et al., 2009). Additionally, research suggests young children with ASD perform better on nonverbal tasks than language tasks (Hartley et al., 2009) and children with ASD tend to have the most substantial delays in socialization, slighter delays in communication, and relative strengths in daily living skills (Bolte and Poustka, 2002). However, little research has been done examining the developmental profiles of concordant and nonconcordant twins with ASD.
Objectives: The goal of the current study is to examine cognitive and adaptive profile differences between and among concordant and nonconcordant twins with ASD.
Methods: Participants included two MZ dyads and 12 DZ dyads, who were evaluated between the ages of 25 to 85 months (M=53.04 months, SD=19.56) in a diverse clinical setting. Twelve pairs of twins received concordant diagnoses of ASD.
Assessments included a developmental or cognitive measure (i.e., the Mullen Scales of Early Learning, Differential Abilities Scales-2nd Edition, or Stanford-Binet Intelligence Scales, 5thEdition), the Vineland Adaptive Behavior Scales, 2nd Edition, Survey Form, and the Autism Diagnostic Observation Schedule. Scores were converted to z-scores to compare group means.
Results: Overall diagnostic concordance was 86%. Diagnostic concordance in DZ twin dyads was 83%. Variability across cognitive and adaptive measures was examined by calculating a difference score for each twin dyad. Concordant twin dyads were highly consistent (i.e., less than 1 SD apart) in their adaptive skills (80-90%) as well as verbal (60%) and nonverbal (64%) cognitive abilities. Concordant twins demonstrated significantly lower verbal IQ than nonverbal IQ ($t(20)=-2.273$, $p<.05$). Nonconcordant twins demonstrated significantly higher verbal IQ ($t(23)=4.44$, $p<.01$), nonverbal IQ ($t(3.57)$, $p<.01$) and higher adaptive communication at a level that approached significance ($t(18)=1.832$, $p=.084$) than concordant twins. Additionally, nonconcordant twins were significantly older than concordant twins ($t(15)=3.99$, $p<.01$).
Conclusions: Data from the current study indicates DZ cognitive profiles among concordant twins are consistent with reported ASD profiles (Bohm et al., 2009). However, adaptive profiles among concordant twins are not consistent with the literature (Bolte and Poustka, 2002). Interestingly, concordant twins in this clinical sample have the most substantial delays in the area of adaptive communication and lesser delays in daily living skills and socialization. Nonconcordant dyads were significantly older at time of diagnosis and displayed better cognitive skills than concordant twins. Although they present with difficulties in the areas of socialization and daily living skills, they also present with stronger cognitive and adaptive communication skills. These profiles may lead to diagnostic ambiguity and later age of diagnosis. Findings indicate cognitive and adaptive profiles differ significantly between diagnostically concordant and nonconcordant twins. Future research should examine the relation between diagnostic concordance and cognitive/adaptive functioning, while controlling for zygosity, which will inform our understanding of heritable and shared environment contributions to cognitive and adaptive profiles in children with ASD.

141 **165.141** Concordance Between DSM-IV and DSM-5: Results from a Large-Scale Epidemiological Surveillance Study

L. A. Carpenter[1], *A. D. Boan*[1], *A. Wahlquist*[2], *A. P. Cohen*[3], *J. M. Charles*[1], *W. Jenner*[1], *J. Spinello*[1] *and C. C. Bradley*[1], *(1)Pediatrics, Medical University of South Carolina, Charleston, SC, (2)MUSC, Charleston, SC, (3)University of Illinois at Urbana-Champaign, Champaign, IL*

Background: In 2013 the American Psychiatric Association made significant revisions to the diagnostic criteria for Autism Spectrum Disorder (ASD), including moving from a series of related Pervasive Developmental Disorder (PDD) diagnoses in DSM-IV-TR to one ASD diagnosis in DSM-5. Changes were based on research suggesting poor distinction among DSM-IV-TR subtypes, and that social communication deficits and restricted repetitive behaviors are both core symptom domains in ASD. However there has been concern that the revised criteria may exclude more mildly affected children from clinical diagnosis.
Objectives: To determine concordance between DSM-IV-TR and DSM-5 ASD diagnoses among school-aged children at risk for ASD.
Methods: Data for this study is from the South Carolina Children's Educational Surveillance Study (SUCCESS), which is designed to assess the prevalence of ASD through population-based screening and evaluation. School-aged children 8-11 years of age were identified as being at risk for ASD using the Social Communication Questionnaire (SCQ). Participants (n=292) completed developmental assessments to determine ASD case status according to both DSM-IV-TR and DSM-5 criteria. Clinical best estimate diagnoses were based on lifetime history of ASD symptoms. Participants were 65% male, 42% white non-Hispanic, 35% black non-Hispanic, 9% non-native English speakers, and 62% from Title 1 public schools (schools with a high percentage of low income students). Average IQ was 93.97 (SD=19.03).
Results: All participants who met criteria for DSM-5 ASD (n=52) also met criteria for one of three DSM-IV-TR PDD diagnoses (Autistic Disorder, Asperger's Disorder, PDD-NOS). Forty percent of those with DSM-IV-TR PDD diagnoses did not meet criteria for DSM-5 ASD. Most discordant participants (30/35; 86%) had a DSM-IV-TR diagnosis of PDD-NOS. Demographic characteristics including gender, race, ethnicity, non-native English speaker status, and Title 1 school status were not associated with DSM-IV-TR/DSM-5 discordance. Those participants who were concordant for DSM-IV-TR PDD and DSM-5 ASD had significantly higher scores on autism-related assessment instruments (ADOS-2, SRS-2, & SCQ), and had significantly lower adaptive scores (Vineland-2). IQ was not significantly different between the two groups. Among those who met DSM-IV-TR but not DSM-5 criteria, 40% failed to fulfill at least 2 restricted repetitive behavior criteria, while 94% failed to fulfill all 3 social communication criteria for ASD.
Conclusions: Results suggest that, among school-aged children, DSM-5 ASD captures participants who have greater severity of ASD symptoms and more functional impairment than those captured under DSM-IV-TR. Individual demographics (SES, race, gender, ethnicity, IQ) do not appear to impact concordance. The majority of discordant participants met DSM-IV-TR criteria for PDD-NOS, a diagnosis that has been criticized for being overly broad and non-specific to ASD, and of these very few had a diagnosis of a PDD/ASD prior to participation in this study. Nonetheless, the fact that 40% of discordant participants met the autism/ASD threshold on the ADOS-2 suggests that some children with symptoms of ASD may not meet DSM-5 criteria for ASD. Particularly in regards to revisions in the social communication criteria, children with milder or fewer symptoms in this subdomain are less likely to be diagnosed with ASD under DMS-5 criteria.

142 **165.142** Confirmatory Factor Analyses of WISC-IV Scores of Children Diagnosed with ASD

L. Peacock, *J. Beck and M. South, Brigham Young University, Provo, UT*

Background: Confirmatory factor analyses confirmed the four-factor structure (verbal comprehension [VC], perceptual reasoning [PR], working memory [WM], and processing

speed [PS]) of the Wechsler Intelligence Scale for Chidren-4th edition (WISC-IV) in the publisher's large standardization sample (*N = 2,200)* of mostly typically-developing children age 6-16. Additional analyses confirmed the validity of interpreting a second-order general intelligence factor. Given that children and adolescents with ASD frequently have uneven IQ profiles, it is not clear that the four-factor structure is appropriate for this clinical population.
Objectives: We sought to investigate whether confirmatory factor analyses would validate or invalidate the four-factor structure of the WISC-IV in children and adolescents with ASD.
Methods: Data used reside in the NIH-supported NIMH Data Repositories, specifically in the National Database for Autism Research (NDAR). WISC-IV data was obtained for children and adolescents who had autism diagnoses confirmed by reported ADOS-2 scores above the diagnostic cut-off (≥7). The sample included 44 participants: 39 males and 5 females age 6-16 years (*M* 11.30) across a broad range of intellectual functioning (FIQ: *M* 96.96, range 48-131). We conducted maximum likelihood confirmatory factor analyses of two-, three-, and four-factor models of the ten core WISC-IV subtests. With more than four participants per observed indicator, our sample approaches the recommended five participants per indicator (Bentler & Chou, 1987). The two-factor model included verbal and nonverbal latent factors; the three-factor model included latent factors for verbal comprehension, perceptual reasoning and a combined factor of working memory and processing speed; and the four-factor model separated the working memory and processing speed factors. We also tested a second-order four-factor model which included a general intelligence factor. Goodness of fit indices were calculated for each model.
Results: All factor loadings in all models were significant ($p < .01$). The fit values for the two-, three- and four-factor models are shown in Table 1. The χ^2 statistics for all models were significant ($p < .05$), indicating poor model fit; however, the χ^2 statistic is notably sensitive to sample size. The conservative RMSEA indices indicated poor fit (> .08) for all models. The CFI values indicated adequate model fit (> .90) for all but the two-factor model, and showed the four-factor model to be significantly better than the three-factor model (difference > .01; Cheung & Rensvold, 2002). Of all the fit indices, the AIC is the most appropriate for comparing models (smaller AIC is better). The AIC values reveal the four-factor second-order model as best. Coding consistently had the smallest factor loading (β = .66 and .65 for the first- and second-order four-factor models).
Conclusions: This research confirms the four-factor model of the WISC-IV core subtests in a small sample of children and adolescents with ASD. Of all the core subtests, Coding should be interpreted most cautiously in terms of how it loads onto its respective composite score (Processing Speed). Future research with larger samples should investigate the validity of the four-factor structure across subgroups based on autism symptom severity.

Table 1

CFA Fit Values for Four Alternative WISC-IV Models (N = 44)

Models	*df*	χ^2	*p*	*RMSEA*	*CFI*	*AIC*
Two factor (V and NV)	34	93.93	< .001	0.20	0.79	2,135.02
Three factors (VC, PR, and WM + PS)	32	56.80	0.004	0.13	0.91	2,101.89
Four factors (VC, PR, WM, and PS), first-order	29	52.89	0.004	0.14	0.92	2,167.38
Four factors (VC, PR, WM, and PS), second-order	31	54.63	0.005	0.13	0.92	2,101.71

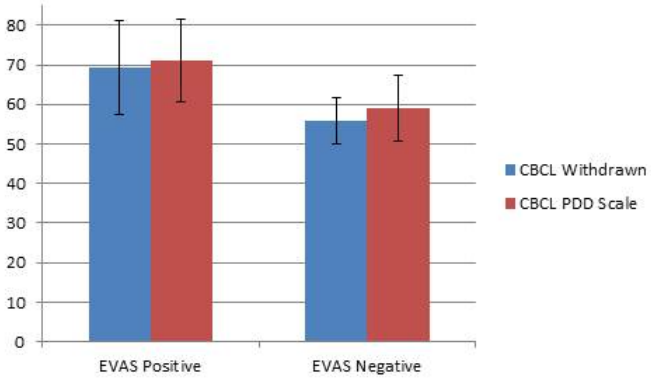
Note . WISC-IV=Weschler Intelligence Scale for Children–Fourth Edition; RMSEA = root mean square error of approximation; AIC = Akaike information criterion; CFI = comparative fit index; V = Verbal; NV= Nonverbal; VC=Verbal Comprehension; PR=Perceptual Reasoning; WM=Working Memory; PS=Processing Speed.

143 **165.143** Convergent and Divergent Validity of the Early Video Guided Autism Screener (EVAS) in a Clinically-Referred Sample

K. Sheperd[1], *K. Boswell*[2], *J. Neely*[3] *and R. Landa*[3], *(1)Kennedy Krieger Institute, Center for Autism and Related Disorders, Baltimore, MD, (2)Kennedy Krieger Institute, Baltimore, MD, (3)The Kennedy Krieger Institute, Baltimore, MD*

Background: Although ASD can be detected as early as age 14 months (e.g., Landa, Gross, Stuart, & Faherty, 2013; Landa, Holman, & Garrett-Mayer, 2007), the average age of diagnosis is four years (ADDM, 2014). The American Academy of Pediatrics (AAP) recommends universal screening at ages 18 and 24 months, though screening and referral practices are inconsistent due to cost, lack of staff training, and time needed for screening. Access to a low-cost screening tool to promote completion of screening and referral can lead to earlier access to diagnosis and treatment. Existing autism-specific tools demonstrate modest sensitivity and specificity. The Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2000) has been evaluated as an efficient means to screen for ASD as well as other possible comorbidities, given the already widespread use of this tool. Several studies have shown that the Withdrawn and Pervasive Developmental Problems scales of the CBCL 1.5-5 version are useful in screening young children for ASD (Havadal et al., 2015; Muratori et al., 2011; Sikora et al., 2008).
Objectives: To examine the construct validity (i.e., divergent and convergent validity) of the EVAS in a clinically referred sample, relative to the CBCL, which shows growing evidence as a potential ASD screening tool.
Methods: Sample of 178 children aged 18-48 months (83.7% male, 52.2% White, Mean age = 33.24 months, SD = 8.43 months) referred to an autism specialty center for diagnostic evaluation due to concerns for possible ASD. Parents completed the EVAS and CBCL online during the clinic intake process prior to their diagnostic visits. A clinical best estimate (CBE) was assigned by the diagnosing clinician following the evaluation.
Results: To account for multiple comparisons, a Bonferroni correction was applied to evaluate differences between the EVAS cut-off and each CBCL syndrome and DSM-oriented scale (.05/13 = .0038). Using this correction, only the CBCL Withdrawn ($t(176) = 3.18$, $p = .002$) and PDD ($t(176) = 3.23$, $p < .001$) subscales differed according to EVAS screening results (See Figure 1). Children who screened positive on the EVAS had T scores over 1 SD higher on the Withdrawn and PDD scales than children who screened negative on the EVAS, suggesting convergent validity of EVAS screening results. Children who screened positive and negative on the EVAS were similar in terms of all other CBCL scales, child age, and child race (all $p > .0038$), suggesting evidence for divergent validity. See Table 1 for a summary of results.
Conclusions: Results provide evidence for construct validity of the EVAS, suggesting it is a valid tool to measure ASD-related concerns. Importantly, results suggest that the EVAS items are specific to ASD, rather than associated comorbidities (e.g., attention or affective concerns). Thus, the EVAS has strong potential as an ASD-specific screening tool.

Figure 1. T Scores of CBCL Withdrawn and PDD Scales by EVAS Screening Results.



Note: Error bars represent standard deviation of the mean

144 **165.144** Creating an Observation System to Quantify Symptomatology Progress during Treatment in Children with Autism Spectrum Disorders

***M. V. Cornejo**, M. V. Van Dyke and J. J. Wood, University of California Los Angeles, Los Angeles, CA*

Background:
Self-reported or parental reported paper and pencil measures are typically used in research settings to generate behavioral profiles of child participants and to quantify changes in their behaviors and symptomatology. Evidence suggests that the change of emotional or maladaptive responses has been difficult to measure using these standard paper and pencil tasks in the ASD population. Currently there is no known system that can assess the progress during therapy through the use of an unbiased observation system.
Objectives:

- To create a reliable observation system that can document change as it is occurring across time during treatment sessions in children with ASD.
- To assess the degree of overlap between a new observation system (PASTOS) and other scales that measure similar constructs such as the Multidimensional Anxiety Scale for Children (MASC), the Social Skills Rating System (SSRS) and the Self-Efficacy Questionnaire for Children (SEQ-C).

Methods:
This study examined treatment session transcripts of twenty-two elementary school-aged children who were participating in a randomized controlled trial of cognitive behavioral therapy (M = 9.0 years, SD = 2 years) diagnosed with high functioning autism spectrum disorder (IQ above 70) and anxiety disorders. In order to assess the therapeutic process, treatment sessions 2, 4, 10, and 15 were chosen to be coded by observers. Coders listened to the entire treatment session while reading the transcript; at the conclusion of an audiotaped session, the coders assigned an extensiveness rating for various symptoms, from 1 to 7, with 1 = not at all, 3 = some of the time, 5 = considerably and 7 = extensively for 27 items divided into 5 subscales. The five subscales consisted of: 1) anxiety and related emotional states, 2) self-help skill mastery, 3) core autism symptoms, 4) child coping strategies, 5) parent-child interactions. Correlations were run using the five subscales and total PASTOS scores with MASC, SSRS and SEQ-C scores.
Results:

- Significant correlations were found between PASTOS and MASC scores at both baseline and post treatment.
- No significant correlations were found between PASTOS scores and SEQ-C ratings at baseline, but total PASTOS scores correlated with total SEQ-C scores at post treatment. At the subscale level, total SEQ-C positively correlated with PASTOS's social communication subscale at post treatment. Self-perception and parental communication subscales also correlated with SEQ-C ratings at post treatment in expected directions.
- SSRS' self-control subscale positively correlated with PASTOS' anxiety and self-perception scales at post treatment.

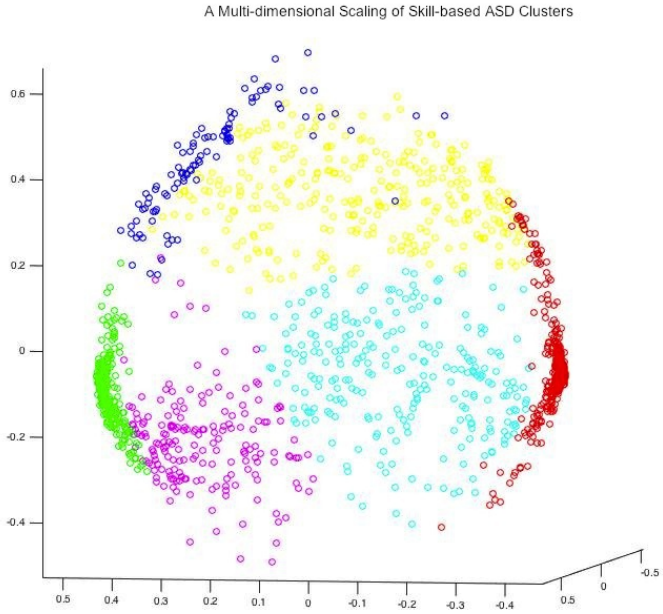
Conclusions:
This investigation sought to create an alternative system to evaluate progress of children with ASD during treatment sessions. The results suggest that PASTOS is a promising system for tracking changes in anxiety and related emotional states, child coping strategies, and self-skill mastery when compared to parental reports. Further research should explore additional alternatives to tracking progress of symptomatology and methods to make observation systems efficient and usable by coders within a standardized training regimen.

145 **165.145** Defining Behavioral Phenotypes in Autism Spectrum Disorders

***D. Dixon**[1] and E. J. Linstead[2], (1)Center for Autism and Related Disorders, Tarzana, CA, (2)Chapman University, Lakewood, CA*

Background: Autism spectrum disorder (ASD) is a heterogeneous disorder. Presentation and severity of symptoms as well as response to treatment vary widely among individuals with ASD. Because of the heterogeneous nature of ASD, individualization of treatment is critical to treatment success. In recent years, the scale and ease at which fine-grained behavioral data can be collected has grown dramatically, providing new avenues of research in predictive analytics for behavioral treatment of ASD. Behavioral phenotyping of ASD is one such avenue that may advance targeted treatment methods, improving treatment efficacy.
Objectives: The purpose of the present study was to identify whether distinct behavioral phenotypes could be defined in a large geographically diverse sample of children with ASD receiving community-based behavioral intervention services.
Methods: A high-dimensional cluster model of ASD was built for 1,619 patients with confirmed diagnoses. Nonparametric techniques were used to statistically determine latent group structure among the population based on responses to a standardized comprehensive assessment of developmental functioning. Unsupervised machine learning methods were utilized to infer cluster membership assignments. Both the classic K-means clustering algorithms with hard cluster assignment output, as well as a

more sophisticated Gaussian mixture model based on expectation maximization were considered. The latter provided a probabilistic framework on which to measure and differentiate clusters.
Results: Results of this study statistically detected the existence of distinguishable subgroups of ASD. Each of these subgroups displayed distinct deficits across developmental domains, including academic, adaptive, cognition, executive functioning, language, motor, play, and social skills. While memberships were significant and statistically distinct for all subgroups, some subgroups displayed clearly unique patterns of deficits while other subgroups showed marked similarities. Profiles for like subgroups suggested a hierarchical relationship, revealing high, moderate, and low levels of functioning for a single composition of deficits.
Conclusions: Findings indicate the existence of distinct behavioral phenotypes within a large sample of children with ASD. It is encouraging that such distinctions were be made using the results of a standardized assessment that can be easily administered. Future research should investigate whether these phenotypes display measurable differences in treatment response. These profiles serve as preliminary templates upon which targeted behavioral treatment programs may be built. The significance of these phenotypes may span beyond behavioral treatment. Further exploration of other distinctions between these groups (e.g., genetic, medical, environmental, etc.) are warranted.



146 **165.146** Defining in Detail and Establishing Consensus on DSM-5 Autism Spectrum Disorder (ASD) Criteria for Case Review

C. E. Rice[1], *L. A. Carpenter*[2], *A. D. Boan*[3], *M. J. Morrier*[4], *C. Skowyra*[5], *S. L. Bishop*[6], *N. Hobson*[7], *A. Thurm*[8], *W. W. Zahorodny*[9] *and C. Lord*[10], *(1)Emory Autism Center, Decatur, GA, (2)Medical University of South Carolina, Charleston, SC, (3)Pediatrics, Medical University of South Carolina, Charleston, SC, (4)Emory University, Atlanta, GA, (5)Washington University in St. Louis, St. Louis, MO, (6)Department of Psychiatry, University of California San Francisco, San Francisco, CA, (7)Independent Consultant, Texas, TX, (8)Pediatrics and Developmental Neuroscience Branch, National Institute of Mental Health, Bethesda, MD, (9)New Jersey Medical School, Westfield, NJ, (10)Weill Cornell Medical College, White Plains, NY*

Background: The diagnostic criteria for autism and related conditions has changed based on clinical and empirical findings; however, the current *DSM-5* diagnosis of ASD remains complex and behaviorally-defined. Diagnosis relies on professional evaluation of a person`s developmental history in light of the specified criteria. Most research into ASD and Pervasive Developmental Disorder (PDD) diagnostic criteria has been on the agreement of overall diagnosis, the validity of subtypes, or on factor analysis of the primary domains and specific criteria representing those domains. Within the given diagnostic taxonomy, little research has been done to specify the concepts and exemplars that serve as evidence for the criteria.
Objectives: To describe a process to define a comprehensive list of exemplars for each of the 7 core *DSM-5* ASD criteria, and report on interrater reliability in applying these exemplars to determine ASD case status.
Methods: The methods followed a format used for population-based prevalence record review. A team of clinicians completed an iterative process to identify specific exemplars for each of the 7 diagnostic criteria and associated features specified in *DSM-5*. This included mapping exemplars to the *DSM-5* ASD criteria from the following sources: the Autism and Developmental Disabilities Monitoring (ADDM) Network *DSM-IV-TR* PDD criteria mapping; the *DSM-5* text; *Autism Diagnostic Observation Scale, Second Edition* (*ADOS-2*); and *Autism Diagnostic Interview-Revised (ADI-R)*. After each phase of mapping, expert input was sought and differences resolved. Use of the detailed criteria was piloted in South Carolina as part of a supplemental study to compare *DSM-IV-TR* and *DSM-5* record review and direct screening with clinical evaluation on a population-based cohort of children. For the initial pilot, composite records detailing developmental evaluations (n=79) of 10 children were independently reviewed by 2 clinician reviewers to determine whether the individual behavioral exemplars could be reliably coded according to *DSM-5* criteria. Primary and blinded reliability review of evaluations for approximately 210 children are underway as is piloting for use in the larger multi-site ADDM Network.
Results: The process resulted in a case review manual detailing concepts and specific behavioral examples (over 300 exemplars) within each criteria (e.g., the example of 'touching or acting on others without regard to other's involvement or reaction" would be an example of "abnormal social approach" under "A1. Deficits in social emotional reciprocity"). For the first 10 cases, interrater reliability averaged 93% agreement on the DSM-5 criteria (range 80-100%), 92% on early developmental concerns, 87% on associated features, 90% on earlier PDD diagnosis, and 90% on final ASD case status. Ratings of severity levels were less consistent. Data (% agreement and Kappas) on the full reliability sample will be presented.
Conclusions: Application of the *DSM-5* ASD criteria is not well-specified in clinical practice, and both researchers and clinicians may be inconsistent in terms of mapping individual behavioral exemplars to diagnostic criteria. More detailed application of exemplars within criteria and domains can be reliably defined and applied. This framework can be further evaluated for improving consistency of ASD diagnoses.

147 **165.147** Development of a Diagnostic Algorithm for the PDD Behavior Inventory Based on Classification Trees

I. L. Cohen[1], *X. Liu*[2], *M. Hudson*[3], *B. Z. Karmel*[4] *and J. M. Gardner*[5], *(1)1050 Forest Hill Rd, New York State Institute for Basic Research in Developmental Disabilities, Staten Island, NY, (2)Queen's University, Kingston, ON, Canada, (3)asd-carc, Kingston, ON, Canada, (4)Infant Development, NYS Institute for Basic Research in Developmental Disabilities, Staten Island, NY, (5)Infant Development, New York State Institute for Basic Research in Developmental Disabilities, Staten Island, NY*

Background: The PDD Behavior Inventory (PDDBI) is a reliable and valid assessment tool that has been shown to yield excellent sensitivity and specificity for children whose diagnoses were confirmed by the ADOS-G and ADI-R (Cohen et al. 2010). Recently, we have shown that the PDDBI can differentiate children with ASD from those with Attention Deficit Hyperactivity Disorder using a Classification Tree, a non-parametric type of machine learning (Cohen, 2013). Due to these results and need for Level 2 screeners for ASD, we explored the use of Classification Trees as a means of developing a diagnostic algorithm for the PDDBI.
Objectives: To develop a reliable and valid diagnostic algorithm for the PDDBI.
Methods: To date, 649 parent and 202 teacher PDDBI forms have been collected from the NYS Institute for Basic Research (IBR), and from Queens University. Approximately 83% of cases have been diagnosed with "ASD" with the remainder ("OTHER") having ASD ruled out as a diagnosis after extensive clinical evaluation or identified by parents as unaffected siblings or who were toddlers taking part in a longitudinal investigation of at-risk infants.
The Classification and Regression Trees module (Statistica, Version 12) was used to develop the algorithm. Inputs included the Repetitive, Ritualistic and Pragmatic Problems Composite T-score, the Approach-Withdrawal Problems Composite T-score, the Expressive Social Communication Abilities Composite T-score, the Autism Composite T-Score, the Social Discrepancy score, and the Semantic-Pragmatic Problems Discrepancy score. Sixty percent of the dataset was used for training and 20% for testing during the development process. The remaining 20% (the "validation set" not used in the model development process) helped validate the final model.
Results: A number of models were explored and yielded similar results. The selected model divided the ASD sample into two parts, a "typical" ASD group and a "high social-functioning" ASD group while the OTHER sample was divided into three groups, a relatively unaffected group, and two smaller sets: 1) a "rigid" group, and 2) a "severe

behavior problem" group.
The two ASD groups differed on IQ, Vineland, and ADOS severity scores; parent reports of seizures; and association with a gene polymorphism linked to autism severity (Cohen et al. 2003).
Sensitivity and Specificity were 83% and 87% for the training set, 86% and 81% for the test set, and 82% and 81% for the validation set. Sensitivity and specificity were 80% each for cases <4 years and 85% and 89%, respectively, for cases >4 years.
Overall agreement between parent and teacher global algorithm diagnoses (ASD vs OTHER) was 78% (Kappa = 0.47) and was 66% (Kappa = 0.52) for the more fine grain groupings. Using only cases in which parent and teacher forms yielded identical groupings, increased sensitivity and specificity to 90% each.
Conclusions: Results confirm previous studies suggesting two forms of ASD, a classic presentation (often associated with intellectual delays and seizures), and a group with better social and language skills having a more optimal outcome. These results suggest that the PDDBI can serve as a useful Level 2 screener.

148 **165.148** Developmental Profiles of Children Missed By Early Autism Screening Compared to Early-Identified Peers

C. Cordeaux[1], *M. Barton*[2] *and D. A. Fein*[2], *(1)University of Connecticut, Storrs, CT, (2)Psychology, University of Connecticut, Storrs, CT*

Background: The American Academy of Pediatrics recommends that all children be screened for ASD at 18 and 24 months of age. ASD-specific screening and diagnostic tools for toddlers such as the M-CHAT and the M-CHAT-R/F make it possible for clinicians to make stable diagnoses at younger ages. However, no screening instrument can identify all cases at 18-24 months. Children who screen negative at 18-24 months old but later screen positive at 30-48 months old with the M-CHAT and M-CHAT-R/F are "potential miss" cases and provide important information about the natural course of ASD as well as the types of children likely to be missed by ASD-specific screening instruments.
Objectives: This study presents data from a two-year follow-up screening with the M-CHAT and the M-CHAT-R/F examining the developmental and sociodemographic profiles of "potential miss" cases.
Methods: Participants were screened at pediatric well-visits at 18-24 months of age. Approximately 2 years after initial screening, children were rescreened with the M-CHAT-R/F; Children who screened positive at 18-24 months and/or 48 months were invited to complete an evaluation. Some children who screened negative at 18-24 months but positive at 48 months received an ASD diagnosis (Missed) (N=27) at 48 months. A subset of children maintained an ASD diagnosis from their initial evaluation to their 48 month evaluation (ASD; N=164).
Results: At 48 months, groups did not differ by age, gender, or race/ethnicity. Groups differed significantly on cognitive ability, adaptive skills, and symptom severity, with the Missed group showing stronger cognitive and adaptive skills and lower symptom severity. There was no difference between groups in the number of DSM-IV criteria met, though Missed children were more likely to receive a PDD-NOS diagnosis compared to the ASD children. Additionally, the groups significantly differed by the age at which first words and phrase speech developed, with the Missed group more likely to develop first words and phrases on time. Sibling status also differed between groups, with children in the Missed group more likely to be the oldest child or first child with ASD. Parent-reported age of first concern or regression did not differ between groups.
Conclusions: These findings indicate that a subset of children with ASD are more likely to be missed by ASD parent-report screening at 18-24 months, may not present with full symptom profiles, or may present with less severe symptoms and milder developmental delays at 18-24 months. These results also emphasize the importance of ASD screening at multiple time points, as a single screening may miss cases, or initial diagnosis may change. Understanding profiles of children who are not diagnosed until late toddlerhood can inform best practices for screening in the community and aid in measure development for ASD-specific screening tools.

149 **165.149** Does Age of ASD Diagnosis Produce Differential Outcomes in Middle Childhood

M. Clark[1], *C. Dissanayake*[2] *and J. Barbaro*[3], *(1)Kingsbury Drive Bundoora, La Trobe University, Melbourne, VIC, Australia, (2)Olga Tennison Autism Research Centre, La Trobe University, Melbourne, Australia, (3)La Trobe University, Melbourne, Victoria, Australia*

Background: To date, no other studies have investigated the development pathways of children with an ASD prospectively ascertained from a community sample. Research that has studied children with an ASD from infancy to school age, has relied on high-risk and infant sibling cohorts (Landa et al., 2013; Landa & Garrett-Mayer, 2006). Further, although it is considered best practice to diagnose ASDs by 2 years of age where possible, the average age of diagnosis in Australia remains between 4 and 6 years of age (Bent, 2015). Research is yet to investigate the impact age of diagnosis has on later outcomes (cognitive and behavioural). Specifically, this study is interested in whether children who receive an earlier diagnosis (at 24 months) experience more positive develpmental outcomes in middle childhood, relative to those who were detected later.
Objectives: The primary focus in this investigation is to assess the developmental progress at school age, of children diagnosed with an ASD at 24 months, first identified through the SACS study. A longitudinal design is employed here. A secondary objective is to compare the outcomes of the SACS cohort at school age, to those children who were formally diagnosed with an ASD after 3 years of age, using a cross sectional design
Methods: All children were involved in a throrough developmental assessment at school age. Cognition was assessed using the Wechsler Abbreviated Scale of Intelligence (WASI) while the Autism Diagnostic Observation Schedule (ADOS) was administered to assess social communication development and autism severity at school age.
Results: Children in the SACS cohort made significant gains in cognition from toddlerhood to school age, with only few meeting criteria for an ID at outcome (7%). Despite changes in severity of autism symptoms, diagnoses of ASD were highly stable over time with 73% of children retaining their early ASD diangosis from toddlerhood to middle childhood. Preliminary between group comparisons reveal that children diagnosed early are demonstrating higher Full Scale IQ (FSIQ) and Verbal IQ (VIQ) and lower ASD severity at school age, relative to children diagnosed later. However, at this stage, these between group differences are not significant.
Conclusions: This research illustrates the cognitive and behavioural trajectories of children at school age, who were identified and diagnosed with an ASD at 24 months as part of the Social Attention and Communication Study (SACS; Barbaro & Dissanayake, 2009). Further, these findings, although preliminary at this stage, will highlight the importance of *age* of ASD diagnosis and will identify whether the timing of diagnosis contributes to differential developmental outcomes in middle childhood.

150 **165.150** Early Intervention Participation in Families with Toddlers with or at-Risk for an Autism Spectrum Disorder

J. Page[1], *S. Zheng*[2], *C. Wong*[1,2] *and K. C. Gallagher*[3], *(1)UNC Chapel Hill, Chapel Hill, NC, (2)University of North Carolina at Chapel Hill, Chapel Hill, NC, (3)FPG Child Development Institute, University of North Carolina at Chapel Hill, Chapel Hill, NC*

Background:
Research has shown that accessing Part C Early Intervention (EI) services at younger ages can alter the trajectory of disability for children with, or at-risk for, autism spectrum disorder (ASD). In studies using quantitative methods intervention services focused on types of services received, parents' satisfaction, with parents of older children with various disabilities. Qualitative investigations with a sufficient sample would help understand family experiences and decisions related to EI service participation, particularly for families with young children that have or are at-risk for autism. It is important to identify families' decisions for accessing services, identify additional services they are not receiving, and possible barriers impacting families' perceptions and experiences with EI.
Objectives:
The current study explores EI service participation and experiences of families with toddlers with or at-risk for ASD, with the following questions:

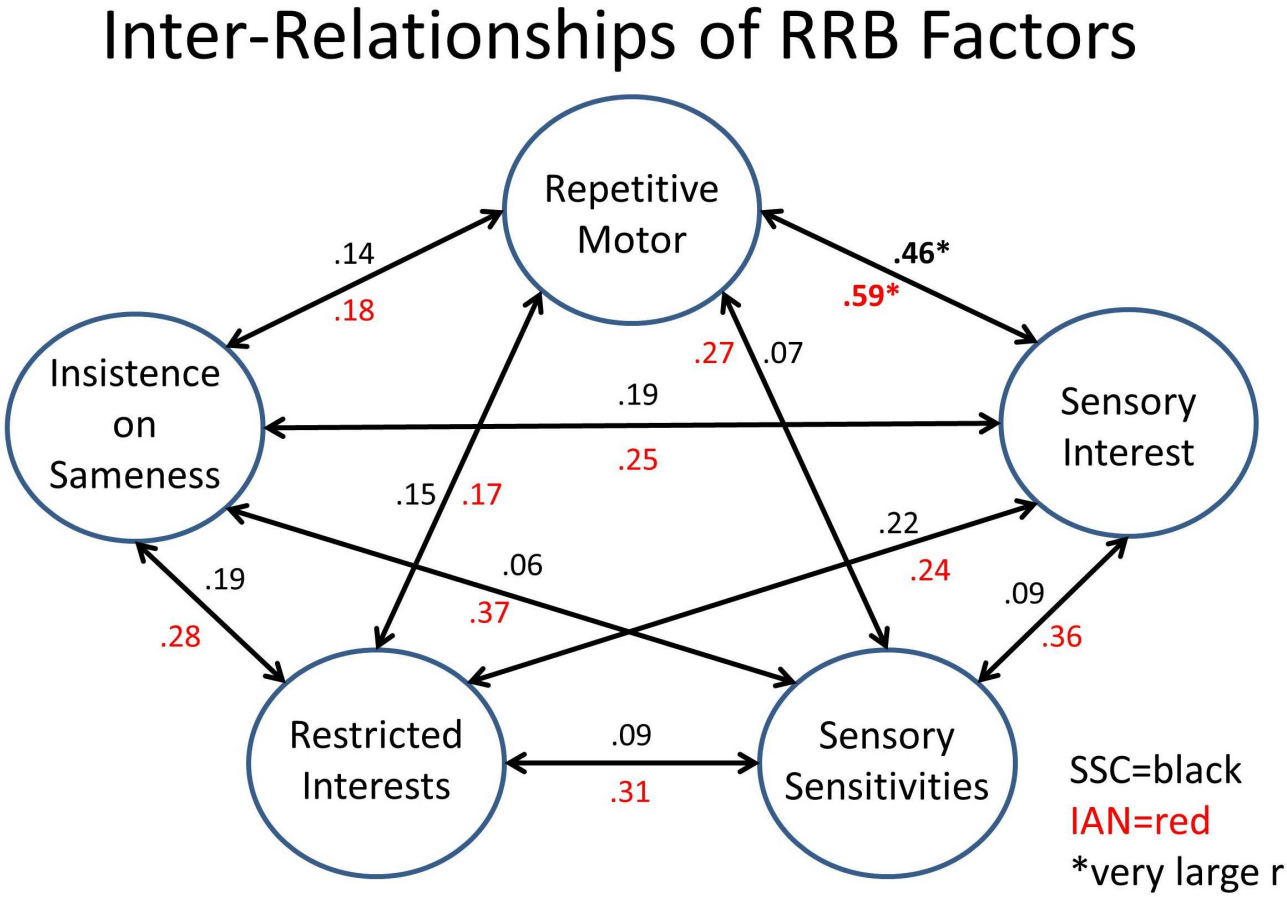
1. What factors impact a family's decision to participate in the EI services that they and their child receive?
2. What services do parents want to receive, and what quantity of services do they desire?

Methods:
Thirty seven semi-structured, 20-minute interviews were conducted with families who participated in a larger randomized control study. Families had a child between 16-36 months of age, failed MCHAT, and were ethnically and racially diverse. Interviews were video recorded and coded by two graduate research assistants, who had established reliability on the codes. Using grounded theory, they generated themes from the data and coded for axial codes (sub-themes within the data).
Results:
Thirty-three of the 37 families were receiving at least one EI service, with speech therapy being the most accessed. On average, children were referred at 20 months, although many parents reported concerns at 12 months. Many families were referred to local EI agencies by pediatricians. Factors impacting families' decision for services accessed include child qualified for service (based upon delay) and services that targeted the specific delay. Many families reported that the most positive part of service was reflected in their child's progress. All of the families reported that they wanted more services for their child; only three mentioned parent support groups for themselves. TEACCH, play group, and occupational therapy were the services parents desired most. By investigating desired and additional resources for families with toddlers, our study identified discrepancies between EI service and parental expectations. Many families cited time, coordinating with service providers, financial burden, a lack of service choices for their child, as barriers to accessing specific services.
Conclusions:
Our findings confirm and extend the literature by interviewing families of toddlers with or at-risk for ASD, in that we identified factors impacting a families' decision to access specific EI services. Parents reported that additional funding and accessing research-based interventions would help their child. Additional research investigating the impact of services for parents is warranted. Identifying and understanding families' preference and decisions to access EI services can help identify gaps in service and practice

151 **165.151** Empirically-Identified Restricted Repetitive Behavior Domains: Informing DSM-6

T. W. Frazier[1] *and A. Y. Hardan*[2]*, (1)Cleveland Clinic Center for Autism, Cleveland, OH, (2)Stanford University, Stanford, CA*

Background:
Restricted, repetitive behavior (RRB) is one of the two symptom domains used to diagnose autism spectrum disorder. Diagnostic and Statistical Manual of Mental Disorders – Fifth Edition (DSM-5) criteria include 4 sub-domains of RRB, including repetitive motor/speech, sameness/inflexibility, restricted interests, and abnormal sensory experience. In contrast, empirical studies of RRB suggest two broad domains – insistence on sameness and repetitive sensory motor behavior. However, diagnostic criteria are based on limited empirical work and previous factor analytic studies of RRB have been restricted to single instruments, limited item sets, or single samples.
Objectives:
To empirically-identify RRB sub-domains using confirmatory factor analyses based on two instruments within each of two separate samples.
Methods:
Parent-reported symptom data were obtained from 2,643 children with ASD included in the Simons Simplex Collection (SSC) using the Social Responsiveness Scale and Repetitive Behavior Scale-Revised and 3,907 children with ASD from the Interactive Autism Network (IAN) using the Social Responsiveness Scale and Social Communication Questionnaire. In each dataset, items were a priori chosen to represent one of five constructs: repetitive motor behavior, insistence on sameness, restricted interests, sensory interests, and sensory sensitivities. A series of confirmatory factor analyses (CFA) were conducted using item-level data with increasingly complex models, including a 1-factor model merging all items, a 2-factor model merging repetitive motor with sensory interests and the remaining three constructs, three 3-factor models iteratively separating restricted interests, sensory interests, and sensory sensitivities from the prior 2-factor model, and a 5-factor model with all five constructs as separate factors. Improved fit across increasingly complex models was evaluated using changes in the Bayesian Information Criterion (BIC), Root Mean Square Error of Approximation (RMSEA), and Confirmatory Fit Index (CFI).
Results:
In both samples, the 5-factor model fit best (smallest absolute improvement: ΔBIC=424, ΔRMSEA=.004, ΔCFI=.024). Absolute fit was marginal for the 5-factor model, as would be expected by multi-item factor analyses without cross-loadings based on complex psychopathology questions. Factor correlations indicated that all RRB constructs had positive, but modest, inter-relationships (SSC r=.06-.22; IAN r=.17-.37), with the exception of the very large relationship between repetitive motor behavior and sensory interests (SSC r=.46, 95%CI=.41-.51; IAN r=.59, 95%CI=.55-.63). Qualitative examination of item loadings revealed that the restricted interests and sensory sensitivities factors, while clearly distinct from other factors, included only a few salient loadings.
Conclusions: Additional large sample studies are needed to confirm and extend the present findings. If confirmed, future revisions of diagnostic criteria may benefit from separating sensory interests and sensory sensitivities, as these two constructs appear only modestly correlated. The present data indicate that sensory interests may be a statistically separable from repetitive motor behavior, although the high correlations observed across samples suggests that future investigations evaluate the clinical and diagnostic utility of this distinction. Only a small number of items were available to evaluate restricted interests, yet this construct clearly separated from other insistence on sameness items, supporting current diagnostic criteria. Future instrument revisions should focus on beefing up measurement of restricted interests and sensory sensitivities.



152 **165.152** Engaging and Adaptive Assessment for Attention in 16p11.2 Deletion Syndrome

A. Brandes-aitken[1]*, S. N. Skinner*[2]*, E. Martucci*[3]*, J. Bower*[3]*, J. A. Anguera*[4]*, A. Gazzaley*[5] *and E. J. Marco*[6]*, (1)Neurology, University of California, San Francisco, San Francisco, CA, (2)University of California, San Francisco, San Francisco, CA, (3)Akili Interactive, Boston, MA, (4)Neurology, UCSF SNAP, San Francicso, CA, (5)Neurology, UCSF, San Francisco, CA, (6)University of California in San Francisco, San Francisco, CA*

Background:
16p11.2 deletion syndrome is associated with a wide range of neurodevelopmental conditions including Attention Deficit and Hyperactivity Disorder (ADHD) and Autism. Despite the high prevalence of ADHD in this population, estimated to be at least 19%, their cognitive control deficits have not been directly measured. Traditional measures of selective attention are often limited by floor effects and lack of participant engagement. Consequently, we hypothesize that a digital platform assessment, with engaging game-like function and adaptive algorithms, would be a more powerful measure of selective attention deficits.
Objectives:
In this study, we aim to determine if children with 16p11.2 deletion show deficits in visual motor processing and sustained attention using the Project: EVO™ (EVO) cognitive assessment. We further investigate sustained and selective attention using standard cognitive measures to investigate whether a difference in delivery platform changes our ability to detect deficits in this clinical population.
Methods:
We recruited children with and without 16p11.2 genetic copy number variations for this cognitive assessment study. Twenty children had a 16p11.2 deletion (mean age 10.1 years +/- 3.9, 6 females) and they were compared with 91 children without known 16p11.2 copy number variation, 16 of which were siblings of the affected individuals (mean age 10.7 years +/-2.2, 41 females). We recruited carrier children and their non-carrier siblings at the Simons VIP annual meetings (Orlando, 2013 and Tyson's Corner, 2015). Neurotypical controls and one family with 16p11.2 deletion were recruited from the UCSF Sensory Neurodevelopment & Autism Program and collaborations with Akili

interactive. Children were administered two traditional measures of selective attention, the Flanker Task and the Visual Search Task and the EVO assessment. EVO consists of three assessment components: visuomotor tracking (participants must steer the iPad through winding paths), perceptual discrimination (responding to relevant targets while ignoring distractors), and multitasking (preforming tracking and discrimination, simultaneously). In addition, we assessed basic motor speed with an iPad tapping assessment.

Results:

Using an ANCOVA analysis (controlling for age), we found no significant difference between response time or response time variability in children with or without 16p11.2 deletions on standard, non-adaptive, assessment tools: the Flanker Task and the Visual Search Task. Using the EVO platform, children with 16p11.2 deletions displayed significantly lower visuomotor tracking level, slower response time, and higher response time variability relative to their siblings and unrelated children without 16p11.2 deletion. A group effect was not present for multitasking abilities. In a subset of children who were able to complete these tasks, we found no statistical difference in motoric tapping speed between groups, suggesting that observed performance disparities using EVO for response time and response time variability are not simply a result of impaired motoric control or familiarity with iPad use.

Conclusions:

These findings suggest that children with 16p11.2 deletion have measurable performance deficits in selective attention and visuomotor tracking compared to related and un-related children without this genetic mutation. Furthermore, an engaging, adaptive assessment tool may be a more powerful assessment strategy than traditional measures.

153 **165.153** Exploration of ASD Symptoms Among Individuals with Pitt-Hopkins Syndrome

S. E. O'Kelley[1], *K. C. Guest*[2], *C. O. Leonczyk*[1], *E. Rahn*[3], *K. D. Krubinski*[4], *B. A. Modi*[4], *A. Kennedy*[3] *and D. Sweatt*[3], *(1)University of Alabama at Birmingham, Birmingham, AL, (2)University of Alabama, Birmingham, AL, (3)Neurobiology, University of Alabama at Birmingham, Birmingham, AL, (4)Psychology, University of Alabama at Birmingham, Birmingham, AL*

Background: Pitt-Hopkins Syndrome (PTHS) is caused by disruption (mutation or deletion) of transcription factor 4 (TFC4, located on chromosome 18). Haploinsufficiency, or inheriting only one working copy of TCF4, causes PTHS. Approximately, 200-300 documented cases of PTHS exist worldwide. Available clinical studies describe individuals with PTHS as exhibiting some of the core symptoms of Autism Spectrum Disorder (ASD), including difficulties in verbal and nonverbal communication, sensory sensitivity, and social interaction difficulties. Significant developmental delays, including motor delays, and intellectual disability are also reported in individuals with PTHS.
Objectives: The current study focused on obtaining specific caregiver-reported descriptions of individuals with PTHS to clarify and characterize the presence of ASD symptoms in this population, with particular emphasis on the social, communication, adaptive, developmental, and repetitive behaviors of individuals with PTHS.
Methods: Parent/caregiver participants were recruited through the Pitt Hopkins Research Foundation and completed questionnaires over the telephone and by mail, including a detailed demographic and background questionnaire, the Modified Checklist for Autism in Toddlers-Revised (M-CHAT-R), Communication and Symbolic Behavior Scales-Infant Toddler Checklist, Repetitive Behavior Questionnaire, Short Sensory Profile-2, and Vineland Adaptive Behavior Scales- II. Additional measures of ASD symptomatology and behavioral difficulties were also obtained.
Results: Data are currently available for 18 individuals with confirmed PTHS, including 11 males. The mean age of the individuals with PTHS at the time of the caregiver interview was 7.67 years (range of 2 to 17 years), and adaptive skills were well below average (mean Vineland-II Adaptive Behavior Composite standard score = 47.9, SD = 10.35), indicating developmental delays across skill areas. On rating scales, individuals with PTHS were described as exhibiting delays in early emerging social-communication skills on the CSBS-ITC (mean total raw score = 21.63, consistent with a range of concern for a child at a 10-month level) and the presence of significant ASD "red flags" on a brief screening tool developed for very young children (mean "failed" M-CHAT-R items = 9.73, considered "high risk"). On the RBQ, a tool that has demonstrated good validity in measuring repetitive behaviors in several genetic syndromes as well as ASD, individuals with PTHS received elevated scores for overall repetitive behaviors and in particular, the presence of clinically significant stereotyped behaviors in 83% of the sample (mean SB score = 9.17, SD = 4.33). A range of sensory differences were also endorsed by caregivers on the SSP-2 for their children. Data collection and analyses are ongoing and will provide additional information about relations between variables and will seek to clarify whether level of functioning and/or level of social-communication impairments better predict the ASD symptom profiles of individuals with PTHS.
Conclusions: Information regarding ASD symptoms and patterns of behavior within genetic syndromes such as PTHS may be helpful in characterizing a broader ASD phenotype. Further, a better understanding of social communication and behavioral difficulties in individuals with known genetic differences and developmental delays may help guide more informed recommendations for intervention.

154 **165.154** Exploring Personality in Children with ASD: Correlations Between Observed, Self-Report, and Parent-Report Measures

A. R. Osuna[1], *D. Delgadillo*[1] *and J. J. Wood*[2], *(1)University of California, Los Angeles, Los Angeles, CA, (2)University of California Los Angeles, Los Angeles, CA*

Background: While personality is a widely accepted framework used to study behavior in typical populations, studying personality in those with ASD is a relatively novel focus. A few studies have indicated that adults self-report behaviors low in openness to experience and extraversion (Anckarsäter et al., 2006), and high in neuroticism (Kanai et al., 2011). In a parent-report study of children aged three to five years, Fortenberry et al. (2011) found that children with ASD scored lower in extraversion, conscientiousness, and openness to experience than those typically developing. There are two significant gaps in this literature. First, studies in this subfield have relied solely on parent- and self-report measures. Secondly, the subjects of ASD personality research are typically adults with the disorder. The present study addresses these gaps by looking at school-aged children and supplementing self- and parent-report measures with an observational approach.
Objectives: The purpose of this study was to: 1) Test a novel observational approach to evaluating personality in children with ASD using the ADOS; and 2) Correlate observational scores, self-reports, and parent-reports of the child's personality.
Methods: The personalities of 43 school-aged children (6 to 13 years) with ASD were examined. Participants completed Module 3 of the ADOS, which was then assessed for personality using a novel observational personality coding scheme (OPS). The OPS looked at the following personality factors: openness to experience, conscientiousness, extraversion, agreeableness, neuroticism, and intelligence. Children self-reported personality using the Big Five Questionnaire for Children (BFQ-C), while parents rated their child's personality using the Hierarchical Personality Inventory for children (HiPIC).
Results: Each of the six OPS personality factors consisted of four or five observable items that yielded reliable internal consistencies ($\alpha > .650$). The OPS and HiPIC significantly correlated within the domains of extraversion and emotional stability, $r(35) = .351$, $p < .05$. Observed extraversion was significantly negatively correlated with agreeableness, $r(35) = -.549$, $p < .01$, and conscientiousness , $r(35) = -.409$, $p < .05$. Furthermore, observed openness to experience was significantly correlated with agreeableness, $r(35) = -.423$, $p < .01$ and observed conscientiousness was marginally significantly correlated with agreeableness , $r(35) = -.316$, $p = .057$. BFQ-C scores did not significantly correlate with any corresponding factor on the OPS or HiPIC.
Conclusions: Our results indicate that the ADOS may be a valuable source of information in regard to assessing the personality of children with ASD. Furthermore, discrepancies between measures on corresponding factors infer that it can be problematic to rely on a single questionnaire. Personality offers an additional lens of evaluating the heterogeneous behavior of children with ASD that is traditionally underutilized. Our forthcoming work will look at psychopathology scores in order to cross-validate the OPS measure. Future research should expand on this work and further explore the personality of individuals with ASD.

155 **165.155** Expressive Language As Predictor for Amount of Assessment Required to Evoke Challenging Behavior

P. Juarez[1], *J. E. Staubitz*[2], *N. Houchins-Juarez*[3], *J. Torelli*[1], *K. M. Simcoe*[1] *and J. L. Staubitz*[3], *(1)Vanderbilt University Medical Center, Nashville, TN, (2)Pediatrics, Vanderbilt University Medical Center, Nashville, TN, (3)Vanderbilt University, Nashville, TN*

Background:
When behavior analysts are enlisted to reduce challenging behavior, valid assessments are needed to develop individualized treatment. The functional analysis (FA) is the most valid measure for this purpose; it methodically tests and confirms hypothesized functions of challenging behavior. The Latency-Based Functional Analysis (LBFA) is an expedited FA model validated for confirming evocative and reinforcing variables of challenging behavior. Length of the LBFA is predicated on the amount of time required to systematically evoke and reinforce challenging behavior, then replicated with experimental control.
Within a randomized controlled trial (RCT) assessing for potential cost-benefit of behavior analytic services within typical inpatient hospital settings, we conducted latency-based FAs of the challenging behavior of [SJ1] 18 children diagnosed with autism and with varying communicative abilities.
Objectives:
Test the hypothesis that patient expressive language skill may predict the speed with which challenging behavior can be evoked within LBFAs.
Methods:
Eighteen children (17 male, 1 female) ages 6-16 (mean 10.3) with autism participated in this study. Twelve were admitted to a university-based child and adolescent psychiatric hospital and six were admitted to a medical floor of a university-based children's hospital. All had history of chronic challenging behavior. We conducted all assessments in inpatient units of these settings; either in participants' rooms or multi-purpose rooms.
Definitions for each participant's target behaviors were operationalized based on caregiver report during pre-FA interviews. LBFAs were conducted using procedures based on Thomasson-Sassi, et al. (2011). Minimum numbers of assessment series required to evoke target behaviors for each participant were recorded. A series was defined as the total set of 2-4 assessment session types (e.g. attention, play, tangible, escape) to be presented within the LBFA. Patients' expressive language skills were rated based upon direct observations by behavior analysts during patient interviews, assessments, and informal observations within the hospital setting. Patient utterances were sorted into two categories: "limited vocal" (patients used approximations of sentences or shorter phrases with limited vocabulary) or "fully vocal" (speaking primarily in full sentences

and using expansive vocabulary).
Finally, we evaluated the degree to which expressive language rating predicted the number of series needed to evoke challenging behavior within the LBFA using a point-biserial correlation.
Results:
Results indicated expressive language rating was positively correlated with the number of series needed to evoke challenging behavior (r_{pb} = .58). Higher verbal ability predicted a higher number of series.
Conclusions:
Results suggest patients demonstrating high levels of expressive language skill may require adaptation of LBFAs for improved results. Limitations of this study include small sample size, and pilot iteration of a language skills assessment. Because language performance was rated based on post-hospitalization reviews of videos capturing participant interactions within behavioral assessments, the experimenters did not have the opportunity to conduct a validated language assessment with the participants. Future research should use previously-validated language measures, further test the expressive language skills rating scale used within this study, verify which adaptations to behavioral assessments can be useful to rapidly evoke and study challenging behavior for verbally skilled patients, and examine replicability.

156 **165.156** Factor Analysis of the Parent Stress Index in Children with Autism Spectrum Disorder and Serious Behavioral Problems

V. Postorino[1], *C. McCracken*[2], *S. E. Gillespie*[3] *and L. Scahill*[4], *(1)Marcus Autism Center, Emory University, Atlanta, GA, (2)Depertment of Pediatrics, Emory University School of Medicine, Atlanta, Georgia, (3)Marcus Autism Center, Children's Healthcare of Atlanta, and Emory University School of Medicine, Atlanta, GA, (4)Pediatrics, Marcus Autism Center, Atlanta 30329, GA*

Background: Children with autism spectrum disorder (ASD) may exhibit a range of disruptive behaviors including tantrums, noncompliance, aggression and self-injury. These behaviors often pose extraordinary strain on parents. The Parent Stress Index-Short Form (PSI-SF) is a common measure of parental stress that has been used across a wide range of children with psychiatric and developmental disorders including those with ASD. In most studies, investigators used the original three factors developed by Abidin (Abidin, 1995). However, a recent factor analysis of the PSI-SF by Zaidman-Zait and colleagues (2011) raised questions about the relevance of the original three factor model in children with ASD.
Objectives: The aim of this study was to examine the factor structure of the PSI-SF in a large sample of parents of children with ASD and disruptive behaviors.
Methods: We used data from two federally-funded, multisite, randomized clinical trials conducted by the Research Units on Pediatric Psychopharmacology (RUPP) and Research Units on Behavioral Intervention (RUBI) Autism Networks. To be included in these trials children had to have: 1. ASD with moderate or greater disruptive behavioral problems as measured by the Aberrant Behavior Checklist-Irritability subscale and the Severity scale of the Clinical Global Impression; 2. IQ of 35 or greater as assessed by the Abbreviated Stanford-Binet 5, the Leiter-R or the Mullen Scales. Parents of 304 medication-free children with ASD completed the PSI-SF at baseline. Preliminary factor analysis with promax rotation was performed using maximum likelihood estimation on all 36 questionnaire items of the PSI-SF. Three factors were retained and items with factor loadings greater than 0.3 were kept. Cronbach's α was calculated to verify each factor as measuring in the direction of a single construct, using a cutoff of 0.7.
Results: The sample of 304 children (263 males; 41 females) had a mean age of 5.8 ± 2.2 years (range 3.1-13.8); 81.3% were white, 10.9% were African American, 10.9% were listed as "Other" (e.g., Asian, Alaskan, Pacific Islander or multi-racial). The mean score on the ABC Irritability subscale was 26.1 ± 7.0. Preliminary factor analysis revealed that 3 items did not load on any factor. The remaining 33 items loaded on factors that were similar to the original three factor structure of the 36-item PSI-SF. The deletion of these three items improved the alpha coefficient for each of the three factors with no change in the alpha value for the total score (Figure 1).
Conclusions: To our knowledge no previous study has examined the factor structure of the PSI-SF in a large sample of children with ASD and serious behavioral problems. In this sample, our preliminary factor analysis suggests that a three factor solution with 33 items may have advantages over the original 36 item measure in this clinical population. Additional exploratory factor analyses may provide further support for this new factor structure of the PSI-SF. We will also examine correlations of these new factors with other measures (e.g., Vineland, ABC, IQ, Home Situations Questionnaire) in this well-characterized population.

Table 1: Cronbach's Alpha, the reliability for the 3 sub-scales in 33 items and the 36 items

Model	Parental Distress	Parent -Child Dysfunctional Interaction	Difficult Child	Total Scale
36 items	12 items: 0.86	12 items: 0.73	12 items: 0.77	0.83
33 items	14 items: 0.87	9 items: 0.90	10 items: 0.90	0.84

Table 2: Preliminary 33-item PSI-SF structure

PSI Factor Results	Factor 1	Factor 2	Factor 3
27) I feel that my child is very moody and easily upset.	**0.806**	0.187	-0.181
30) My child gets upset easily over the smallest thing.	**0.804**	-0.089	-0.051
34) There are some things my child does that really bother me a lot.	**0.795**	-0.040	0.034
29) My child reacts very strongly when something happens that my child doesn't like.	**0.767**	-0.257	-0.082
28) My child does a few things which bother me a great deal.	**0.724**	-0.001	0.015
36) My child makes more demands on me than most children.	**0.723**	-0.049	0.044
25) My child seems to cry or fuss more often than most children.	**0.649**	0.271	-0.204
21) It takes a long time and it is very hard for my child to get used to new things.	**0.646**	-0.125	-0.008
2) I find myself giving up more of my life to meet my children's needs than I ever expected.	**0.641**	-0.208	0.422
20) My child is not able to do as much as I expected.	**0.555**	0.133	0.066
1) I often have the feeling that I cannot handle things very well.	**0.545**	0.247	0.323
31) My child's sleeping or eating schedule was much harder to establish than I expected.	**0.442**	-0.031	0.179
35) My child turned out to be more of a problem than I had expected.	**0.440**	0.387	0.218
18) My child doesn't seem to learn as quickly as most children.	**0.370**	0.021	-0.040
15) My child smiles at me much less than I expected.	-0.013	**0.836**	0.006
16) When I do things for my child, I get the feeling that my efforts are not appreciated very much.	0.369	**0.754**	0.158
19) My child doesn't seem to smile as much as most children.	0.164	**0.746**	-0.165
14) Sometimes I feel my child doesn't like me and doesn't want to be close to me.	-0.053	**0.735**	0.024
17) When playing, my child doesn't often giggle or laugh.	-0.289	**0.610**	0.002
13) My child rarely does things for me that make me feel good.	-0.190	**0.600**	0.228
26) My child generally wakes up in a bad mood.	-0.091	**0.588**	-0.009
23) I expected to have closer and warmer feelings for my child than I do and this bothers me.	-0.320	**0.574**	0.180
24) Sometimes my child does things that bother me just to be mean.	0.035	**0.528**	0.131
5) Since having a child, I feel that I am almost never able to do things that I like to do.	0.097	-0.048	**0.764**
12) I don't enjoy things as I used to.	0.019	0.082	**0.747**
9) I feel alone and without friends.	-0.129	0.030	**0.671**
3) I feel trapped by my responsibilities as a parent.	0.064	0.084	**0.616**
4) Since having this child, I have been unable to do new and different things.	0.296	-0.092	**0.613**
11) I am not as interested in people as I used to be.	-0.185	0.108	**0.592**
7) There are quite a few things that bother me about my life.	0.239	-0.025	**0.579**
10) When I go to a party, I usually expect not to enjoy myself.	-0.282	0.131	**0.574**
8) Having a child has caused more problems than I expected in my relationship with my spouse.	-0.027	0.226	**0.475**
6) I am unhappy with the last purchase of clothing I made for myself.	-0.217	0.212	**0.367**

157 **165.157** Factors That Promote Early ASD Diagnosis Among Simplex Families in an Urban Setting

M. Thompson[1], *E. A. Fox*[2], *T. Ward*[3], *J. Gerdts*[4] *and R. Bernier*[4], *(1)University of Washington Autism Center, Seattle, WA, (2)University of Washington Center for Human Development and Disability, Seattle, WA, (3)Seattle Pacific University, Seattle, WA, (4)University of Washington, Seattle, WA*

Background:
Early diagnosis of ASD and subsequent intervention have been found to significantly and positively impact child outcomes (Zwaigenbaum et al., 2015). It is unclear, however, which factors promote early diagnosis. Studies have focused on environmental factors (e.g., poverty, accessibility of services, presence of an older sibling with ASD), but little is known about the biological and behavioral factors that may impact early diagnosis (Herlihy et al., 2015; Liptak et al., 2008). Recent advances in the understanding of the genetic factors implicated in autism also necessitate an examination of the relationship between genetic status and age at diagnosis.
Objectives:
To determine the factors that promote early ASD diagnosis for children in simplex families within a homogeneous socio-demographic community.
Methods:
Participants included 182 children with ASD (79.9% male, mean age = 9.41 years) from the University of Washington's Simons Simplex Collection (SSC) site. 28 children had an identified Likely Gene-Disrupting Mutation (LGD), while 154 were without an LGD. Age of diagnosis was extracted from an interview used to qualify subjects for study participation. Child variables hypothesized to impact age at diagnosis included gender, presence of an LGD, developmental regression, and intellectual ability. Presence of regression was extracted from the ADI-R, as was age at first parental concern. Intellectual ability was assessed via full-scale IQ. Demographic characteristics hypothesized to affect age at diagnosis were obtained from the SSC Background History Form. To account for multiple comparisons during correlation and regression analyses, a stricter p-value of p<.008 was used.

Results:
Bivariate correlations were performed using variables of interest and age at diagnosis. Significant positive correlations between age at diagnosis and both age at parental concern and intellectual ability were identified ($r(166) = .25$, p=.000; $r(166) = .353$, p=.000). Results indicated significant negative correlations between age at diagnosis and regression, $r(166) = -.30$, p=.000. Multiple linear regression was performed to assess which variables had the strongest effect on age at diagnosis. There was a main effect of intellectual ability on age at diagnosis ($B = .448$, $t(128) = 3.31$, p=.001). A trend suggested age at parental concern also predicted age at diagnosis ($B = .596$, $t(128) = 2.37$, p=.02). There was no main effect for any demographic characteristic.
Conclusions:
When environmental factors like income, education, and geographic access to services are consistent, children's intellectual ability, a characteristic not specific to autism, may affect when children are diagnosed. Additionally, while parental concern has not, historically, been shown to promote early ASD diagnosis, it appears to contribute to age at diagnosis in this sample, likely driven by similar factors (e.g., intellectual impairments are identified earlier). Since having an older sibling with ASD has been shown to promote early diagnosis, focusing on simplex families gives important insight into the factors that impact diagnosis when families do not have prior ASD experience. The results indicate a need for parent education to help parents recognize ASD symptoms, specifically for those children who may not exhibit other developmental delays.

158 **165.158** Informant Discrepancies in Externalizing and Internalizing Symptoms and Adaptive Skills of High-Functioning Children with ASD

C. A. McDonald[1], *C. Lopata*[1], *J. P. Donnelly*[1], *M. L. Thomeer*[1], *J. D. Rodgers*[1] *and A. K. Jordan*[2], *(1)Institute for Autism Research, Canisius College, Buffalo, NY, (2)University at Buffalo, SUNY, Buffalo, NY*

Background: Assessment of clinical symptoms requires information from multiple informants. However, informant discrepancies may have significant repercussions when performing evaluations (i.e., access to services, treatment planning, progress monitoring; De Los Reyes & Kazdin, 2004). Understanding informant discrepancies may be more important for children with ASD, who often have difficulty generalizing across settings (Stratis & Lecavalier, 2015). Despite potential effects on access to services and intervention planning, there is a paucity of research that has comprehensively examined informant discrepancies for scales assessing externalizing, internalizing, and adaptive behaviors for children with HFASD.
Objectives: This study examined parent-teacher discrepancies for ratings of externalizing and internalizing symptoms and adaptive skills of children with HFASD.
Methods: This study included a total of 236 BASC-2 ratings of children with HFASD from two informant groups (parents and teachers). Each parent-teacher pair (n = 118 parents/caregivers and n = 118 teachers) rated the same child. The children with HFASD, ages 6 to 11 years, were recruited from clinical trials and had a prior clinical diagnosis of ASD, WISC-IV short-form IQ > 70, and VCI or PRI factor score >80. All diagnoses were confirmed using the ADI-R. The dependent measure used was the *Behavior Assessment System for Children-2 (BASC-2), Parent (PRS) and Teacher (TRS) Rating Scales*. Protocols were scored using the BASC-2 ASSIST Plus computer scoring software. Scores on the Internalizing Problems, Externalizing Problems, and Adaptive Skills Composites were examined for mean differences, level of agreement, linear relationships, and moderators of discrepancies.
Results: Mean difference comparisons were non-significant for the Externalizing Composite and its Aggression and Conduct Problems scales (negligible-to-small effect size *d*s, .02 - .25). Only the Hyperactivity scale within this composite yielded a significant between-groups difference ($d = .45$). For the Internalizing Composite and its scales, all between-groups comparisons were non-significant and the effect sizes were small-to-negligible (*d*s < .17). Parent-teacher ratings on these Composites and scales were significantly correlated (generally moderate). In contrast, teacher ratings were significantly higher than parents for the Adaptive Skills Composite and several of its constituent scales. Effect sizes on these significant comparisons ranged from small ($d = .48$) to large ($d = 1.06$), with the Adaptive Skills Composite difference reflecting a medium effect size ($d = .73$). Between-groups comparisons for non-significant scales resulted in small effect sizes (*d*s = .20-.30). Correlations between informants on the Adaptive Skills Composite were significant (low-to-moderate), with variability in the correlations among its constituent scales. Parent-teacher discrepancies were not moderated by child or parent variables.
Conclusions: This study suggests a reduced likelihood of informant discrepancies for externalizing and internalizing symptoms, with larger discrepancies expected when assessing adaptive skills. Reasons for the inconsistent pattern of findings are unknown but may involve more diversity in skills making up the adaptive skills construct or greater salience of behavioral symptoms. Poor agreement may have treatment and progress monitoring implications (e.g., difficulties identifying targets, establishing baselines, assessing intervention efficacy).

159 **165.159** Intelligence Profile and Diagnosis Model in Children with Autism Spectrum Disorder (ASD)

B. Chen[1], *H. Deng*[1], *X. Zou*[1], *J. He*[1] *and B. Wu*[2], *(1)Children Developmental & Behavioral Center, The Third Affiliated Hospital of Sun Yat-Sen University, Guangzhou, China, (2)School of Mathematics & Computational Science, Sun Yat-Sen University, Guangzhou, China, Guangzhou, China*

Background:
Differences in intelligence profile for ASD and other developmental disabilities such as ADHD are commonly observed in clinical practice. Some studies indicate that the intellectual-indicators may contribute to diagnostic discrimination. This study establishes a novel computerlearning-model for ASD diagnosis, which is demonstrated to have satisfied performances in discriminating ASD from ADHD individuals.
Objectives:
1. To explore diagnostic prediction accuracy of ASD and ADHD base on individual intelligence profile.
2. To provide informative models for decision making for ASD diagnosis based on performance pattern differences on intelligence measurement.
Methods:
The study population consisted of 605 children from Chinese Han population, which includes 275 children diagnosed as ASD by clinical-judgments according to DSM5 criteria, 192 with ADHD, 104 with Intellectual-Disabilities, and 36 Typically-Developed individuals. Chinese-Wechsler Intelligence Scale for Children (C-WISC) was administered between 01/2013 to 01/2015 in all subjects. We built a Random-Forest model to make diagnostic classification by randomly taking 2/3 samples as the training dataset and 1/3 as the test, then applied bootstrap strategies to re-sample 100 times. The Random-Forest method is used to build the diagnostic model, where each factor's contribution to diagnostic classification are evaluated and the important factors are selected to build the prediction model. We presented the decision tree for ASD diagnosis using intellectual-indicators.
Results:
In those with Full-Scale IQ ≥70 , Arithmetic, Comprehension and Similarities were the most important factors for ASD diagnosis, with the general prediction accuracy for ASD of 0.537 and ADHD 0.74. With the threshold of Arithmetic Standard score (S-score) ≥8.5, plus | VIQ – PIQ | >10, the prediction accuracy for ASD increases to 82% if Picture Arrangement S-score is <8.5 plus Information S-score ≥14. With the Arithmetic S-score < 8.5 and Block Design S-score ≥12, the prediction of ASD diagnosis shows 77% accuracy without requirement of VIQ and PIQ differences. In those with Full-Scale IQ <70, Comprehension became a primary component in the ASD decision making process, followed by Block Design and Object Assembly. General prediction accuracy is 0.822 to separate ASD from others including ADHD, ID and TD. With | VIQ – PIQ | >5, predicting accuracy for ASD diagnosis could reach to 100% in a total of an 18 case subset, with Comprehension S-score <1.5 and Block Design S-score ≥7.5. In the subgroup without Verbal IQ and Performance IQ differences requirement, predicting accuracy for ASD diagnosis is 93% with Comprehension S-score <1.5 and Block Design S-score ≥6.5.
Conclusions:
Our findings suggest that a low Comprehension level shows promising predictive accuracy in low functioning children with ASD, with an individual's visual learning abilities remaining at a similar level. This may contribute to the effectiveness for rescreening ASD missed-diagnosis in other developmental-disabilities population, especially children who receive a prior diagnosis of intellectual disability. In higher functioning children with ASD, the predictors include normal visual learning skills and cognition, but abilities related to logic or reasoning are poor. Risk factors in other intellectual assessments which may contribute to ASD diagnosis should be explored in further research.

160 **165.160** International Survey of Autism Spectrum Disorder Diagnostic Procedures

W. M. Weikum[1], *J. Shen*[2] *and N. E. Lanphear*[1], *(1)Sunny Hill Health Centre, University of British Columbia, Vancouver, BC, Canada, (2)Child & Family Research Institute, Vancouver, BC, Canada*

Background: Efficient diagnosis of Autism Spectrum Disorder (ASD) is essential for timely access to intervention services. The "gold standard" diagnosis of ASD is often multidisciplinary teams with structured observation and diagnostic interviews. However, differences in timing, personnel and diagnostic tools exist among centers.
Objectives: Since no universally accepted diagnostic method exists, we surveyed ASD centers to better understand current international practices.
Methods: A diagnostic tool and protocol survey was emailed to centers serving children with ASD. We collected 178 surveys from all world regions that correspond in English.
Results: Most children (42%) are assessed between 3-6 years of age. Multiple disciplines are used in 97% of centers, with an average of 4 (SD=2) disciplines used at each center. Psychologists (89%), Speech/Language Specialists (71%), Pediatricians (63%) and Psychiatrists (48%) are the most commonly used disciplines. Centers (n=90) from non-English speaking countries (N-ENG) use more Psychiatrists ($p<.05$) and centers (n=88) from English speaking countries (ENG) use more Pediatricians ($p<.05$). When questioned about their assessment protocols, 80% of centers report using standard procedures. The most frequently reported diagnostic tools are the Autism Diagnostic Observation Schedule (ADOS/ADOS-2; 84%), Autism Diagnostic Interview (ADI-R; 57%), Modified Checklist for Autism in Toddlers (48%) and Childhood Autism Rating Scale (CARS/CARS-2; 46%). The ADI-R is used more in N-ENG countries ($p=.05$), but the ADOS is used more in ENG countries ($p<.05$). Additional psychological testing is done in 78% of centers. The most common tests reported examine Intelligence (62%), General Development (50%) and Adaptive Behavior (38%), while Speech/Language specific tests are only reported by 17% of centers. The most frequently used tests are the Wechsler Scales (57%) and Vineland Adaptive Behavior Scales (28%). N-ENG countries

report more appointments [3.3 visits (SD=1.7) vs. 2.5 visits (SD=1.6); $p< .05$], however, both ENG countries [5.9 hours (SD=2.7)] and N-ENG countries (6.1 hours; SD=4.3) spend similar numbers of hours in appointments. The average number of weeks from referral to diagnosis is 25 weeks (SD=21) for all centers. Although wait time from first assessment visit to diagnosis is similar for ENG [7.5 weeks (SD=9.5)] and N-ENG countries [7.2 weeks (SD=6.5)], ENG countries have significantly longer wait times between referral and the first assessment visit [26.3 (SD=21) weeks vs. 9.5 (SD=12) weeks; $p<.05$]. Specifically, Canada [45 (SD=23) weeks] has significantly longer referral wait times ($p<.05$), even when compared to other ENG countries such as the United States [19 (SD=13) weeks], and other Commonwealth countries [23 (SD=21) weeks].
Conclusions: The majority of centers use multidisciplinary teams and report using interview and child observation tools. Results show ENG centers have significantly longer referral wait times, use more Pediatricians and use the ADOS more often. Conversely, N-ENG countries report using more Psychiatrists and the ADI-R more frequently. Despite more appointments in N-ENG countries, there are similar amounts of time spent in appointments and nearly equivalent wait times between first appointment and diagnosis for both ENG and N-ENG countries. ASD diagnostic centers will be interested in comparing their own procedures to our findings.

161 **165.161** Investigating Symptom Overlap Between Individuals with High-Functioning Autism Spectrum Disorder and Schizophrenia

S. Brocke[1], *K. Cook*[2], *L. Rabany*[1], *S. Corbera*[1,2], *K. Pelphrey*[3], *M. Bell*[2,4] *and M. Assaf*[1,2], *(1)Olin Neuropsychiatry Research Center, Hartford, CT, (2)Yale Psychiatry, New Haven, CT, (3)Yale Child Study Center, Yale School of Medicine, New Haven, CT, (4)Department of Veteran Affairs, West Haven, CT*

Background: Autism Spectrum Disorders (ASD) and Schizophrenia (SZ) are traditionally conceptualized as separate clinical entities. However, recent findings have suggested that they might overlap, as both are neurodevelopmental disorders characterized by negative affect, reduced social interaction and deficits in social cognition. Importantly, the symptom overlap profile, as defined by standard clinical assessments is not clear.
Objectives: Compare scores on standard symptom assessments, focusing on positive and negative symptoms as well as social and communication deficits in individuals with high-functioning ASD, SZ and in healthy controls (HC).
Methods: 29 individuals with ASD, 36 individuals with SZ, and 45 HC ages 18-32 were recruited to date. We administered a battery of clinical assessments to confirm diagnosis and quantify symptoms, including: Structured Clinical Interview for DSM-IV TR (SCID), Positive and Negative Syndrome Scale (PANSS) and the Autism Diagnostic Observation Schedule (ADOS). One way ANOVAs were performed to assess the differences in scores between the groups and correlation analyses to assess the relationship between positive and negative psychotic symptoms and social and communication deficits.
Results: One way ANOVAs showed main effect of group on ADOS Total, Communication (C) and Social Interaction(SI) subscale scores($p <.001$). Post-hoc Tukey HSD tests demonstrated that HC showed significantly lower scores than the patient groups with no significant differences between the patient groups on all scores. The PANSS Total score showed a main effect for group ($F(1,57)=11.93$, $p=.001$) as did the subscale scores(positive, negative and general)($p <.05$). However, SZ participants showed significantly higher (worse) scores compared to the ASD group on all PANSS scores.
SZ participants showed a significant correlation between PANSS and ADOS scores, including positive correlations between PANSS Negative and ADOS C, SI and Total scores ($r(33) = .494$ $p =.003$, $r = .746$, $p< .001$, and $r = .71$, $p <.001$, respectively). This group also exhibited a trending inverse correlation between PANSS Positive and ADOS SI and Total ($r (34) = -.311$, $p = .065$, $r = -.321$, $p =.056$, respectively). Finally, PANSS total scores also showed a correlation with SI ($r(33) = .342$, $p = .044$) and a trend with ADOS Total ($r = .319$) $p = .062$).
ASD participants showed significant correlations between PANSS general and ADOS C, SI and Total scores ($r(22) = .410$, $p = .046$, $r(22) = .481$, $p =.017$, $r(22) = .585$. $p=.003$, respectively). In addition, this group showed a significant correlation between the PANSS total score and the ADOS SI and total ($r(22)= .480$, $p = .018$, $r(22) - .427$, $p = .037$, respectively). There were no significant correlations between PANSS Negative and ADOS scores.
Conclusions: Our data support the hypothesis that social and communication deficits in SZ are similar to those of ASD. However, the pattern of correlation between these deficits and symptoms related to psychosis, especially negative symptoms, is different between these groups. These results have implications for future research on the underlying biology of both diagnoses as well as to patient assessment in clinical setting in order to fully characterize individual symptoms and their severity.

162 **165.162** M-CHAT Screening in Toddlers Referred to Early Intervention

B. L. Eaton[1], *K. L. Traub*[2], *D. Thao*[2], *N. Basu*[2], *S. E. Levy*[3], *A. Bennett*[4], *H. Kruger*[5] *and D. L. Robins*[2], *(1)Autism, Chester County Intermediate Unit, Downingtown, PA, (2)AJ Drexel Autism Institute, Drexel University, Philadelphia, PA, (3)Children's Hospital of Philadelphia, Philadelphia, PA, (4)Developmental & Behavioral Pediatrics, The Children's Hospital of Philadelphia, Philadelphia, PA, (5)The Children's Hospital of Philadelphia, Philadelphia, PA*

Background:
Early detection of autism spectrum disorder (ASD) is a priority to facilitate early intervention. The Childhood Autism Team CHeck (CATCH) Team is a cross-system specialized screening and assessment process in Chester County, PA for children in Early Intervention. Children are referred to the CATCH team if they screened positive on the Modified Checklist for Autism in Toddlers (M-CHAT) at 18-36 months and/or if the early intervention providers and parents express concerns about ASD. Referral to the CATCH team (including developmental pediatrics, school psychologist, and behavioral health professionals) results in a diagnostic evaluation.
Objectives:
The objectives of the current study were to (1) evaluate the utility of the M-CHAT to detect ASD in a community-based high-risk sample, (2) compare M-CHAT scores to final diagnosis, and (3) examine the preliminary psychometric properties of the M-CHAT among children referred to the CATCH team for ASD assessment.
Methods:
Archival data (2005-2014) from CATCH included 246 toddlers who screened positive on the M-CHAT and 12 who screened negative but were referred by a provider due to concerns of ASD. From this sample, 197 were diagnosed with ASD (79.8% male; mean age=2.20 years, *SD*=.51, range: 1.10-2.90) and 61 were diagnosed with other developmental delays (69.6% male; mean age=2.32 years, *SD*=.45, range: 1.11-2.90). Diagnoses in the non-ASD group included language delay (n=40), global developmental delay (n=19), and other (n=2, separation anxiety, behavior concern). Evaluation tools included ADOS(2), CARS(2), medical history and parent interview to inform a DSM(-IV/5) checklist. Data were extracted from clinical evaluation records. M-CHAT scores included total and/or critical score (note: some children had only one score available); final diagnosis was a clinical best estimate considering all available data.
Results:
Total M-CHAT score was not significantly different between ASD (mean=7.13, *SD*=3.8) and non-ASD (mean=6.50, *SD*=3.7), $t(225)=-1.50$, $p=.294$. However, critical score was significantly higher for the ASD group (mean=3.30, *SD*=1.6) compared to the non-ASD group (mean=2.32 *SD*=1.4, $t(108)=-2.89$, $p=.005$. The M-CHAT was positive (based on either total or critical score) for 190 (96.4%) of the ASD cases, indicating high sensitivity among those children referred for specialized ASD assessment by the CATCH team. Similar to other studies, the M-CHAT was not specific to ASD, but in the current sample, positive predictive value (PPV) was .77 indicating that positive screens were much more likely to be diagnosed with ASD than in low-risk samples (e.g., .06 PPV for the single-stage M-CHAT in Chlebowski et al., 2013).
Conclusions:
ASD screening tools may perform differently in high-risk samples compared to low-risk samples. Examining utility of ASD screeners in community-based settings facilitates the implementation of research tools in real-world settings. In a high-risk sample of toddlers, the M-CHAT critical score may be more useful in differentiating ASD from non-ASD delays, rather than the total score. PPV indicated high confidence that positive screens are likely to have ASD. Findings from the current study corroborate that standardized screening paired with referrals for diagnostic evaluation can facilitate identification of young children with ASD.

163 **165.163** Non-Binary Gender Is Associated with Higher Autistic Traits

T. Loucas[1], *P. Beaman*[1], ***L. E. Martin***[2] *and M. Younas*[2], *(1)Psychology and Clinical Language Sciences, University of Reading, Reading, United Kingdom, (2)University of Reading, Reading, United Kingdom*

Background: There is a relationship between autistic traits and gender: it is well-established that they are higher in males than females and ASD is more commonly diagnosed in males. There is now also evidence that individuals attending gender identity clinics for gender re-assignment score highly on measures of autistic traits, but those self-identifying as of non-binary gender need not be seeking gender re-assignment, and the incidence of autistic traits in this broader case of non-binary gender experience is unknown
Objectives:
This study aims to provide initial data on autistic traits in those who experience their gender as non-binary.
Methods:
An online survey advertised to students at University of Reading and through social media sites used by individuals identifying as of non-binary gender. The Autism Spectrum Quotient (AQ) was used as a measure of autistic traits. Respondents were asked to report their gender and male, female or other. The other category offer a list of further options based on self-identification: agender,androgyne, bigender, genderfluid, genderqueer, neutrois, pangender, trans*female, trans*male, trans*person, two-spirit, and a “prefer not to say” option. Respondents were also asked basic demographic questions, including age, country, first language, educational level and fluency in English and whether they had a diagnosis of ASD.
Results:
329 adults started the survey, 39 individuals completed gender questions but not AQ. 273 completed the AQ and the gender questions, of these 40 respondents reported receiving an ASD diagnosis and 12 chose not to disclose this information. 221 respondents reporting no ASD diagnosis were included in the analysis: N=33 male, N=119 female, N=69 non-binary. Mean (SD) AQ scores for male = 22.9 (8.2), female = 17.4 (8.2), non-binary = 28.3 (7.4). Multinomial logistic regression was used to look at the association between gender and AQ score, controlling for reported ASD diagnosis and demographic variables. The model was significant ($\chi^2(12) = 91.0$, $p < .001$). Only AQ

score was a significant predictor of reported gender. An increase in AQ score was associated with an increased likelihood of reporting male gender relative to female (odds ratio = 1.08; 95% confidence interval = 1.037-1.136). An increase in AQ score was also associated with an increased likelihood of respondents their gender as non-binary relative to female (odds ratio = 1.183; 95% confidence interval = 1.124-1.245).
Conclusions: We replicate the association between higher ASD traits in males relative to females and extend the association to adults who self-identify as non-binary. This is consistent with reports from clinical samples and suggests, further, the broader experience of non-binary gender is also associated with higher reported autistic traits. The causes of this association are unclear, but suggestions have included: prenatal androgen exposure and interpreting a problem relating to others, and associated feelings difference, as a problem of being in the wrong gender. Differences in interoception reported in ASD may also be implicated in gender dysphoria. It is also possible that the association we find is because everyday social interactions experienced by individuals identifying with non-binary gender results in increased reporting of autistic traits.

164 **165.164** Online Remote Verbal IQ Testing for Large-Scale Autism Studies and the Issue of Cheating

A. Zoltowski[1], *C. C. Clements*[2,3], *L. Bateman*[1], *N. Stein*[4] *and R. T. Schultz*[5,6], *(1)The Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (2)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (3)Psychology, University of Pennsylvania, Philadelphia, PA, (4)Department of Statistics, Wharton School, University of Pennsylvania, Philadelphia, PA, (5)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (6)Departments of Pediatrics and Psychiatry, University of Pennsylvania, Philadelphia, PA*

Background: Online phenotyping for autism research has many attractive properties, especially when the desired sample size is large and in-person testing burdensome. For skill testing, computer adaptive testing (CAT) based on item response theory can be an accurate and efficient alternative. We have developed an online Verbal IQ test (CARAT-V; Clements et al., 2015) that can be conveniently taken remotely with the precision of a standard IQ test. However, remote testing without study personnel supervision leaves open the possibility that test-takers will ignore directions to do the test without seeking help from others or the internet.
Objectives: To develop and test an algorithm for detecting item responses suggestive of cheating during an online test.
Methods: We collected CARAT-V data from N=3383 anonymous participants, excluding N=151 who sped through the test at such a rate that effort was compromised (response faster than median on >80% of items; accuracy <30%). The current analyses focused on developing a detection algorithm using self-reported cheating as the gold standard. In the final analyses to be reported at IMFAR, we will refine the algorithm using the more reliable gold standard of participants recruited for a randomized trial who receive instructions that cheating is permitted or not. For a subset of participants aged 8-10 years, the data noted whether the participant left the "full-screen test mode" during a question (allowing internet searching), and this feature will be extended to adult samples in upcoming trials.
Results: Incidence of self-reported cheating differed significantly between adults, adolescents, and children ($\chi^2 = 49.74$, $p < .001$). Self-reported cheating among adults was so infrequent (Table 1) that further investigation is needed. For adolescents, an algorithm was created which i) divided items into quintiles by response time and ii) flagged participants whose accuracy on items in the slowest quintile was more than 1 standard error greater than for all other quintiles combined, correctly capturing 45% of adolescents who self-reported cheating. For children, leaving full-screen mode during the item was a compelling indication of potential cheating, since item accuracy was 7.3% higher when the participant did so instead of staying on the testing screen ($t = 3.85$, $p < .001$). Self-reported cheating was not associated with total score for any age group, as baseline abilities and the frequency of this behavior may vary.
Conclusions: Our analyses suggest that tracking when participants exit full screen mode and our response time algorithm are promising tools to help researchers determine if and when an online result is suspect for child and adolescent participants. A limitation of our approach, however, is that our current gold standard leads to an all or none detection strategy, and we would ideally eliminate select data as suspect from each test taker. We will address these problems and further refine our algorithms in upcoming trials. The ability to screen for cheating is a prerequisite to confidently deploying a test remotely to study samples, thus allowing wider adoption and larger scale data collection, which is especially attractive for genetic studies.

Table 1. Sample size and incidence of self-reported cheating by age group

	Children (8-13 years)	Adolescents (14-17 years)	Adults (18+ years)
N	1720	558	954
Incidence	6.0%	4.0%	0.4%

165 **165.165** Outcome Summaries of Latency-Based Functional Analyses Conducted in Inpatient Units of Hospital Settings

P. Juarez[1], *J. Lambert*[2], *J. E. Staubitz*[3], *J. Torelli*[1], *M. Mahoney Hopton*[1], *K. M. Simcoe*[1] *and N. Houchins-Juarez*[2], *(1)Vanderbilt University Medical Center, Nashville, TN, (2)Vanderbilt University, Nashville, TN, (3)Pediatrics, Vanderbilt University Medical Center, Nashville, TN*

Background:
Latency-based functional analysis (LBFA) may be a viable alternative to traditional Functional Analysis (FA) when evoking and reinforcing high rates of problem behavior is not advisable, or when client time, appropriate and safe assessment space, and/or staffing are limited. In practice, this means that the conditions under which families reported seeing problem behavior were systematically presented for the participant and that data collectors measured how soon problem behaviors occurred when different conditions and potential reinforcers were applied. Comparing this latency to problem behavior across different conditions is a valid way to confirm the functional reinforcer(s) for a behavior. Embedded within a randomized controlled trial (RCT) to assess for potential cost-benefit of behavior analytic services within typical inpatient hospital settings, we conducted LBFAs of the problem behavior of 18 children diagnosed with autism in inpatient hospital settings.
Objectives:
The purpose of this study was to provide preliminary descriptive evidence of the capability of LBFAs to identify functional reinforcers for problem behavior when conducted within typical inpatient hospital settings.
Methods:
Eighteen children (17 male, 1 female) with autism ages 6-16 years (mean 10.3) participated in this study. Twelve had been admitted to a university-based child and adolescent psychiatric hospital and six had been admitted to a medical floor of a university-based children's hospital. Additionally, all had a reported history of chronic problem behavior. We conducted all assessments in inpatient units of the above-mentioned hospital settings; either in subjects' rooms or in multi-purpose rooms found within these units.
Definitions for each subject's target response(s) were operationalized based on caregiver report during pre-FA interviews (definitions available upon request). A preference assessment was conducted with the patient, followed by initiation of a latency-based FA. Assessment procedures were based on those described by Thomasson-Sassi et al. (2011).
Therapists also tracked latency to occurrence of non-targeted problem behavior during FA trials when subjects engaged in multiple topographies of problem behavior. Because latencies for these topographies were obtained within the context of highly controlled antecedent manipulations, we conceptualized data obtained from this secondary analysis as a structured descriptive assessment (SDA; Freeman, Anderson, & Scotti, 2000), with latency to unconsequated problem behavior as its dependent variable.
Results:
Eighteen latency-based FAs were conducted in inpatient hospital settings to identify the function of problem behavior of 15 subjects diagnosed with ASD. Eight latency-

based FAs successfully identified the functions of eight response topographies. Conversely, eight latency-based FAs produced inconclusive results. Four latency-based SDAs were simultaneously conducted on the secondary responses of four subjects. Differentiated response patterns emerged for two patients.
Conclusions:
Despite some limitations, which were specific and unique to the study settings and therapeutic contexts, results indicate it is possible to identify behavior function through latency-based FAs conducted by novel therapists in inpatient hospital units after evoking and reinforcing a minimal number of target responses. Furthermore, we outlined a latency-based strategy for collecting descriptive data on non-targeted problem behavior during FA sessions.

166 **165.166** Parents' Concerns As They Relate to Their Child's Development and Later Diagnosis of Autism Spectrum Disorder

M. Richards[1] *and D. L. Robins*[2]*, (1)Drexel University, Philadelphia, PA, (2)AJ Drexel Autism Institute, Drexel University, Philadelphia, PA*

Background: An important part of developmental and autism specific surveillance in toddlers is when physicians elicit parents' concerns. The relationship of parents' concerns and an autism spectrum disorder (ASD) diagnosis has been examined based on age at and nature of first concern, however the difference in parents' concerns between children diagnosed with ASD compared to children who are diagnosed with other developmental delays has not been studied.
Objectives: Data from children evaluated as part of a toddler screening study were used to examine: 1) differences between the ASD and non-ASD groups in the categories of developmental concerns reported by parents prior to diagnostic evaluation, 2) congruence of parent concerns with their child's later diagnosis, 3) the extent to which parent concern(s) predicted the therapies their child received and type of specialists consulted, and 4) the association between the number of parental concern categories and clinical measures.
Methods: Toddlers who screened positive for autism spectrum disorder (ASD) risk on the Modified Checklist for Autism in Toddlers (-Revised) during well-child check-ups received a diagnostic evaluation. Prior to evaluation, but after screening, parents completed a history questionnaire about their child (n=532). Parents' reports of concerns about their child's health and development, therapy received, and specialists consulted were coded into discrete categories.
Results: Most parents (>90%) had concerns about their child's development. The most common concern in both the ASD and non-ASD diagnostic groups was speech/communication (78.6%). Parents of children with ASD were significantly more likely than parents of non-ASD children to endorse speech/communication (p<.001), restricted and repetitive behaviors (p=.001), and social concerns (p=.001). Parents of non-ASD children were significantly more likely than parents of children with ASD to have behavior (p=.005) and medical concerns (p=.004). The mean number of concern categories was not significantly different between the ASD parents (mean=2.2, SD=0.072) and the non-ASD parents (mean=2.02, SD=0.075), (t(530)=1.82, p=.62), indicating that the ASD parents did not have more concerns overall. Parents of children diagnosed with ASD were more likely to have an autism specific concern (speech, restricted and repetitive behaviors including sensory, behavior, or autism label) compared to parents of a child diagnosed with non-ASD (p<.001). Parent concerns predicted type of therapy received and specialists consulted. Parents who reported a speech concern were 1.6 times more likely to receive speech therapy compared to a child whose parents did not have a speech concern. The number of concern categories endorsed was positively associated with several ASD scores: M-CHAT score (r=.279, p<.001; n=176), M-CHAT-R score (r=.146, p=.006; n=356), CARS (r=.130, p=.003). Number of concern categories was not associated with the ADOS severity score (r=.023, p=.705).
Conclusions: The developmental concerns expressed by parents of undiagnosed toddlers were highly consistent with the diagnosis the child later received. Based on their areas of concerns, parents made contact with the appropriate professionals and their children received some therapy prior to diagnosis. Finally, parents who reported concerns across different developmental areas endorsed more symptoms during screening. Results emphasize the importance of incorporating parent concerns during the referral and diagnostic processes.

167 **165.167** Performance of M-CHAT and ITC Screeners in High-Risk Siblings

E. Schriver[1]*, D. L. Robins*[2]*, L. A. Croen*[3]*, M. D. Fallin*[4]*, I. Hertz-Picciotto*[5]*, R. Landa*[6]*, S. E. Levy*[7]*, S. Ozonoff*[8]*, J. Pandey*[7] *and C. J. Newschaffer*[1]*, (1)A.J. Drexel Autism Institute, Philadelphia, PA, (2)Drexel University, Philadelphia, PA, (3)Division of Research, Kaiser Permanente, Oakland, CA, (4)Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD, (5)Dept of Public Health Sciences, School of Medicine, UC Davis MIND Institute, Davis, CA, (6)The Kennedy Krieger Institute, Baltimore, MD, (7)Children's Hospital of Philadelphia, Philadelphia, PA, (8)UC Davis MIND Institute, Sacramento, CA*

Background: It is important to examine screening efficacy in determining children at risk for ASD. Most studies have included low-risk toddlers; younger siblings of children diagnosed with ASD are a high-risk population of particular interest, given their elevated ASD prevalence of 1 in 5.4 (Ozonoff et al, 2011) compared to the general population's prevalence of 1 in 68 (CDC, 2014).
Objectives: To examine two screening tools, the Infant-Toddler Checklist (ITC) and the Modified Checklist for Autism in Toddlers (M-CHAT), and to examine concordance between screening outcomes and ASD classification at 36 months.
Methods: Parents of high risk siblings (n=166; 74 females, 92 males) completed the ITC at 6, 12, and/or 18 months and/or the M-CHAT at 18 and/or 24 months. Sensitivity, specificity, and positive likelihood ratios were examined for each screener at each timepoint, combinations of timepoints for each screener, and both screeners at 18 months using clinical best estimate for classification.
Results: As children got older, the percent who screened positive on each tool decreased (37.9%, 25.5%, and 22.4% for ITC, 25.8% and 21.6% for M-CHAT). The ITC sensitivity ranges from 48.5-69.2% and specificity from 65.2-91.1% for ages 6-18 months. The M-CHAT sensitivity ranges from 53.8-62.1% and specificity from 81.9-92.7% for ages 18-24 months. Sensitivity for ITC at any age from 6-18 months is 83.9% and for M-CHAT from 18-24 months is 82.1%. At 18 months, screening positive on one or both screens yielded 71.4% sensitivity and 76.4% specificity, while screening positive on *both* at 18 months resulted in 50.0% sensitivity and 95.8% specificity. The ITC at 18 months, the M-CHAT at 24 months, and screening positive on both the M-CHAT and ITC at 18 months had the highest positive likelihood ratios of 7.8, 8.5, and 11.9 respectively, meaning that children with ASD are that much more likely to screen positive than those without ASD. The combination of screening positive on the M-CHAT at 18 or 24 months and the combination of screening positive on both the M-CHAT and ITC at 18 months had both sensitivity and specificity >70%.
Conclusions: High-risk siblings are at elevated risk of ASD and also elevated risk of other developmental disorders. Therefore, it is important to examine the performance of tools that have been validated in low-risk samples to determine their utility in identifying siblings at the greatest risk of ASD. Performance on both tools was better in older children than in younger children, consistent with the literature (e.g., Pandey et al., 2008). Both the ITC and the M-CHAT demonstrated moderate sensitivity and moderate to good specificity at various ages; there was not a single tool at a specific age that was notably best at detecting ASD. However, the combination of M-CHAT at either age and the combination of either tool at 18 months met thresholds for adequate sensitivity and specificity; this suggests that in the complex developmental trajectories of siblings at risk for ASD, it will be important to consider multiple tools or multiple ages to best assess risk for ASD.

168 **165.168** Presentation of ASD in Females: Examining DSM Criteria in a Clinical Sample

R. Jamison*, Center for Child Health and Development, University of Kansas Medical Center, Kansas City, KS*

Background: Prevalence rates of a 4:1 male to female ratio for autism spectrum disorder results in narrow population of study, with females representing less than 15% of participants in ASD samples across published intervention studies (Watkins et al., 2014). Early research suggested girls with ASD were more likely to have an intellectual disability as compared to boys with ASD. However, recent research suggests that girls and women with ASD may present with different symptoms as compared to boys and men, resulting in a delayed diagnosis for females or missing high functioning females (Head et al, 2014; Lai et al, 2011; Begeer et al, 2013; Niller, 2014).To date, much research focuses on sex differences between males and females with ASD on specific measures with less emphasis on characteristics that may influence diagnosis or changes in symptoms over time.
Objectives: The primary objective is to examine the presentation of ASD in a clinic sample of females referred for an autism evaluation. The secondary objective is to consider potential sex differences in diagnostic criteria and to identify variables for further study and hypotheses regarding manifestation of ASD in females.
Methods: We examined characteristics of ASD through a retrospective analysis of a clinical sample, including potential sex differences in diagnostic variables (age at diagnosis, co-existing symptoms) as well as a descriptive analysis of DSM criteria in females with ASD as compared to males. Our sample includes data from our clinical database (n > 1300) of patients referred for an autism evaluation in our interdisciplinary clinics across the past three years. Analysis includes descriptive statistics, frequencies, and t-tests to compare groups. DSM criteria is examined in a subsample of males and females.
Results: Females are less likely to receive a diagnosis of ASD as compared to males with a significantly lower rate of diagnosis. Although we did not find a significant difference for age of ASD diagnosis in our clinical sample, females that did not receive a diagnosis were significantly older compared to males that did not receive a diagnosis. Similar to Hiller et al. (2014), females in our sample demonstrated low rates of restricted interests. We also found fewer symptoms related to deficits in nonverbal communication, play, or stereotyped behaviors.
Conclusions: Females in our clinical sample demonstrate some differences in diagnostic criteria as compared to males, with some symptoms predicting an increased likelihood of diagnosis in females. These data provide direction for further study and potential hypotheses related to how ASD manifests differently in females.

169 **165.169** Profiles of Classroom Active Engagement Among Early Elementary Students with Autism Spectrum Disorder

N. J. Sparapani[1]*, V. P. Reinhardt*[2,3]*, L. Morgan*[2]*, C. Schatschneider*[2] *and A. M. Wetherby*[2]*, (1)Arizona State University, Tempe, AZ, (2)Florida State University Autism Institute, Tallahassee, FL, (3)JFK Partners Universiy of Colorado School of Medicine, Aurora, CO*

Background: Classroom active engagement is essential for effective educational programming for students with Autism Spectrum Disorder (ASD; National Research Council, 2001). However, students with ASD display constellations of challenges that may interfere with active engagement in classroom activities. A recent study using the

Classroom Measure of Active Engagement (CMAE), a multidimensional observational tool, reported a pattern of overall limited yet variable active engagement in elementary students with ASD in classroom activities (Sparapani, Morgan, Reinhardt, Schatschneider, & Wetherby, 2015). Identifying profiles of active engagement may guide effective programming for students with ASD by describing patterns of skills and behaviors that influence classroom performance and learning.
Objectives: The purpose of this study was to identify profiles of active engagement within a sample of elementary students with ASD using the CMAE.
Methods: Participants included 196 students with ASD and their educators (n = 126) in kindergarten through second grade (M = 6.36 years, SD = 1.01) who were video-recorded in their classrooms at the beginning of the school year. This study used latent profile analysis (LPA), a statistical method for identifying subgroups of individuals that share characteristics (Jung & Wickrama, 2008) to define distinct profiles of active engagement in elementary students with ASD. LPA was used to compare models with two, three, four, and five profiles based on seven components of active engagement from the CMAE including productivity, eye gaze, responding, directed communication, generative language, flexible behavior, and flexible attention.
Results: Preliminary findings indicated that four latent profiles best described classroom active engagement within the sample (Entropy =.94), showing excellent overall model fit, the best fit in comparison to competing models, and strong overall membership probability (0.93 to 0.98). Below is a brief description of each profile.
Profile 1, the largest profile (64%), was characterized by limited eye gaze (1.5 SD below the mean) and less frequent directed communication and generative language (0.5 SD below) than each of the other profiles. Students in **Profile 2** (12%) exhibited greater classroom active engagement than each of the other profiles, showing the highest frequency of eye gaze (5.5 SD above), directed communication (2 SD above), and generative language (1.5 SD above). **Profile 3** (18%) was also characterized by a higher frequency of eye gaze (5 SD above); however each of the other active engagement components appeared to be within the typical range compared to the total sample. **Profile 4**, the smallest profile (6%), was characterized by a higher frequency of generative language (1.5 SD above) than directed communication and responding (approaching 1 SD above), and students' frequency of eye gaze was below the sample mean (approaching 0.5 SD).
Conclusions: These findings indicate that components of active engagement form constellations of skills and behaviors that vary among elementary students with ASD. This study provides preliminary data about a promising method to identify profiles of active engagement, which may help guide educational programming and support educational outcomes in elementary students with ASD.

170 **165.170** Prospective Clinical Evaluation of a Machine-Learning Based Test for Rapid Detection and Triage of Autism

M. Duda[1], *J. Daniels*[2] *and D. Wall*[1], *(1)Department of Pediatrics, Stanford University, Stanford, CA, (2)Stanford University, Palo Alto, CA*

Background:
The incidence of autism has increased dramatically over recent years, making this mental disorder one of the greatest public health challenges of our time. The standard practice of diagnosis is based on behavioral characteristics, as the genome has largely proved intractable for diagnostic purposes. Yet, the most commonly used behavioral instruments take up to 3 hours to administer by a trained specialist, contributing to the substantial delays in diagnosis experienced by many children, who may go undiagnosed and untreated until ages beyond when behavioral therapy would have had more fundamental positive impacts. In an effort to mitigate these challenges, we have developed a machine-learning based system for accurate classification of autism that requires minutes to administer and that can be delivered via mobile technologies.
Objectives:
Enabled in part by the 2013 Slivka/Ritvo Innovation Award, we completed a clinical study at the Developmental Medicine Center at Boston Children's Hospital. The objective was to test the sensitivity and specificity of a new, electronically administered, 7-question autism spectrum disorder (ASD) screen to triage those at highest risk for ASD in a prospective clinical population of children at risk for autism and/or other developmental delays between the ages of 16 months and 17 years.
Methods:
We created a mobilized web-accessible system for obtaining answers to a parent-directed classifier and a short home video of the child for machine classification. We administered the test in advance of the clinical team's evaluation at the DMC (via iPhone, iPad, or personal computer). All subjects were recruited from a convenience sample of children referred for consultation of developmental/behavioral concerns. Once the predetermined sample size of 200 was exceeded, we abstracted data from the medical record to compare the best estimate clinical diagnosis against the outcome from the ML classification tool.
Results:
A total of 222 families participated in the study, with a 69% rate of assent. The children assessed ranged in age from 1 to 16 years of age, with a median age of 5.8 years. 76.1% were male, and most participants had an intelligence/developmental quotient score >85; 69 of participants (31%) received a clinical diagnosis of ASD. The sensitivity of the MCDC in detecting ASD was 89.9% [95% CI = 82.7-97]; the specificity was 79.7% [95% CI = 73.4-86.1].
Conclusions:
Approaches that enable families to bridge the gap between initial warning signs of developmental delay and clinical diagnosis of autism quickly and effectively are critically needed for the field. The results from this clinical trial in a representative tertiary care facility suggest that the ML approach has clinical reliability across a range of ages and likelihood of high adoption by families. The study demonstrates the feasibility of accurate pre-clinical assessments and highlights the possibility of using mobile techniques for clinical triage, to reduce bottlenecks and reach a larger percentage of the population in need.

171 **165.171** Psychometric Properties of the Dimensional, Diagnostic and Dimensional Interview Version for Adults (3DIVA)

K. Clarke[1], *M. McKenner*[2], *C. Allison*[3], *S. J. Wheelwright*[4], *S. Baron-Cohen*[3], *D. H. H. Skuse*[5] *and* ***W. Mandy***[6], *(1)Clinical Psychology, UCL, London, United Kingdom, (2)UCL, London, United Kingdom, (3)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (4)Department of Psychiatry, Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (5)Institute of Child Health, London, United Kingdom of Great Britain and Northern Ireland, (6)University College London, London, United Kingdom*

Background:
A substantial number of cases of autism spectrum conditions (ASC) (also know as 'autism spectrum disorder', or 'autism') go undetected in childhood, and people do not grow out of ASC as they become adults. Therefore a number of individuals with autism progress to adulthood without receiving a diagnosis, in particular those with subtle symptoms, occurring in the context of a normal-range IQ and fluent language. As a result there is increasing acknowledgement amongst policy makers and healthcare professionals of the need to develop valid means of assessing autism in adults, to inform targeted support and intervention.
A cornerstone of autism assessment is informant report, preferably from someone (such as a parent) who knew the assesse in childhood. A valid assessment requires that such informant reports be integrated with self-report and direct observational information. Currently there are no validated, standardised informant-report measures designed for assessing adult autism, as defined in DSM-5.
The Dimensional, Diagnostic and Dimensional Interview version for adults (3DIVA) comprises 71 questions, 24 of which are historical, covering the assessee's life between birth and adolescence. Its algorithm outputs scores for the two DSM-5 domains of 'social communication and social interaction' and 'restricted repetitive patterns of behaviour, interests or activities'. The 3DIVA is intended for use with adults who have an IQ above 70, reflecting the increased risk of such individuals being missed in childhood and so presenting to adult services for assessment. It is a highly structured interview, and so is suitable for administration both in person and by telephone, as in the assessment of adults, parental report can sometimes be attained over the telephone but not face-to-face.
Objectives: To measure the reliability and validity of the 3DIVA, including its ability to discriminate autism from mental disorders such as anxiety, psychosis and depression.
Methods: Participants (N=86) were: (1) adults with autism (n=39); (2) adults without autism who were receiving clinical intervention for a mental health problem ('clinical comparison group') (n=20); and (3) adults without autism from the general population ('non-clinical comparison group') (n=27). The groups did not differ on IQ, number of years in education, or age. In the majority (85%) of cases the informant completing the 3DIVA was the index participant's mother.
Results: The 3DIVA showed excellent reliability (Cronbach's alpha's >.93, inter-rater reliabilities >.98). Criterion validity was shown by the strong sensitivity and specificity of the instrument, which correctly identified 93% of those with autism (sensitivity), and 92% of the non-autism participants (specificity). Evidence for construct validity was shown by the lack of association between 3DIVA DSM-5 algorithm scores and age or IQ.
Conclusions: The 3DIVA shows promise as a quick (< 40 minutes), reliable and valid informant-report tool for assessing whether an adult has high-functioning autism. It was able to discriminate between autism and conditions such as anxiety, psychosis and depression, and so could be used in general adult mental health settings, as well as in specialist neurodevelopmental services.

172 **165.172** Reaching the Other Half: Moving Towards Symptom-Based Referral Methods in a Community-Derived Sample

C. K. Kraper[1], ***C. Rothwell***[2,3], *J. L. Martucci*[4], *A. Verbalis*[5], *S. Seese*[2], *J. Safer-Lichtenstein*[6], *A. B. Ratto*[7], *L. Kenworthy*[8] *and L. G. Anthony*[5], *(1)Children's National Health System, Rockville, MD, (2)Center for Autism Spectrum Disorders, Children's National Medical Center, Rockville, MD, (3)Catholic University of America, Washington, DC, (4)Neuropsychology, Children's National Health System, Rockville, MD, (5)Children's National Medical Center, Rockville, MD, (6)Georgetown University, Washington, DC, (7)Children's National Medical Center, Silver Spring, MD, (8)Children's Research Institute, Children's National Medical Center, Rockville, MD*

Background: Current research practices typically limit participation to individuals with prior clinical diagnoses. This limits findings and generalizability to families who have sought care (Durkin et al., 2015). In answer to this, approaches that do not require a previous diagnosis, as supported by Patient-Centered Outcomes Research (PCOR) health disparities methodology, reach families who have not previously accessed mental health services by sampling underserved communities referred for symptoms rather than diagnosis. This approach has the potential to broaden the generalizability of research findings and directly impact underserved children and families.
Objectives: This study seeks to understand differences between previously-diagnosed and newly-identified children with ASD and/or ADHD in a community-based sample.
Methods: Participants include 160 families referred by high-poverty schools in the Washington, DC metropolitan area for participation in a comparative effectiveness trial of

two school-based executive function interventions. At this time, 94 cases have been assessed and entered. In this sample, race/ethnicity was reflective of the community (48.7% Latino, 22.7% White, 15.9% Black, 6.8% other). 27.4% of families were primarily Spanish speaking. 45.8% of the ASD group (n=24) and 52.9% of the ADHD group were newly-identified through gold standard assessment. FSIQ did not differ between children with and without prior diagnosis. At baseline, demographic information, behavioral/emotional functioning (CBCL), and family strain were measured.
Results: Independent samples t-tests and chi-square analyses revealed no significant differences in family income and parent education level between children with and without prior diagnosis. For children with prior diagnosis, families reported significantly more strain (t(75)=-2.12, p=.037) and greater child externalizing problems (t(70)=-2.67, p=.009). There was a higher proportion of English-speaking families within children with prior diagnosis (χ^2(1, N=75)=8.361, p<.006). Multiple linear regression analyses showed language spoken in the home significantly predicted prior diagnosis after accounting for behavioral/emotional problems (CBCL Total Problems; R^2=.189, F(1, 67)=8.037, p=.006). Importantly, within the ASD group, neither ASD symptom severity (ADOS-2), Total Problems, family strain, nor language spoken in the home differed between those who were previously identified vs. newly diagnosed.
Conclusions: Children previously identified as ADHD were more likely to have parents who spoke English, reported feeling more parenting strain, and noticed more problems in their children. In contrast, children previously diagnosed with ASD did not differ from those newly-identified on these variables or in autism-specific symptomatology. Thus, there is value in symptom-based referral methodology for ASD studies, as these methods allow for accurate identification of individuals who meet full diagnostic criteria. Additionally, roughly half of both final diagnostic groups were newly identified. Although ADHD can be reliably diagnosed by community providers, ASD diagnosis continues to be difficult to access, and children are being missed despite showing the same degree of symptomatology. Further research should explore factors related to difficulty accessing specialized ASD diagnosis. In sum, studies allowing for symptom-based referrals, rather than diagnosis-based referrals, have the potential to impact communities and better capture the full ASD population.

173 **165.173** School Refusal Behavior in Students with Autism Spectrum Disorder, an Exploratory Study of Prevalence and Associated Factors

***E. K. Munkhaugen**, Oslo University Hospital, Oslo, Norway*

Background:
School refusal behavior refers to unauthorized absenteeism in compulsory school; it is defined as child-motivated refusal to attend school and/or difficulties remaining in class for an entire day. Failure to attend school might negatively influence the student's academic, psychological and social development and increase the risk for dropping out of school.
Despite increased research in factors associated with quality of school experiences less attention has been directed to absenteeism and school refusal behavior in students with ASD. The research is to our knowledge sparse, however, parent reports from the Danish and the Swedish Autism Association found a prevalence of school refusal behaviour in students with ASD, 39% and 36.5%, respectively. A better knowledge of the prevalence and the individual risk factors can be important for professionals to prevent and treat school refusal behavior in students with ASD.
Objectives:
This study aimed to explore the prevalence of school refusal behaviour in students with ASD aged 9-16 years without intellectual disability (IQ > 70), compared to typically developing (TD) students in Norwegian schools. Further, to explore if individual characteristics can predict risk for displaying school refusal behavior in the students with ASD.
Methods:
A cross-sectional study involving 80 students with a confirmed diagnosis of ASD without intellectual disability, and a comparison group of 138 children and adolescents at the same age, sex and classes with no disabilities are included in the study. The participants were recruited from schools, child and adolescent psychiatric and pediatric outpatient clinics or via the Norwegian Autism Association website. The diagnoses were assessed and confirmed by specialists in child and adolescent psychiatric and paediatric outpatient hospital clinics. Teachers and parents registered absences and school refusal behavior over 20 days. Parents answered a socioeconomic questionnaire. To assess data characterizing the students with ASD, parents answered the Behavior Rating Inventory of Executive Function (BRIEF), the Child Behavior Checklist (CBCL) and the Social Responsiveness Scale (SRS) questionnaires. Information regarding demographic factors was collected via the Norwegian educational information system.
Results:
School refusal behaviour was revealed in 42% of students with ASD compared to 7.1% of TD students based on teachers collected data. Parent registrations showed a prevalence of school refusal behaviour in 52.6% of the students with ASD and 2.3% of the TD students. Strong associations were found between school refusal behaviour and illness in other family members and in those attending junior high school. Preliminary results in total scores from the BRIEF, the SRS and the CBCL showed significant differences between students with ASD and students with ASD and school refusal behavior.
Conclusions:
Findings showed that school refusal behaviour in students with ASD is most prevalent and associated with illness in other family members, and attending eight to tenth grade. Further, students with ASD and school refusal behaviour tend to have more problems assessed with the BRIEF, the SRS and the CBCL.

174 **165.174** Screening Practices and Factors Influencing Autism Spectrum Disorder Screening By Community Paediatricians

***A. Ip**[1], A. Dupuis[2], E. Anagnostou[3,4,5], A. Loh[6], A. Munoz[7], T. Dodds[7] and S. Smile[7,8], (1)Developmental Paediatrics, Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada, (2)The Hospital for Sick Children, Toronto, ON, Canada, (3)University of Toronto, Toronto, ON, Canada, (4)Bloorview Research Institute, Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada, (5)Paediatrics, University of Toronto, Toronto, ON, Canada, (6)Surrey Place Centre, Toronto, ON, Canada, (7)Bloorview Research Institute, Toronto, ON, Canada, (8)Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada*

Background:
Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder which affects 1% of the population. Research has shown that ASD can be diagnosed in children 2 to 3 years of age with some accuracy. High risk children have been identified prior to 24 months of age. In Canada the median age of diagnosis of ASD is 39 to 55 months, which suggests a later time to diagnosis than seen in other developed countries. Screening is important for early identification of children with ASD, potentially leading to earlier intervention. Research has identified some potential barriers to early identification of ASD; however, information regarding general paediatric practices around ASD screening in Canada is lacking.
Objectives:
The aim of the study is to examine the use of ASD screening tools and developmental screening tools by community pediatricians. We also evaluated facilitators and barriers to ASD screening by community paediatricians.
Methods:
A cross sectional survey of community paediatricians was conducted. A questionnaire was developed based on previous survey data. The survey was reviewed by developmental paediatricians and community pediatricians to ensure clarity and ease of use. The questionnaire was distributed to five hundred and sixty paediatricians.
Results:
There was a 48% response rate (267/560)of whom 132 were eligible. Ninety three percent of responders use a developmental screening tool, namely the Nipissing Developmental Screen, Rourke Baby Record and Ages and Stages Questionnaire. Seventy one percent (71%) of responders use an ASD screening tool when there are concerns for ASD noted. Only 15% of community paediatricians routinely use ASD screening tools, and 14% never use an ASD screening tool. The most commonly used ASD screening tool is the Modified Checklist for Autism in Toddlers, Checklist for Autism In Toddlers and Social Communication Questionnaire. Community paediatricians refer a child who they suspect of having ASD to a clinical specialist primarily to confirm the diagnosis and to facilitate access to resources and interventions. Community paediatricians are keen to incorporate a formal ASD screening tool in their practice but identified the need for clearer guidelines for ASD screening.
Conclusions:
The majority of community paediatricians use an ASD screening tool when there are specific concerns for ASD. The time to screen for ASD and the ability to navigate ASD resources and interventions are important barriers for community paediatricians. Clarity around guidelines as to when and how to screen for ASD is needed.

175 **165.175** Screening for Autism Spectrum Disorder: A Measurement Agreement Study

***D. Kamara**[1], K. M. Walton[1] and A. N. Witwer[2], (1)The Ohio State University, Columbus, OH, (2)The Ohio State University, Gahanna, OH*

Background: Children with Autism Spectrum Disorder (ASD) often show developmental delays prior to their diagnosis of ASD (Zwaigenbaum et al., 2009). Autism screening for children with developmental delay (DD) can help identify children that are in need of autism-specific services. The Modified Checklist for Autism, Revised with Follow-up (M-CHAT-R/F; Robins et al., 2014) is a widely accepted screening tool for autism in toddlers. In addition to the M-CHAT-R/F, there are also measures in place for identifying problems with behavior problems and social-emotional competence (i.e. social-emotional functioning). Some of these social-emotional screening tools, including the Ages and Stages: Social-Emotional (ASQ:SE; Squires, Bricker, & Twombly, 2002), the Brief Infant Toddler Social Emotional Assessment (BITSEA; Briggs-Gowan & Carter, 2006), and the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2000), are also used as screening tools for autism and are commonly given in early intervention settings. The ASQ:SE contains items that are meant to flag for autism, but has not yet been validated as an autism-specific screening tool. Despite this, in a survey of birth to three providers, the ASQ:SE was reported to be the most commonly administered screening tool for ASD (Shaw & Hatton, 2009). The BITSEA also includes items that are meant to flag for ASD. An Autism score derived from these items has demonstrated promise in identifying children with ASD (Kruizinga et al., 2014). The CBCL has a pervasive

developmental problems (PDP) scale that can be used to identify children with ASD. A recent meta-analysis suggests that the CBCL PDP scale may be sensitive, but not specific at identifying ASD (Hampton & Strand, 2015). Given the varied use of these tools in community settings, it is worthwhile to know how much these measures agree with each other in terms of identifying children with DD who are at-risk of ASD.
Objectives: To examine the agreement between the M-CHAT-R/F, the BITSEA Autism score, the CBCL PDP scale, and the ASQ:SE in classifying children as at-risk for ASD in a sample of toddlers with developmental delay.
Methods: Participants were young children between the ages of 18-36 months, and their parents, enrolled in early intervention services in Ohio. Parents completed a packet of questionnaires on their child's social-emotional functioning. All measures were completed within one month of each other. Agreement was calculated based on dichotomous risk outcomes (at-risk or not at-risk) with Cohen's Kappa, which corrects for chance agreement. Each social-emotional screening tool was compared individually to the M-CHAT-R/F.
Results: Preliminary results suggest moderate to substantial agreement between measures. So far, the CBCL PDP scale appears to have the strongest agreement with the M-CHAT-R/F. Data collection is ongoing. We expect to have results from approximately 50 children and parents by IMFAR.
Conclusions: Within a population of toddlers with developmental delays, the social-emotional screening tools, particularly the CBCL PDP scale had good agreement with the M-CHAT-R/F. These results suggest that these tools may be appropriate for screening children with developmental delays for ASD. Further research needs to examine the sensitivity and specificity of these measures.

176 **165.176** Screening for Autism Spectrum Disorders in Childcare Centers Using the M-CHAT-R/F

B. Ferreira[1], *D. Thao*[1], *A. Spiller*[1], *N. Tomy*[1], *T. Scott*[2] *and D. L. Robins*[1], *(1)AJ Drexel Autism Institute, Drexel University, Philadelphia, PA, (2)Delaware Valley Association for the Education of Young Children, Philadelphia, PA*

Background: Early detection of autism spectrum disorders (ASD) leads to early intervention which in turn leads to better outcomes. The average age of diagnosis is 4 years old. Pediatricians are mandated to complete ASD specific screenings at 18 and 24 months, but with the multitude of tasks that must be performed during a short check-up, ASD specific screenings may not be offered. Early Childhood Education Providers (ECEPs) may be an ideal source to increase access to screening.
Objectives:

1. Assess the feasibility and acceptability of autism screening in childcare centers.
2. Evaluate the concordance of M-CHAT-R/F results from parents and teachers.

Methods: A mixed method approach included focus groups to serve as a needs assessment and to provide data on acceptability of screening completed by ECEPs. Ten childcare sites were recruited; ECEPs participated in a 90-minute training about symptoms of ASD, a demonstration of the web-based system, and an interactive discussion. A questionnaire was administered to ECEPs to understand perceptions about developmental screening and monitoring. To support screening, researchers attended parent events, and were available at pick-up and drop-off times to help parents complete the M-CHAT-R/F. ECEPs also completed M-CHAT-R/F. Children that screened positive were invited for a diagnostic evaluation; parents received oral and written feedback about their child.
Results:
Nine primary caregivers (mean age=42, *SD*=12.8, range:20-56 years) of young children participated in the first focus group. Participants were predominately African American (88.89%), and 44% of participants held some type of college degree. Approximately one-third of participants voiced familiarity with autism. Caregivers felt benefits of childcare included socialization and learning foundational skills. Caregiver concerns about ECEPs included lack of training and familiarity, and lack of a relationship with their children.
Seven ECEPs participated in the second focus group; they were enthusiastic about the role of childcare providers in developmental monitoring and screening, and endorsed use of continuous monitoring for children. 57.1% of participants held an advanced degree. Methods for monitoring varied across centers. 28% reported using the Ages and Stages Questionnaire, 14% reported a mixture of methods, but 57% consider their monitoring techniques to be "informal".
Over half of ECEPs (*n*=57) who completed pre-study questionnaires indicated they have experience monitoring development of children in the classroom, yet over 25% have never talked with parents about concerns related to their child's development.
Although more than 700 children within our qualifying age range were enrolled across all 10 childcare centers, uptake has been low. Of the 95 children who have completed screening, 10 children screened positive: 6 based on parent report, 3 based on teacher report, and 1 child screened positive on both reports. Concordance for screening results was 76%.
Conclusions: ECEPs are accepting of screening for ASD, but low participation rates among parents indicate barriers to screening in childcare settings. Concordance among ECEPs and parents is high when children are screened by multiple informants. With strong teacher support, screening is more widely accepted by parents, and the use of M-CHAT-R/F can contribute to the early detection of autism.

177 **165.177** The Faison-Quality of Life Questionnaire: A Brief Survey of Outcome and Indicators for Individuals with Autism Spectrum Disorder

E. T. Newcomb[1] *and* ***R. K. Gilbert***[1,2], *(1)The Faison School for Autism, Richmond, VA, (2)University of Richmond, University of Richmond, VA*

Background: Given the high and increasing incidence rate of autism spectrum disorder (ASD), it is key for providers, families, and other stakeholders to possess a tool to measure an individual with ASD's quality of life (QOL). Further, given the challenges and resources required to deliver and receive treatment, it is also important that such tool expeditiously capture important information within pivotal areas. Although a number of QOL survey tools and structured interview rating forms currently exist, none satisfied the general criteria set by the investigators, which included: a) Identifying something brief (to administer), b) Capturing information from a variety of important domains, and c) Utilizing something carefully tailored to individuals with ASD and related developmental disorders.
Objectives: To assess student health and wellness outcomes
Methods: A 25-item questionnaire was created to quickly assess a student's QOL. The QOL questionnaire contained five subsections: 1) Physical, 2) Emotional, 3) Behavioral, 4) Social, and 5) Independence. Questions were each arranged on a 4-point Likert scale ranging from strong agreement to strong disagreement, resulting in a range of scores from 25 (high QOL) to 100 (low QOL).The questionnaire was administered to 62 parents of children who attended a school for students with autism.
Results: Preliminary results indicated a number of commonalities between gender and age bracket subsets, as well as from subsection to subsection across participants. Further, results are discussed in terms of individual-family level implications as well as additional steps required to validate the questionnaire and assess reliability.
Conclusions: This study is a strong preliminary step in exhibiting trends across physical, emotional, behavioral, social, and level of independence, quality of life-related outcomes amongst individuals with Autism Spectrum Disorder. It also offers a viable metric tool that can be utilized in an educational setting to inform service providers.

178 **165.178** The Importance of Visually Guided Screening: An Examination of an Autism Screener with and without Video Depiction of ASD Symptomology

K. Boswell[1], *K. Sheperd*[2] *and R. Landa*[3], *(1)Kennedy Krieger Institute, Baltimore, MD, (2)Kennedy Krieger Institute, Center for Autism and Related Disorders, Baltimore, MD, (3)The Kennedy Krieger Institute, Baltimore, MD*

Background: Autism Spectrum Disorder may be detected during the second year of life (e.g., Landa et al., 2007; 2014), though average age of diagnosis is after 4 years (ADDM, 2014). At present, screeners for ASD do not possess adequate sensitivity and specificity to detect subtle behavioral manifestations. Emerging research shows that video referencing improves accuracy of caregiver behavioral ratings and may improve caregiver-professional communication about behavior (Sices et al., 2008, Marrus et al., 2015).
Objectives: Preliminary findings demonstrated that a new web-based video-guided screener for detecting the risk of ASD in young children (the Early Video-Guided Autism Screener [EVAS]) has moderate predictive power when compared to the current diagnostic gold standard, the Autism Diagnostic Observation Schedule (ADOS) and clinical judgment. The present study aims to examine the added value of video examples on the EVAS.
Methods: Parents of 103 children aged 12-60 months (mean age 24.57 months (11.51 SD), 52.4% male, 70.9% Caucasian) completed a paper-based question-only version (no videos) of the EVAS screener prior to their child receiving an evaluation that included the ADOS. Receiver operating curves (ROC) analysis utilized a diagnostic classification of ASD vs No-ASD generated through the ADOS and clinical judgment to determine this sample's cut-off for classification and to examine the effect of removing video guidance (using just the EVAS questions) on performance of the screener by comparing results with existing data previously obtained using the full video-guided tool (EVAS).
Results: Using the questions-only version of the screener, findings paralleled some aspects of previously obtained results involving use of the questions with video-guidance. In both versions of the tool, ROC analyses suggested a cut-off of 53 as the optimal selection for classification (Figure 1). A comparison of the area under the curve (AUC) in the two datasets was not significantly different (p=0.23), though the video-guided sample performed slightly better. Further examination of the criterion validity of the questions-only version relative to the video-guided version suggested lower sensitivity (27.6%, 95% CI: 19.0-36.2 vs. 89.4%, 95% CI: 83.6-95.2) and a moderate, but slightly lower, positive predictive value (80.0%, 95% CI: 72.3-87.7 vs. 92.2%, 95% CI: 87.2-97.2). The specificity performed slightly higher at 97.3% (95% CI: 94.2-100.4 vs. 88.4%; 95% CI: 82.4-94.4). See Table 1.
Conclusions: These findings suggest that while the EVAS questions help informants to differentiate between having ASD-related concerns from typical development, video guidance appears to enhance parents' ability to differentiate ASD-specific concerns from other general developmental concerns. This supports the budding literature highlighting the need for well validated, video-guided, screeners to enhance parent report of behavior and facilitate early detection of ASD.

Figure 1. Comparison of Classification Performance Utilizing a Cut-off of 53.

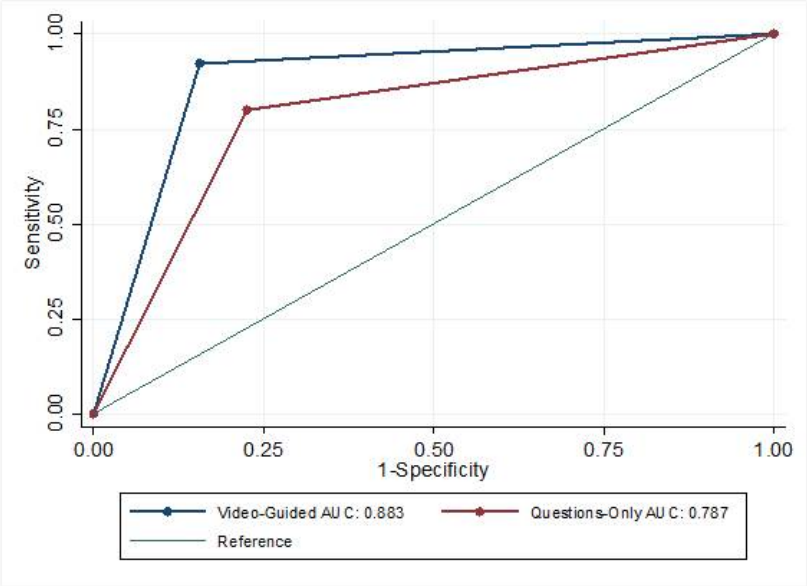


Table 1. Sensitivity and Specificity Analyses by Sample

	% (95% CI)			
	Sensitivity	Specificity	PPV	NPV
Video-Guided	89.4 (83.6-95.2)	88.4 (82.4-94.4)	92.2 (87.2-97.2)	84.4 (77.6-91.3)
Questions-only	27.6 (19.0-36.2)	97.3 (94.2-100.4)	80.0 (72.3-87.7)	77.4 (69.3-85.5)

179 **165.179** The Social Communication Questionnaire (SCQ) As a Population-Based Screening Instrument for Autism Spectrum Disorder

C. C. Bradley[1], *A. D. Boan*[1], *A. Wahlquist*[2], *A. P. Cohen*[3], *J. M. Charles*[1] *and L. A. Carpenter*[4], *(1)Pediatrics, Medical University of South Carolina, Charleston, SC, (2)MUSC, Charleston, SC, (3)University of Illinois at Urbana-Champaign, Champaign, IL, (4)Medical University of South Carolina, Charleston, SC*

Background: The Social Communication Questionnaire – Lifetime Version (SCQ) is a 40-item parent-report screening measure for Autism Spectrum Disorder (ASD) that is widely used in research and clinical practice. Although the SCQ has been studied in both clinical and general population samples, the sample sizes have been small and there is limited data available regarding how demographic factors, such as gender, race, or SES might impact parent responses on the SCQ.
Objectives: (1) To determine the sensitivity and specificity of the SCQ as a screening instrument for ASD in a large, epidemiological sample of youth; (2) To examine the impact of various demographic factors on SCQ scores.
Methods: Data for the present study comes from the South Carolina Children's Educational Surveillance Study (SUCCESS) which was designed to assess the prevalence of ASD in children born in 2004 (aged 8-10 at the time of participation) through direct screening and evaluation. SCQs were distributed to all children in the study area through schools. Participants with SCQ≥15, as well as 20% of those with scores between 8 and 14 were invited to participate in a diagnostic assessment.
Results: Of the 8246 SCQ's that were distributed, 4085 (50%) were returned. Total SCQ scores were available for 3720 participants (91%) with a mean of 6.09 (SD = 5.44, Range: 0 to 36) and a median score of 5. Over 7% of the sample had an SCQ score of 15 or higher, with another 23% of SCQs falling between 8 and 14. Participants were 49% male, 52% white non-Hispanic, 23% black non-Hispanic, 4% Hispanic, and 51% from Title 1 public schools (schools with a high percentage of low income students). Unsurprisingly, males had significantly higher mean SCQ scores than females (6.87 vs. 5.34, p<.0001). Title 1 school status was also associated with higher SCQ scores (7.35 vs. 5.03, p<.0001). Race and ethnicity data was available for less than half of the sample due to differences in data availability in each school district. Non-Hispanic black families reported higher SCQ scores than non-Hispanic white families (7.65 vs. 5.08, p<.0001) and families who identified as Hispanic also had significantly higher SCQ scores (9.41 vs. 6.24, p<.0001). For youth with SCQ≥15 who completed an in-person assessment, the unadjusted OR = 1.32, indicating a 32% increase in risk for meeting DSM-5 criteria for ASD for each additional SCQ point above 15. The mean SCQ score amongst youth diagnosed with DSM-5 ASD was 23.54.
Conclusions: This study includes one of the largest samples ever to utilize the SCQ for population-based screening for ASD. Significant mean score differences based on demographic factors including race, ethnicity, and Title 1 school status suggest that this instrument may perform differently in different populations. Further sensitivity and specificity analyses are ongoing, as well as analyses focusing on the extent to which completing the Spanish-language SCQ impacts the association between ethnicity and the SCQ as many Hispanic families elected to complete the Spanish-langauge SCQ.

180 **165.180** The Utility of the ADOS-Toddler Module in an Independent Sample

L. B. Swineford[1,2] *and A. Thurm*[2], *(1)Department of Speech and Hearing Sciences, Washington State University, Spokane, WA, (2)Pediatrics and Developmental Neuroscience Branch, National Institute of Mental Health, Bethesda, MD*

Background: Calibrated severity scores (CSS, also termed comparison scores) have been developed for the Autism Diagnostic Observation Schedule, second edition (ADOS-2) and the two diagnostic domains, Social Affect (SA) and Restricted and Repetitive Behaviors (RRB) (Gotham et al., 2009; Hus, Gotham, & Lord, 2014). These scores are published for modules 1-3 of the ADOS-2 in an attempt to provide a metric of ASD severity not conflated by cognitive and language abilities. With the recent addition of the toddler module (ADOS-T), there is now a version of the ADOS available for children between 12 and 30 months of age. Sensitivity, specificity, and predictive value of raw ADOS-T scores support the use of the ADOS-T in early diagnostic practices (Luyster et al., 2009; Guthrie et al., 2013). However, the ADOS-T is still new compared to the other ADOS modules. The recent publication of the ADOS-T CSS scores (Esler et al. 2015) highlights the need for further examination of its utility using independent samples.
Objectives: The aim of the present study was to examine the utility of the CSS scores for the ADOS-T in an independent sample of children with ASD, non-ASD delays, or typical development.
Methods: Participants included 116 toddlers (mean age: 21.44 months; range 12.60-29.76 months) who screened for autism research in the Pediatrics and Developmental Neuroscience Branch of the National Institute of Mental Health. Of the 116 toddlers, 21 met criteria for ASD, 37 for non-ASD delays, and 58 for typical development. All participants received the ADOS-T and the Mullen Scales of Early Learning as part of the screening evaluation.
Results: In the ASD group, 95% (n=20) of participants had raw scores that fell into the moderate-to-severe concern range. In contrast, 81% (n=30) of children in the non-ASD group and 93% (n=54) of children in the typical development group fell in the little-to-concern range. The mean CSS score in the ASD group was 8.38 (SD 1.62, range 4-10) which was significantly higher than the CSS scores for the non-ASD delay (mean = 2.59, SD = 1.65, range 1-7) and typical development (mean = 1.86, SD = .963, range 1-5) groups. The same pattern was observed for the SA and RRB CSS scores (see Figures 1 and 2). In the ASD group, neither the raw nor CSS scores (SA, RRB, total score) correlated with nonverbal or verbal DQ.
Conclusions: This study provides further support for the use of the clinical concern ranges on the ADOS-T. Further, results suggest that the CSS and even raw scores of the ADOS-T are an independent metric of ASD symptom severity, as the raw scores were also not related to measures of language and cognitive ability. These findings contrast the original ADOS-T CSS publication which suggested the raw and CSS scores (less so for the latter) were influenced by language abilities. Overall, while longitudinal studies need to compare CSS scores from the ADOS-T to other modules, the ADOS-T CSS scores will be useful in allowing for comparison of ASD symptoms over time.

Figure 1. ADOS-T Social Affect Calibrated Severity Scores by Diagnostic Groups.

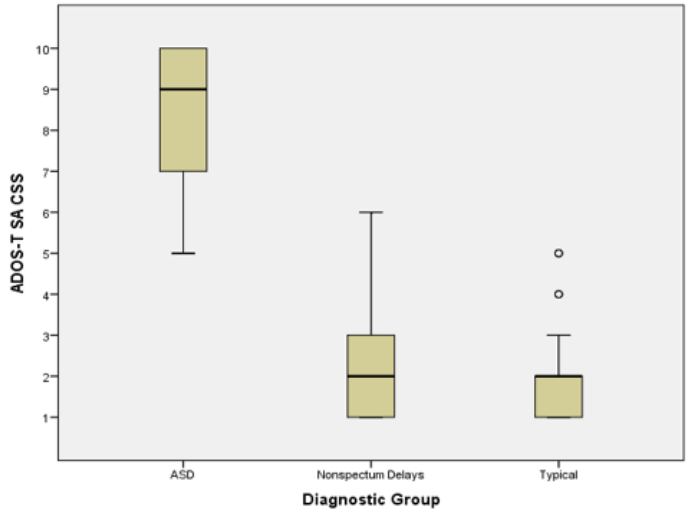
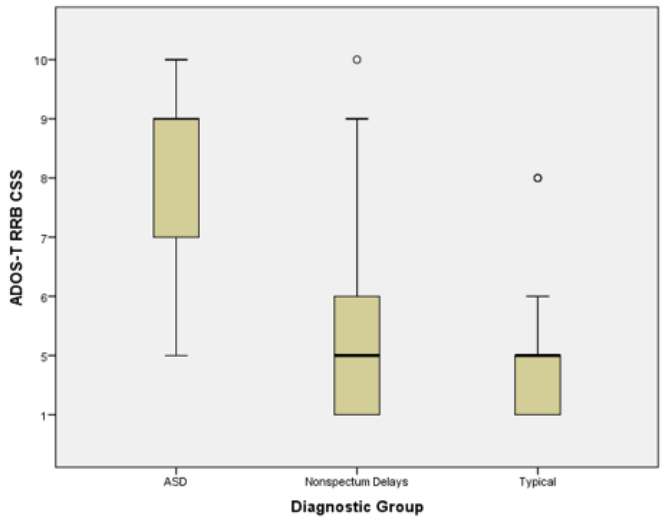


Figure 2. ADOS-T Restricted and Repetitive Behavior Calibrated Severity Scores by Diagnostic Groups.

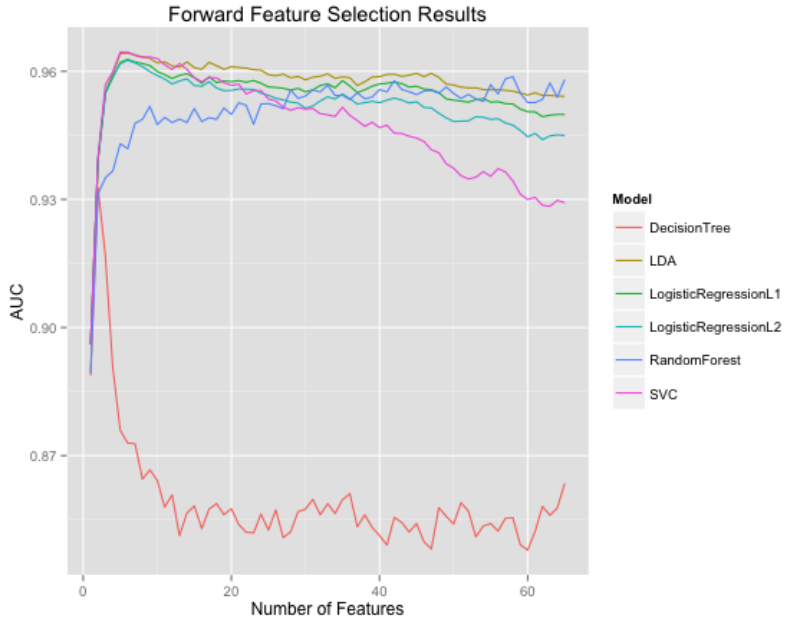


181 **165.181** Use of Machine Learning for Behavioral Distinction of Autism and ADHD

M. Duda[1], *R. Ma*[2], *N. Haber*[2] *and D. Wall*[3], *(1)Department of Pediatrics, Stanford University, Stanford, CA, (2)Pediatrics, Stanford University, Stanford, CA, (3)Stanford University, Palo Alto, CA*

Background: Though autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD) continue to rise in prevalence, together affecting >10% of today's pediatric population, the methods of diagnosis remain subjective, cumbersome and time intensive. Furthermore, considerable behavioral overlaps between the two disorders, including impulsivity and trouble with social interactions, can complicate differential diagnosis for clinicians. Methods to quickly and accurately assess risk for these, and other, developmental disorders are necessary to streamline the process of diagnosis and grant families access to much-needed therapies sooner.
Objectives: In light of our prior success in applying machine learning to gold-standard diagnostic tools distinguish ASD from non-ASD, we elected to apply similar methodology for the distinction of ASD and ADHD. The aims of this study were to determine 1) whether machine learning can be used to discern between autism and ADHD with high accuracy and 2) whether this distinction can be made using a small number of commonly measured behaviors.
Methods: Using forward feature selection, as well as undersampling and ten-fold cross validation, we trained and tested six machine learning models on complete 65-item Social Responsiveness Scale (SRS) score sheets from 2925 individuals with either ASD (n = 2775) or ADHD (n = 150).
Results: We found that only 6 of the 65 behaviors measured by the SRS were sufficient to distinguish ASD from ADHD with high accuracy (AUC = 0.964).
Conclusions: These results support our previously stated hypotheses, providing a method for accurate classification of ASD and ADHD with a minimal set of behavioral

features. This classification system shows promise for use as an electronically administered, caregiver-directed resource for preliminary risk evaluation and/or pre-clinical screening and triage that could help to speed the diagnosis of these disorders.



182 **165.182** Utility of the SCQ and RBS-R to Confirm Caseness of Adolescents and Adults in ASD Research

L. A. Pepa[1] *and V. Hus Bal*[2]*, (1)Center for Autism and the Developing Brain, Weill Cornell Medicine, White Plains, NY, (2)Department of Psychiatry, University of California San Francisco, San Francisco, CA*

Background: Better tools are needed to screen and diagnose adolescents and adults with ASD (IACC, 2013). The Autism Diagnostic Interview-Revised (ADI-R; Rutter et al., 2003a) may be useful to establish “caseness,” but is cost and time-intensive and often infeasible for parents of older individuals. Less is known about the predictive validity of the Social Communication Questionnaire Lifetime and Current forms (SCQ-L, SCQ-C; Rutter et al., 2003b) in older samples. The original SCQ validation (Berument et al., 1999) included individuals from 4-40 years, but did not report findings separately by age group. In a study of adults with ID, both SCQs yielded good sensitivity (79-89%), but low specificity (SCQ-C=66%; SCQ-L=48%; Sappok et al., 2015). No study has examined the predictive validity of the SCQ in adolescent or adult ASD samples spanning the full range of cognitive ability.
Objectives: This study aims to 1) compare sensitivity and specificity of the SCQ-L, SCQ-C and ADI-R and 2) assess whether combination with the Repetitive Behavior Scale-Revised (RBS-R; Bodfish et al., 2000) improves predictive validity.
Methods: Participants were drawn from a study focused on improving ASD diagnostic methods for adolescents and adults. Analyses included 49 individuals with diagnoses of ASD and 12 participants with non-ASD diagnoses (Age M=19.70, SD=3.43; NVIQ M=79.54, SD=32.57) who had an ADI-R, SCQ-C, SCQ-L and RBS-R completed at a single time point. ADI-R sensitivity and specificity were based on standard algorithm cutoffs and CPEA criteria (Lainhart et al., 2006); for both SCQ forms, cutoff=15. ROC analyses were used to derive cutoffs for SCQ-C, SCQ-L and RBS-R.
Results: For both groups, the SCQ showed moderate to strong correlations with the ADI-R and IQ. The ADI-R yielded the best balance of sensitivity (78-88%) and specificity (67-71%) using standard or CPEA criteria, respectively. The SCQ-L offered comparable sensitivity (76%), but poorer specificity (58%); a cutoff of 16 yielded somewhat better specificity (67%) without significant reduction in sensitivity (73%). In contrast, the SCQ-C yielded superior specificity (92%), but poor sensitivity (47%); lowering the cutoff to 13 reduced specificity (67%) and only improved sensitivity to 61%. Combining SCQ-L and SCQ-C did not improve predictive validity over either form alone. Although not intended as a screener, an RBS-R cut-off of 10 yielded results comparable to the SCQ-L (sensitivity=71%, specificity=58%). Requiring participants to meet on the SCQ-L or RBS-R provided the same balance of sensitivity (78%) and specificity (67%) as the standard ADI-R. Combining the SCQ-C and/or the RBS-R resulted in good specificity (>83%), but sensitivity remained below 62%.
Conclusions: Combining the SCQ-L and RBS-R yielded comparable sensitivity and specificity to the ADI-R, suggesting this combination may be a useful alternative to confirm “caseness” in adolescent and adult ASD research. In a sample of more diverse cognitive abilities, SCQ-C provided higher specificity, but lower sensitivity than studies of individuals with ID (Sappok et al., 2015); similar results with the SCQ-L were achieved, albeit with a lower cutoff. Future directions include replicating results in an independent sample and exploring whether combination with the ADOS further improves predictive validity.

Table 1
Correlations Between Demographic and Target Variables: ASD

	1	2	3	4	5	6	7	8
1. Age (Years)	-							
2. Verbal IQ	-.44	-						
3. Nonverbal IQ	-.64	.82**	-					
4. SCQ-C Total	.06	-.24	-.28**	-				
5. SCQ-L Total	.13	-.53**	-.48**	.57**	-			
6. ADI (A) Total	.09	-.60**	-.52**	.46**	.74**	-		
7. ADI (BNV) Total	.21	-.61**	-.56**	.45**	.79**	.67**	-	
8. ADI (C) Total	-.07	-.07	-.16	.44**	.55**	.49**	.32*	-

*p<.05, **p<.01

Table 2
Correlations Between Demographic and Target Variables: Non-ASD

	1	2	3	4	5	6	7	8
1. Age (Years)	-							
2. Verbal IQ	-.10	-						
3. Nonverbal IQ	-.22	.94**	-					
4. SCQ-C Total	-.41	-.61*	.73**	-				
5. SCQ-L Total	-.28	-.03	.05	.39	-			
6. ADI (A) Total	-.43	-.09	.05	.56	.59*	-		
7. ADI (BNV) Total	-.12	-.24	-.19	.28	.77**	.75**	-	
8. ADI (C) Total	-.51	-.01	-.05	.19	-.14	.23	-.04	-

*p<.05, **p<.01

183 **165.183** Validation of the Early Video-Guided Autism Screener (EVAS) in a Clinically-Referred Sample

J. Neely[1], *K. Sheperd*[2], *K. Boswell*[3] *and R. Landa*[1], *(1)The Kennedy Krieger Institute, Baltimore, MD, (2)Kennedy Krieger Institute, Center for Autism and Related Disorders, Baltimore, MD, (3)Kennedy Krieger Institute, Baltimore, MD*

Background: Although ASD can be detected as early as 14 months (e.g. Landa et al., 2007, 2013), the average age of diagnosis is four years (ADDM, 2014). The American Academy of Pediatrics (AAP) recommends universal screening at ages 18 and 24 months, though screening and referral practices are inconsistent due to cost, lack of staff training, and time needed for additional in-person evaluation. Access to a low-cost and efficient screening tool to promote further assessment can lead to earlier access to diagnosis and treatment. Existing ASD screeners have modest sensitivity and positive predictive value, and lack video examples of specific behaviors. Evidence is emerging that video guided examples of child development behaviors activate parents' evaluative thinking about their child's developmental well-being and may improve accuracy of parent report (Lievens et al., 2008; Marrus et al., 2015; Sices et al., 2008).

Objectives: The present study sought to validate the Early Video-guided Autism Screener (EVAS) in a clinically-referred sample. The EVAS is an innovative, accessible, and cost-efficient screener for children ages 18-48 months. The EVAS previously demonstrated strong sensitivity (SN), specificity (SP), positive predictive value (PPV), and negative predictive value (NPV) in a relatively small, but developmentally diverse sample (n=109). The present study will evaluate the previously derived EVAS cut-off score, and compare it with the gold-standard diagnostic tool the Autism Diagnostic Observation Schedule Second Edition (ADOS-2), and clinical best estimate (CBE) diagnoses.

Methods: A cut-off score of 53 was derived in a sample of 109 children with typical development (n=29), suspected developmental delays (n=15), suspected ASD (n=35), and diagnosed ASD (n=30) (Landa et al., 2014). The present sample included 170 children aged 18-48 months (mean age 2.75 years (.75 SD), 84.1% male, 55.9% Caucasian) clinically referred for ASD evaluation due to suspicion of ASD. All were administered the EVAS online as part of their clinic intake. The ADOS was completed during diagnostic evaluations. Examiners rated CBE following the evaluation. Most (74.1%) received an ASD diagnosis; 7.7% had CBE of 'at-risk for ASD'.
Results: The EVAS cut-off score for ASD risk of 53 was replicated resulting in moderate SN (84.1%; 95% CI: 78.6-89.6), SP (71.4%; 95% CI: 64.6-78.2), and strong PPV (98.6%; 95% CI: 96.8-100.4). Additionally, EVAS scores correlated moderately with the ADOS Toddler Module algorithm score ($n = 54$, $r = .29$, $p < .05$) and the Module 1 algorithm score ($n = 84$, $r = .24$, $p < .05$). The correlation between the EVAS and ADOS Module 2 algorithm score failed to reach significance ($n = 32$, $r = .32$, $p = .07$).
Conclusions: Results provide strong evidence of the criterion validity of the EVAS suggesting it could be a valid, efficient, and cost-effective tool for ASD screening in specialty clinic settings. This tool provides a convenient and efficient method for caregivers to consider the degree to which their child exhibits signs of ASD and may improve caregivers' communication about their child's behavior during diagnostic evaluations.

184 **165.184** Validation of the Electronic 2-Stage Modified Checklist for Autism in Toddlers, Revised, with Follow-up (M-CHAT-R/F)

D. L. Robins[1], *K. A. Haynes*[2], *R. K. Ramsey*[3] *and L. B. Adamson*[3], *(1)AJ Drexel Autism Institute, Drexel University, Philadelphia, PA, (2)Georgia State University, Atlanta, GA, (3)Psychology, Georgia State University, Atlanta, GA*

Background: Currently, the AAP recommends universal screening for ASD in toddlers. However, barriers have limited implementation, and median age of diagnosis remains after the fourth birthday (CDC, 2014). Simplifying procedures for administration and scoring of tools like the Modified Checklist for Autism in Toddlers, Revised, with Follow-Up (M-CHAT-R/F) may improve uptake and sustained use in community settings.
Objectives: Although the M-CHAT-R/F has been validated (Robins et al., 2014), it is important to examine validity when changing mode of delivery. The goal of the current study was to validate the adaptation of M-CHAT-R/F for electronic delivery.
Methods: Four private practices and one urban public clinic offered electronic M-CHAT-R/F screening during routine toddler check-ups at 18 and 24 months. Parents completed screening on a Chromebook in the office or using an at-home portal prior to the check-up. All participants completed consent, demographics, and the initial 20 M-CHAT-R items; when children scored in the moderate risk range (total score 3-7), the appropriate Follow-Up items were launched automatically during the same screening session. Follow-Up items were adapted for self-report by converting open-ended questions to forced-choice. Children who screened positive (initial score ≥8, or Follow-Up score ≥2) or had physician concerns about ASD were invited for diagnostic evaluation. The screening sample was divided based on clinic type, considering the effect of maternal education, which is a marker for socioeconomic status, on screening (e.g., Khowaja et al., 2015). The sample included 1719 children from private practices (49.2% male; 75.2% Caucasian, 10.6% African-American; 83.3% mothers had a college degree) and 687 children from an urban public clinic (53.4% male; 2.8% Caucasian, 88.1% African-American; 13.0% mothers had a college degree). Results were compared to published M-CHAT-R/F data (Robins et al., 2014), in which parents completed the initial M-CHAT-R on paper, and the Follow-Up via phone interview with research staff.
Results: The screen positive rate on the initial electronic M-CHAT-R was commensurate between the paper sample (7.2%) and the private practices (7.6%), but notably higher in the public clinic (14.7%). Drop-out at the Follow-Up stage was eradicated (1 family (<1%) failed to complete needed Follow-Up, compared to 18% dropout in the paper sample). A higher percentage of children who completed electronic Follow-Up continued to screen positive (4.3% private, 7.9% public) compared to phone Follow-Up (2.2%). The ASD detection rate was comparable across electronic and paper samples (7.9 and 6.7 per 1,000, respectively). Nineteen children were diagnosed with ASD (13 private; 6 public); 18 were detected by M-CHAT-R/F, one from physician concern.
Conclusions: Initial screen positive results are consistent across mode of delivery (electronic vs. paper), when participants using the electronic assessment in private practices were compared to published norms for the paper version. The elevated screen positive rate after Follow-Up using the electronic version may indicate differences in parent responses during an interview vs. on computer, interviewer deviation from the Follow-Up script, or differences in findings due to eradication of the dropout at the Follow-Up phase of screening. Commensurate ASD detection rate supports the validity of the electronic M-CHAT-R/F.

185 **165.185** Validity of Standardized Diagnostic Instruments for Autism Spectrum Disorders in Toddlers Recruited from a Population-Based Cohort: The Influence of Parental Concern

A. Havdahl[1,2,3], *S. L. Bishop*[4], *P. Suren*[3], *A. S. Oyen*[2,3], *C. Lord*[1], *A. Pickles*[5], *S. von Tetzchner*[6], *S. Schjolberg*[7], *N. Gunnes*[3], *M. Hornig*[8], *M. Bresnahan*[8], *W. I. Lipkin*[8], *E. Susser*[9], *P. Magnus*[3], *N. Stenberg*[10], *T. Reichborn-Kjennerud*[3,6] *and C. Stoltenberg*[3,11], *(1)Weill Cornell Medical College, White Plains, NY, (2)Lovisenberg Diaconal Hospital, Oslo, Norway, (3)Norwegian Institute of Public Health, Oslo, Norway, (4)Department of Psychiatry, University of California San Francisco, San Francisco, CA, (5)Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (6)University of Oslo, Oslo, Norway, (7)Mental Health, Norwegian Institute of Public Health, Oslo, Norway, (8)Columbia University, New York, NY, (9)Epidemiology and Psychiatry, Columbia University, New York, NY, (10)Oslo University Hospital, Oslo, Norway, (11)University of Bergen, Bergen, Norway*

Background:
Diagnostic instruments for autism spectrum disorders (ASD) have been validated primarily in samples of children referred to ASD specialty clinics for suspected ASD, and there is little information about the performance of these instruments when used with children identified in other ways.
Objectives:
This study examined the validity of widely used diagnostic instruments for ASD among toddlers recruited from a population-based study, and the influence of the identification route.
Methods:
Participants were 679 toddlers (age 35-47 months) who received multi-disciplinary diagnostic evaluations of ASD. We examined agreement of the Autism Diagnostic Interview-Revised (ADI-R) (Toddler algorithms) and the Autism Diagnostic Observation Schedule (ADOS) (ADOS-2 algorithms) with clinical best-estimate diagnoses. Receiver operating characteristic and logistic regression analyses were used to assess the diagnostic accuracy of the ADI-R and ADOS scores and cutoffs, and the additive value of combining the instruments. The analyses were carried out in the overall sample as well as for the comparison of toddlers identified based on 1) parental concern about ASD and 2) parent-reported behavioral signs of ASD (screening) *without* a specific concern about ASD.
Results:
The ADOS cutoffs showed consistently well-balanced sensitivity and specificity, whereas the ADI-R cutoffs missed a substantial proportion of toddlers ultimately diagnosed with ASD, especially among toddlers whose parents did not have a specific concern about ASD (43%). However, continuous scores from both the ADI-R and ADOS agreed well with clinical diagnoses (AUC=0.87-0.95), and contributed additively to their prediction ($p<0.001$). When applying modified ADI-R cutoffs, good balance between sensitivity and specificity was found also among toddlers without parental concern about ASD.
Conclusions:
The results underscore the utility of combining standardized instruments based on parental interview and clinician observation in diagnosing ASD. The established ADI-R cutoffs had low sensitivity among toddlers whose parents did not have a specific concern about ASD. Future studies should examine the utility of adjusting classification criteria on the ADI-R and other parental report-based ASD instruments to account for the influence of parental ASD concern.

Poster Session
166 - Epidemiology
5:30 PM - 7:00 PM - Hall A

186 **166.186** A Prospective Birth Cohort Study on Intra-Uterine Inflammation and Developmental Disabilities Including Autism Among Preterm- and Term- Born Children

M. Li[1], *M. D. Fallin*[2], *R. Landa*[3], *L. K. Hironaka*[4], *L. Sices*[4], *T. Stivers*[4], *D. M. Caruso*[5], *J. L. Kaczaniuk*[1], *C. Pearson*[4], *B. Zuckerman*[4] *and X. Wang*[6], *(1)Wendy Klag Center for Autism and Developmental Disabilities and Center on Early Life Origins of Disease, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (2)Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD, (3)The Kennedy Krieger Institute, Baltimore, MD, (4)The Boston University Medical Center, Boston, MA, (5)Center on the Early Life Origins of Disease, Department of Population, Family, Reproductive Health, JHBSPH, Baltimore, MD, (6)Center on Early Life Origins of Disease, Department of Population, Family, Reproductive Health, JHBSPH, Baltimore, MD*

Background: Maternal intra-uterine inflammation (IUI) is suspected to play a role in the development of autism spectrum disorder (ASD); limited epidemiologic evidence has linked indirect markers of IUI such as maternal infection and inflammatory cytokines with risk of ASD. However, the effect of IUI may not be specific to ASD, but general to any neurodevelopmental disorder. Studies on IUI and neurodevelopmental disorders mostly included children born extremely preterm; the effect of IUI among children born with longer gestation is unknown.
Objectives: Using a prospective birth cohort enriched by preterm birth, we sought to examine the effect of IUI, measured by clinical chorioamnionitis (CA), in combination with a range of gestational ages, in the development of ASD. We also included analyses on other developmental disorders (DD) in parallel to examine if the effects are specific to ASD or common across various DDs.

Methods: This study included 2359 children (87 ASD cases) with clinical CA data, a subset of the Boston Birth Cohort who completed at least one postnatal study visit at Boston Medical Center between 1998 and 2014. Cases of ASD, intellectual disabilities (ID), attention-deficit hyperactive disorder (ADHD) and other DD were identified based on ICD9 codes of physician diagnoses in electronic medical records. Gestational age was defined by an algorithm based on prenatal ultrasound before 20 weeks of gestation and date of last menstrual period. CA was identified if the mother and the child had at least two of the clinical signs and symptoms of CA. Using Cox proportional hazard regression model controlling for potential confounders, risk of each type of DD was compared among children with different gestational age and CA status.
Results: Controlling for gestational age, CA was associated with increased risk of ASD (Hazard Ratio: 1.9 [95% confidence interval: 1.0-3.6]) and ID (Hazard Ratio: 3.7 [95% confidence interval 2.1-6.4]), but not ADHD or other DD in children. Jointly, early preterm birth (less than 34 weeks of gestation) without and with CA were both associated with greatly increased risks of ASD (Hazard Ratio: 4.6 and 6.3) and ID (Hazard Ratio: 3.2 and 8.5), and moderately increased risks of ADHD (Hazard Ratio: 2.1 and 2.7) and other DD (Hazard Ratio: 1.7 and 3.0). Term birth with CA and late preterm birth (34 to 36 weeks of gestation) without CA were also significantly associated with increased risk of ID (Hazard ratio: 4.7 and 1.9), while late preterm birth with CA was significantly associated with increased risk of other DD (Hazard ratio 2.1).
Conclusions: This is the first prospective study on the effect of IUI on DDs across gestational ages. We found IUI to have heterogeneous associations with DDs independent of preterm birth: it is a risk factor for ASD and ID, but not ADHD and other DD. We also found IUI to be a risk factor for ID among term children.

Table 1. Independent associations of gestational age category and chorioamnionitis with developmental disorders

Characteristics	ASD (n=87) vs. TD (n=1439)			ID (n=76) vs. TD			ADHD (n=218) vs. TD			Other DD (n=442) vs. TD		
	HR	95% CI	p-value	HR	95% CI	p-value	HR	95% CI	p-value	HR	95% CI	p-value
Gestational age category												
Term birth	Ref			Ref			Ref			Ref		
Late PTB	1.40	(0.80, 2.48)	0.24	1.63	(0.92, 2.89)	0.097	1.20	(0.84, 1.73)	0.32	1.29	(1.01, 1.64)	0.042
Early PTB	4.37	(2.60, 7.36)	<0.001	2.88	(1.58, 5.24)	0.001	2.13	(1.49, 3.03)	<0.001	1.81	(1.38, 2.38)	<0.001
CA												
No CA	Ref			Ref			Ref			Ref		
CA	1.89	(0.99, 3.60)	0.05	3.57	(2.05, 6.23)	<0.001	1.19	(0.76, 1.86)	0.45	1.29	(0.94, 1.77)	0.12

Notes: The results were obtained from Cox Proportional Hazard regression models that include both gestational age category and CA, along with child sex, year of birth, maternal age, parity, obesity and diabetes status.
Abbreviations: HR=Hazard Ratio; ASD=Autism Spectrum Disorder; TD=Typically Developing; ID=Intellectual Disability; ADHD=Attention Deficit-Hyperactive Disorder; DD=Developmental Disorders; PTB=Preterm Birth; CA= Chorioamnionitis.

Table 2. Associations of the joint status of gestational age category and chorioamnionitis with developmental disorders

Characteristics	ASD (n=87) vs. TD (n=1439)			ID (n=76) vs. TD			ADHD (n=218) vs. TD			Other DD (n=442) vs. TD		
	HR	95% CI	p-value	HR	95% CI	p-value	HR	95% CI	p-value	HR	95% CI	p-value
Joint status of gestational age categories and CA												
Term birth w/o clinical CA	Ref			Ref			Ref			Ref		
Term birth w/ clinical CA	2.00	(0.88, 4.55)	0.10	4.68	(2.37, 9.26)	<0.001	1.24	(0.69, 2.22)	0.48	0.95	(0.59, 1.53)	0.83
Late PTB w/o clinical CA	1.38	(0.75, 2.54)	0.30	1.92	(1.02, 3.60)	0.042	1.24	(0.84, 1.81)	0.28	1.22	(0.94, 1.58)	0.14
Late PTB w/ clinical CA	3.17	(0.75, 13.45)	0.12	3.67	(0.86, 15.59)	0.078	1.19	(0.43, 3.27)	0.74	2.06	(1.17, 3.61)	0.012
Early PTB w/o clinical CA	4.56	(2.64, 7.90)	<0.001	3.27	(1.68, 6.38)	0.001	2.11	(1.44, 3.09)	<0.001	1.67	(1.24, 2.26)	0.001
Early PTB w/ clinical CA	6.25	(1.47, 26.63)	0.013	8.45	(2.51, 28.41)	<0.001	2.72	(1.17, 6.30)	0.020	3.04	(1.73, 5.32)	<0.001

Notes: The results were obtained from Cox Proportional Hazard regression models that include the joint status of gestational age categories and CA, along with child sex, year of birth, maternal age, parity, obesity and diabetes status.
Abbreviations: HR=Hazard Ratio; ASD=Autism Spectrum Disorder; TD=Typically Developing; ID=Intellectual Disability; ADHD=Attention Deficit-Hyperactive Disorder; DD=Developmental Disorders; PTB=Preterm Birth; CA= Chorioamnionitis.

187 **166.187** ASD Screening in Primary Care: 10 Years of the M-CHAT Program in Spain

*P. Garcia Primo[1], M. V. Martín Cilleros[2], M. Magan Maganto[2], B. Esteban Manjón[2], M. Posada[1], M. T. Sáez Martín[2], G. Bueno Carrera[2] and **R. Canal-Bedia**[2], (1)Carlos III National Health Institute, Madrid, Spain, (2)University of Salamanca, Salamanca, Spain*

Background: Great efforts have been put into developing methods for early identification of toddlers with autism spectrum disorder (ASD) (Zwaigenbaum et al 2015). Despite the recommendation from the American Academy of Pediatrics (AAP) to do population-based screening (first-level) for ASD (Johnson & Myers, 2007) applied specifically at least in two occasions to all children before two years of age, it has hardly been approached from the public health system (PHS) perspective. Moreover there is a need to validate the usage of standardized instruments as a cost-efficient strategy in the PHS.
Objectives: The main goal of this study is to evaluate the "M-CHAT and M-CHAT-R ASD Early Screening Program" in community settings, after 10 years ongoing in two regions of the North of Spain (Salamanca and Zamora), in terms of feasibility, reliability and costs with the purpose of extending the program at regional and national levels.
Methods: Parents of 18 months and/or 24 months aged children residing in the selected geographical area during the study period (October 2005-October 2015), were asked to fill the Spanish version of the M-CHAT (updated version M-CHAT/R since April 2014) at the outpatient health services (compulsory vaccination programme and well-child check-up programme respectively) by a professional working at any of the total 54 pediatric teams (nurses and pediatricians) of the PHS that received training and agreed to participate (every team in the area). Scripted phone follow-ups were performed for positive (failed) screens and, differential diagnosis was done following a standardized protocol, using Vineland, Merril-P and ADOS-G. A well stablished coordination with the ASD early intervention centres and the Hospital diagnosis units in the area served as surveillance for tracking false negatives of both provinces.
Results: A total of 17332 M-CHAT were administered considering both M-CHAT and M-CHAT/R Spanish versions. Out of the total, 1600 (9.2%) resulted as ASD high-risk, of which 156 (9.7%) were confirmed as positive with the follow-up interview. Out of these, 54 children received a diagnosis of any ASD and 88 other disorders of childhood onset according to DSM-IV . The 74% of the participant professionals felt the program was totally feasible and 22% felt it was viable but with reservations (n = 54). Lastly, false negatives surveillance system identified 8 ASD cases out of the total of screened children. These results show a sensitivity of 0.87, a specificity of 0.99 and a PPV of 0.38 for ASD cases in this screening program (PPV of 0.94 when considering other DD).
Conclusions: This study has been able to show for the first time in Spain, the feasibility of a long lasting ASD screening program within the PHS. The current findings suggest that training on social and communicative development and dissemination of ASD early signs among pediatric teams, besides the use of a standardized tool, is essential for progress in the early detection of these disorders. The feasibility of this program should be considered for future strategies regarding ASD early detection by Health Policy makers at international level.

188 **166.188** An Expanded Examination of Neonatal Cytokines and Chemokines As Predictors of Autism Risk: The Early Markers for Autism (EMA) Study

L. S. Heuer[1], *K. L. Jones[2], C. K. Yoshida[3], R. Hansen[4], O. Zerbo[3], P. Ashwood[5], L. A. Croen[3], J. Van de Water[6] and R. Yolken[7], (1)UC Davis, Davis, CA, (2)University of California at Davis, Sacramento, CA, (3)Division of Research, Kaiser Permanente, Oakland, CA, (4)Pediatrics and the MIND Institute, University of California Davis, Davis, CA, (5)UC Davis, Sacramento, CA, (6)University of California at Davis MIND Institute, Davis, CA, (7)Johns Hopkins, Baltimore, MD*

Background: Previous work by our group identified cytokines and chemokines (CyChs) in neonatal bloodspots as potential biomarkers for evaluating autism risk. Obtaining

an early biomarker is crucial to preventative medicine in autism spectrum disorder (ASD), allowing for earlier identification and earlier intervention, potentially leading to improved outcomes.
Objectives: Utilizing a more sensitive and expansive immunoassay, we aimed to expand upon our earlier findings in the characterization of newborn bloodspot profiles of CyChs in a larger sample population of children with autism spectrum disorders (ASD), children with developmental delay (DD) without ASD, and children considered to be typically developing.
Methods: Data are from the Early Markers for Autism (EMA) study, a population-based nested case control study that utilizes archived maternal mid-pregnancy and neonatal blood specimens from mother-baby pairs. Birth records were linked to the California Department of Developmental Services (DDS) client databases to identify children with ASD (N=370) and children with DD without ASD (N=140). General population controls (GP, N=378) were randomly selected from the remaining birth records, matched to ASD cases on child month and year of birth and gender. Final diagnostic status, based on DSM-IV-TR criteria, was determined by expert clinical review of abstracted diagnostic and clinical information in DDS client records. Newborn bloodspots were eluted and assayed for 42 different CyChs using a multiplex platform. CyChs that had significant non-detects or that remained non-normally distributed after natural log transformation were broken into quartiles. Comparisons of CyChs concentrations between groups were carried out on a cytokine by cytokine basis using a multivariate logistic regression models, adjusting for birth type (cesarean vs vaginal), gestational days at birth, age at time of newborn bloodspot collection, infant gender, birth weight, and birth season, as well as parental (maternal and paternal) age, education, race, and plate number to control for plate to plate variation. Normally distributed CyChs were subjected to a linear regression model incorporating the aforementioned covariates. The corresponding residuals from each CyCh were used in partial least squares discriminant analysis (PLS-DA), a multivariate approach to derive combinations of CyChs that would discriminate between cases and controls.
Results: Children with ASD had significantly increased neonatal levels of IL-4, IL-6, IL-8, IFN-g, and Eotaxin-1 compared to GP controls. In addition, children with ASD had significantly decreased levels of Eotaxin-1 and increased IL-12p70 levels relative to DD children. We observed no significant differences in CyChs levels between the DD and GP groups. After adjusting for multiple comparisons by FDR, all associations were no longer statistically significant. Furthermore, the PLS-DA multivariate approach did not identify any combinations of CyChs that discriminated between study groups.
Conclusions: Elevated levels of some cytokines and chemokines measured in newborn bloodspots indicated a higher level of immune activation at birth in children who were subsequently diagnosed with ASD. However, this expanded sample set was not sufficient to determine if the CyCh analytes noted herein will constitute reliable biomarkers of ASD risk, and thus should be repeated in future studies.

189 **166.189** Androgens and Neurodevelopmental Disorders: Maternal Polycystic Ovarian Syndrome As a Risk Factor for ASD and ADHD

R. M. Gardner[1], *L. Widman*[2], *C. Dalman*[3] *and K. Kosidou*[4], *(1)Tomtebodavagen 18A, Karolinska Institutet, Stockholm, Sweden, (2)Centre for Epidemiology and Community Medicine, Stockholm County Council, Stockholm, Sweden, (3)Karolinska Institutet, Stockholm, Sweden, (4)Department of Public Health Sciences, Karolinska Institutet, Stockholm, Sweden*

Background:
ASD and ADHD are neurodevelopmental disorders that are becoming increasingly common in childhood. The two conditions are highly co-morbid and are skewed by sex, with rates being considerably higher for boys. It may be that the two conditions share genetic and environmental risk factors. It has been hypothesized that ASD and ADHD are partially caused by prenatal androgen exposure. Recent evidence supports the hypothesis that fetal steroid exposure is associated with the risk of ASD.
Objectives:
We hypothesized that maternal polycystic ovary syndrome (PCOS), a condition associated with excess androgens, would increase the risk of ASD in the offspring. We furthermore tested whether risk attributable to PCOS is specific for ASD or if the condition is also associated with risk of ADHD.
Methods:
Here we compare the results of two matched case-control studies, for ASD and ADHD, both nested within the total population of Sweden (children aged 4-17 who were born in Sweden from 1984 to 2007). PCOS, ASD, and ADHD were defined from ICD codes through linkage to healthcare registers. Controls were matched by birth month and year, sex, and region of birth. Conditional logistic regression was used to evaluate the association between maternal diagnosis with PCOS and offspring outcomes.
Results:
We identified 23 748 ASD cases and 208 796 matched controls, as well as 58 938 ADHD cases and 504 983 matched controls. 16% of ADHD cases also had a diagnosis of ASD. Maternal PCOS increased the odds of ASD in the offspring by 59%, after adjustment for confounders (OR 1.59, 95% CI 1.34 – 1.88). However, maternal PCOS increased the odds of ADHD in offspring by 41% (OR 1.41, 1.26 – 1.58). After exclusion of the 16% of ADHD cases who also had a diagnosis of ASD, the OR for maternal PCOS was somewhat attenuated, though the association remained (OR 1.32, 1.17 – 1.51).
Conclusions:
These studies indicate that maternal PCOS is a risk factor for both ASD and ADHD, independent of co-morbidity between the disorders. Further studies are necessary to determine the mechanisms by which the metabolic and hormonal disturbances of maternal PCOS may influence fetal neurodevelopment.

190 **166.190** Antidepressants during Pregnancy and Autism Risk: Update from the Stockholm Youth Cohort

D. Rai[1], *B. Lee*[2], *C. Dalman*[3], *C. J. Newschaffer*[4], *G. Lewis*[5] *and C. Magnusson*[3], *(1)University of Bristol, Bristol, United Kingdom, (2)Drexel University, Philadelphia, PA, (3)Karolinska Institutet, Stockholm, Sweden, (4)A.J. Drexel Autism Institute, Philadelphia, PA, (5)UCL, London, United Kingdom*

Background: It is still uncertain whether exposure to antidepressants during fetal life is causally linked with autism spectrum disorders (ASD). All seven epidemiologic studies published to date found crude associations between antidepressant use during pregnancy and offspring ASD. However, there was evidence of confounding, raising concern that the observed association reflected the risk of autism due to the underlying condition for which the medications were prescribed. One study reported that the risk of ASD with antidepressant use during pregnancy attenuated after adjustment for maternal depression, but an association with attention deficit hyperactivity disorder (ADHD) persisted. Further research is required to establish whether these associations are causal in order to inform clinical guidance.
Objectives: To assess the association between maternal antidepressant use during pregnancy with offspring ASD (with and without intellectual disability), ADHD and intellectual disability; ii) to carry out analyses to strengthen causal inference, including using paternal antidepressant use during the period of pregnancy as negative control exposures, and propensity score matching methods to account for confounding by indication.
Methods: Cohort study using the subset of the Stockholm Youth Cohort born between 1 January 1996 and 31 December 2010 (n=414,105). Data on parental depression and other potential confounders were prospectively recorded before the birth of the child. The sample was divided into two sub-cohorts: first the children with data on maternal report of medication use collected at the first antenatal interview (cohort born between 1996 and 2004, n=194,466); and second those with information on parental antidepressant use extracted from prescription records using the national patient register (cohort born after 2006, n=135,189). Children born in 2005 were excluded due to lower quality coverage of medication use in the registers. A total of 4,184 ASD cases were identified within these sub-cohorts using multisource case-ascertainment. Cluster robust logistic regression was used for primary analysis.
Results: In both sub-cohorts, a maternal history of depression was associated with an increased risk of offspring ASD but this association was not present for paternal depression. Maternal use of antidepressants was associated with higher risk for ASD in both cohorts after adjustment for birth-year, sex, parity, parental ages, family income, parental country of birth, education and history of depression (adjusted OR sub-cohort 1: 2.07 (1.62, 2.65); OR for subcohort 2: 2.13 (1.24, 3.67)). A higher risk of ADHD was also observed with maternal antidepressant use during pregnancy in both cohorts (subcohort1: OR=1.89 (1.54, 2.33); subcohort2: OR=2.13 (1.01, 4.50)) after adjustment for the above covariates, but there was no heightened risk observed for individuals with intellectual disability. The negative control and propensity score matched analyses are underway.
Conclusions: The associations mirror previous findings of associations between antidepressant use during pregnancy and offspring ASD, and were observable using both maternal self report and prescription records data. The results of our ongoing analyses will be informative in relation to the causal meaning of these findings.

191 **166.191** Are Mothers of Children with Autism More Likely to Have Studied a STEM Degree? a Study of 2,000 Women

S. Baron-Cohen, *P. Smith and C. Allison, Autism Research Centre, University of Cambridge, Cambridge, United Kingdom*

Background:
Fathers and grandfathers of children with autism are more likely to work in the field of engineering, compared to fathers and grandfathers of typically developing children (Baron-Cohen et al, 1997, *Autism*). This is in line with higher rates of autism in geographical regions that have higher rates of people working in fields such as information technology, like Eindhoven in the Netherlands (Roelfsema et al, 2012, *JADD*). Such results are also consistent with the hyper-systemizing genetic theory of autism, which suggests that the genetics of autism overlaps with the genetics of strong systemizing talent. Mothers of children with autism in the San Fransisco Bay Area were more likely to work in STEM occupations (Windham et al, 2009, *Autism Research*). Mothers of children with autism also have elevated Systemizing Quotient scores (Grove et al, 2015, *BJP*) and faster/more accurate scores on the Embedded Figures Test of attention to detail (Baron-Cohen and Hammer, 1997, *J Cog Neurosci*). To date, no study has investigated the degrees that mothers of children with autism have studied, prior to having their child.
Objectives:
To test if mothers of children with autism were more likely to have studied (1) a Narrow STEM (science, technology, engineering, or mathematics) degree, and/or (2) a Broad STEM (e.g., linguistics, economics, and other systems-centred) degree, compared to mothers of typically developing children.
Methods:

We recruited 1,961 women, comprising 749 mothers of a child with autism, age 18-75 years old, registered at the online Cambridge Autism Research Database (CARD), and who had provided information about their degree type; and a control group of 1,212 age-matched mothers of a typically developing child who had registered at the online cambridgepsychology database, who had no family history of autism. All women selected their degree type from a drop-down menu of 180 degrees, and these were coded into Narrow STEM, Broad STEM, or Non-STEM, by two independent judges, with 100% agreement.
Results:
Of those women who had also completed the Autism Spectrum Quotient (AQ), mothers of children with autism scored higher than controls (p=0.0045), replicating earlier findings. A Chi Square test of Narrow STEM, Broad STEM, and Non-STEM degrees revealed that mothers of children with autism were more likely to have studied a STEM degree than mothers of typically developing children (Mothers of children with autism: 83%; mothers of typically developing children: 77.5%, Chi Square (1) = 8.84, p=0.003).
Conclusions:
This study is the first to show that mothers of children with autism are over-represented in STEM degrees in their graduate education. This association with risk of autism is likely to reflect both genetic factors (since maternal grandfathers are also over-represented in STEM) and prenatal epigenetic factors (since mothers of children with autism are more likely to have elevated endocrine conditions during pregnancy). Future research should test the genetic and epigenetic basis of this maternal group difference.

192 **166.192** Associations Between Exposure to Ambient Nitrogen Dioxide and Autism Spectrum Disorder in Israel: A Population-Based Nested Case-Control Study

R. Raz[1], *M. Weisskopf*[2], *D. M. Broday*[3], *Yuval*[3], *O. Pinto*[4] *and H. Levine*[1], *(1)Braun School of Public Health and Community Medicine, The Hebrew University of Jerusalem - Hadassah, Jerusalem, Israel, (2)Harvard School of Public Health, Boston, MA, (3)Faculty of Civil and Environmental Engineering, Technion, Israel Institute of Technology, Haifa, Israel, (4)Research and Planning Department, National Insurance of Israel, Jerusalem, Israel*

Background: Increasing evidence suggests that environmental exposures may contribute to risk of autism spectrum disorder (ASD). Several studies in the United States have suggested that perinatal air pollution exposure, and in some studies specifically traffic-related pollution, is associated with risk of ASD. Only two studies in Europe have examined this, but they did not see an association. However, those studies looked at autistic traits, or case status based on a traits scale cutoff, rather than clinically diagnosed ASD.
Objectives: To examine associations between various perinatal exposure periods to nitrogen dioxide (NO_2) - a marker of traffic-related pollution - and risk of ASD in the central coastal area of Israel.
Methods: We conducted a case-control study nested within the total population of children born in the central coastal region of Israel between the years 2005-2009. Children with ASD were identified from records of the Israel National Insurance Institute, which provides a service needs-independent financial benefit to families with children with expert physician-confirmed ASD. Our study sample included all children with ASD and a random sample of 20% of the children without ASD in the study area. Exposure was estimated by the new Optimized Dispersion Model (ODM), which takes into account output of a traffic allocation model (traffic volume and average speed per each road segment out of ~12,000 road segments) and half-hourly meteorological and air quality monitoring records from more than 20 monitoring stations distributed across the study area. The model calculates half-hourly NO_2 concentration estimates over the whole study area at 500X500m grid resolution. NO_2exposure was assigned to the children's home addresses based on their census tract at birth. We used generalized additive models with a binary outcome to estimate odds ratios (OR) and 95% confidence intervals (CI), adjusted for year and month of birth, child's sex, population group (Israeli Arabs / ultraorthodox Jews / general population), multiple births, parents immigration, census poverty index, paternal age, paternal wage, maternal age and maternal wage.
Results: The study sample included 2,098 children with ASD and 54,197 children without ASD. The median exposure for NO_2 during pregnancy was 16.8 ppb with an interquartile range (IQR) of 5.85 ppb. There was no indication of a non-linear association with NO_2 during pregnancy. The adjusted OR for ASD in the offspring per IQR NO_2 during pregnancy was 1.07 (95% CI: 0.99-1.17), with the 3rd trimester showing a stronger association (OR=1.10, 95% CI: 1.03-1.18) than the 1st trimester (OR=1.05, 95% CI: 0.98-1.12) and the 2nd trimester (OR=1.03, 95% CI: 0.96-1.10). Associations with exposure during the 1st and the 2nd years of life were slightly stronger (OR=1.10, 95% CI: 1.02-1.19 and OR=1.11, 95% CI: 1.03-1.20, respectively). Further adjustments for prematurity or gestational age at birth did not change the results.
Conclusions: Perinatal exposure to traffic-related air pollution in the central coastal area of Israel is associated with increased risk of autism, with stronger and significant associations observed for exposures beginning at the 3rd trimester.

193 **166.193** Autism Spectrum Disorder Administrative Prevalence in Texas School Children of Immigrant Parents

A. S. Dickerson[1] *and A. S. Dickerson*[2], *(1)Office of Research and Development, Environmental Protection Agency, Durham, NC, (2)Argosy University, Atlanta, GA*

Background: Texas is the second most populated state in the US and has the third highest foreign-born population. Although the etiology of autism spectrum disorder (ASD) is not well understood, migration and ethnicity have been implicated as possible risk factors. However, results from studies on associations between immigration and ASD diagnosis and prevalence have been conflicting.
Objectives: To (1) calculate administrative estimates of children from homes speaking 128 different languages enrolled in Texas schools systems (2) investigate differences in ASD administrative prevalence by comparing estimates for immigrant populations to that of English-speaking children with ASD in Texas school systems.
Methods: We conducted a cross-sectional study using data from educational records of children from pre-K to 12th grade ranging from age 3 to 22 years provided by the Texas Education Agency (TEA). Through a Public Information Request, the total number of children meeting eligibility to receive autism services from TEA was provided in aggregate form from the TEA Special Education Data Book. Additionally, TEA was able to provide cross referenced data on students who met autism eligibility criteria within 128 specific language groups based on reports from Home Language Surveys (HLS). ASD administrative prevalence estimates for Texas students were derived using the total number of children with an educational autism designation stratified by reported home language. Additionally, languages were grouped by primary geographic region and administrative prevalence estimates for geographic regions were calculated. Lastly, using 2 by 2 tables, relative risks and 95% confidence intervals were calculated for administrative estimates of these languages with English language as a reference.
Results: Data for 1225 Local Education Agencies (LAEs), showed that 100% of schools provided services to English-speaking children. Of these 89% also reported serving children whose home language was Spanish. There were approximately 35,555 children of from English-speaking households with an ASD educational designation, accounting for 81% of all children with an ASD designation. Of the 11,524 children from homes speaking Chinese languages, 129 had a TEA autism educational designation, making the estimated risk of ASD 37% higher for these children compared to children from English speaking households (RR=1.37; 95% CI: 1.19, 1.54). Furthermore, although risk of ASD education designation was significantly higher in children of families from West Africa (RR=3.53; 95% CI: 3.26, 3.80), East Africa (RR=2.05; 95% CI: 1.72, 2.37), and South Africa (RR=3.72; 95% CI: 2.76, 4.69), results were not significant for those from Central Africa (RR=1.33; 95% CI: 0.79, 1.87).
Conclusions: Studies of differences based on ethnicity and country of origin could yield results that will contribute to more knowledge on factors associated with receiving an ASD diagnosis. Additionally, social stigma and language barriers may reduce diagnosis and identification of immigrant children with ASD, suggesting that the increased administrative prevalence seen in our study may only be a small indicator of a potentially larger prevalence. The views expressed in this abstract are those of the author and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency.

194 **166.194** Combined Exposures to Prenatal Pesticides and Folic Acid Intake in Relation to Autism Spectrum Disorders

R. J. Schmidt[1], *V. Kogan*[2], *J. Shelton*[3], *L. Delwiche*[4], *R. Hansen*[5], *S. Ozonoff*[6], *D. J. Tancredi*[7], *I. Hertz-Picciotto*[8] *and H. E. Volk*[9], *(1)Public Health Sciences and the MIND Institute, University of California at Davis, Davis, CA, (2)3Departments of Preventive Medicine and Pediatrics, Zilkha Neurogenetic Institute, Keck School of Medicine, Children's Hospital Los Angeles, University of Southern California, Los Angeles, CA, (3)Public Health Sciences, University of California Davis, Davis, CA, (4)Public Health Sciences, University of California, Davis, Davis, CA, (5)Pediatrics and the MIND Institute, University of California Davis, Davis, CA, (6)UC Davis MIND Institute, Sacramento, CA, (7)Pediatrics, UC Davis School of Medicine, Sacramento, CA, (8)Dept of Public Health Sciences, School of Medicine, UC Davis MIND Institute, Davis, CA, (9)Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD*

Background:
Many pesticides are neurotoxic by design and some have been linked to autism spectrum disorder (ASD). Periconceptional folic acid (FA) is associated with reduced ASD risk. In animal studies, maternal FA provides protection from environmental chemicals with developmental toxicity.
Objectives:
We examined combined exposures to maternal FA and selected pesticides, both in-home and agricultural, in relation to ASD risk.
Methods:
California children aged 24-60 months enrolled in the CHARGE case-control study from 2003-2011 were clinically confirmed to have ASD (n=505) or typical development (n= 346). Maternal supplemental FA intake before and during pregnancy and indoor use of products containing pesticides were retrospectively collected by telephone interview. Agricultural pesticide exposure was determined by linking mothers' addresses shortly before, during, and after pregnancy to California's commercial Pesticide Use Reports using 1250 m buffers.
Results:
For all comparisons, the reference group was women with above-median FA intake (800+ µg) during the first pregnancy month and no pesticide exposure. ORs were adjusted for home ownership. Women with <800 µg FA intake and regular exposure (for 6+ pregnancy months) to indoor pesticides had children with elevated ASD risk (OR=5.1, 95% CI: 2.3-11.4). This was over twice that of those with 800+ µg FA and regular pesticide exposure (OR=2.3, 1.3-4.1). ORs for combined low maternal FA intake and any exposure to agricultural pesticides 3 months before or after conception were: 1.6 (0.6-4.4) for chlorpyrifos, 2.1 (1.0-4.4) for organophosphates, 1.9 (0.9-4.1) for

pyrethroids, and 2.1 (0.7-5.9) for carbamates. Except for carbamates, these ORs were larger than those for combinations of pesticide exposure with higher FA intake. All results were consistent with joint multiplicative or additive effects.
Conclusions:
Supplemental FA could potentially reduce the risk of ASD associated with pesticide exposure. Larger studies and research on potential mechanisms are warranted.

195 **166.195** Development and Validation of a Streamlined Autism Case Confirmation Approach for Use in Epidemiologic Risk Factor Research

C. J. Newschaffer[1], *E. Schriver*[1], *L. Berrigan*[2], *R. Landa*[3], *W. L. Stone*[4], *S. L. Bishop*[5], *A. Golden*[6], *L. V. Ibanez*[4], *A. Kuo*[7], *K. D. Lakes*[8], *D. S. Messinger*[9], *S. J. Paterson*[10] *and Z. Warren*[11], *(1)A.J. Drexel Autism Institute, Philadelphia, PA, (2)AJ Drexel Autism Institute, Philadelphia, PA, (3)The Kennedy Krieger Institute, Baltimore, MD, (4)Department of Psychology, University of Washington, Seattle, WA, (5)Department of Psychiatry, University of California San Francisco, San Francisco, CA, (6)Icahn Schol of Medicine at Mount Sinai, New York, NY, (7)Health Care Transitions Research Network for Autism Spectrum Disorders, Los Angeles, CA, (8)Pediatrics, University of California, Irvine, Irvine, CA, (9)Psychology, University of Miami, Coral Gables, FL, (10)Department of psychology, Temple university, Philadelphia, PA, (11)Vanderbilt University, Nashville, TN*

Background: The cost and effort associated with incorporating standardized observational assessments and diagnostic interviews in large-scale epidemiologic studies of autism spectrum disorders (ASD) risk factors can be substantial. More streamlined approaches for confirming ASD case status would benefit the implementation of these studies.
Objectives: To evaluate the performance of three streamlined ASD case confirmation approaches, alone and in combination, for potential application in large epidemiologic studies.
Methods: We conducted a multi-site, cross-sectional criterion validity study in a convenience sample of 388 three-year olds scheduled for neurodevelopmental evaluation that broadly represent children who would fail a stage 1 screen like the M-CHAT. ASD case classification as determined by a battery of three novel assessment instruments (the Early Video-guided Autism Screener E-VAS; the Autism Screening Interview, ASI; the Screening Tool for Autism in Toddlers Extended, STAT-E), each of which designed to be administered in less than 30 minutes by lay staff, was compared to case-classification based on the DSM-based diagnostic assessment from a qualified clinician. Sensitivity and specificity of each instrument alone and in combination were estimated. Order of instrument administration was randomly assigned. Alternative cutpoints were identified under different criteria and two-stage cross validation was used to avoid overfitting. Findings were interpreted in the context of a simulated prospective pregnancy cohort study seeking to estimate relative risks (RRs) of varying strengths for dichotomous exposures of varying prevalences using a two-stage case finding approach where the first stage would be a screener like the M-CHAT and the second stage would be case confirmation based on the instruments tested here. The bias introduced in RR estimation under different case-confirmation approaches was calculated, informed by the sensitivity and specificity estimates for each of the alternative approaches developed here.
Results: Under the instruments' initial recommended cutpoints, sensitivity ranged from 0.63 to 0.94 and specificity from 0.34 to 0.70. Alternative cutpoints that gave equal weight to sensitivity and specificity resulted in sensitivity estimates ranging from 0.56 to 0.84 and specificity ranging from 0.45 to 0.77. Additional sets of alternative cutpoints holding sensitivities at 50% resulted in specificities near 80%. And, while these were lower than the >80% for both sensitivity and specificity that comes with using ADOS and ADI-R in combination (Kim and Lord, 2012), this lower sensitivity and specificity had only modest effect on the extent of bias in dichotomous exposure RR estimates. Several strategies (including use of the direct observation STAT-E alone and the combined administration of the parent interview ASI and parent self-report E-VAS) resulted in performance suitable for application as a second stage case-confirmation tool in an epidemiologic study like that considered here.
Conclusions: Use of more streamlined methods of case-confirmation in large-scale prospective cohort epidemiologic investigations of ASD risk factors appears feasible.

196 **166.196** Development of an Automated Classification Algorithm for the Surveillance of Autism Spectrum Disorder

M. J. Maenner[1], *M. H. Yeargin-Allsopp*[1], *K. Van Naarden Braun*[2], *D. Christensen*[3] *and L. A. Schieve*[2], *(1)Centers for Disease Control and Prevention, Atlanta, GA, (2)National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention, Atlanta, GA, (3)Centers for Disease Control (CDC), Atlanta, GA*

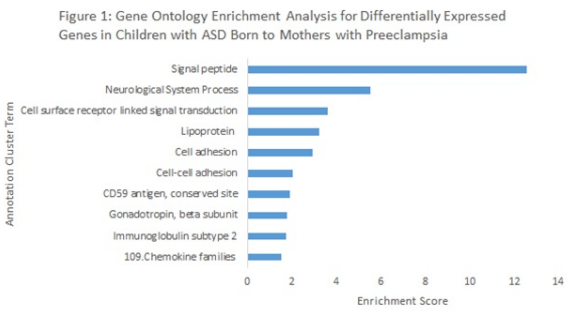
Background: The Autism and Developmental Disabilities Monitoring (ADDM) Network conducts population-based surveillance of autism spectrum disorder (ASD) among 8-year old children in multiple US sites. Each ADDM site collects special education records and/or medical records from providers who evaluate children for developmental problems. Information is abstracted from developmental evaluations that contain descriptions of behaviors consistent with ASD. Trained clinicians then review all abstracted evaluations to determine whether the child meets the ASD surveillance case criteria. The number of abstracted evaluations has dramatically increased since the year 2000, affecting the resources and timeliness of the surveillance system.
Objectives: To develop and evaluate a machine-learning classifier that predicts surveillance ASD case status using the words and phrases contained in children's developmental evaluations.
Methods: We used data from the 2008 metropolitan Atlanta ADDM site to create an algorithm that predicts whether a child meets ADDM ASD case status using words and phrases contained in the child's developmental evaluations. The sample comprised 1,162 children (including 601 meeting ADDM ASD case status) with a total of 5,396 developmental evaluations. Evaluations for each child were concatenated into a single file, and the text was processed to remove punctuation, remove the suffixes of words, and count the occurrence of all words and 2-3-word phrases. A random forest algorithm constructed 10,000 classification trees to identify the words and phrases that were informative for predicting ASD case status. We trained a second, "final", random forest classifier using only the informative words and phrases. We assessed the algorithm's performance by having it predict ASD case status for the records collected by the metropolitan Atlanta ADDM site for the 2010 surveillance year (1,450 children with 9,811 evaluations; 754 children met ADDM ASD case status). We compared the algorithm's predictions to the clinician-assigned case classifications. We also estimated ASD prevalence based on the algorithm's classifications.
Results: The algorithm predicted ASD case statuses that were 86.6% concordant with the clinician-determined case statuses (84.1% sensitivity, 89.4% predictive value positive). The area under the resulting receiver-operating characteristic curve was 0.932. The algorithm was more likely to disagree with the clinician ratings on records where the clinicians indicated greater uncertainty about the case classification. Algorithm-derived ASD "prevalence" for 2010 metropolitan Atlanta study area was 1.46% compared to the published (clinician-determined) estimate of 1.55%.
Conclusions: A machine-learning algorithm was able to discriminate between children that do and do not meet ASD surveillance criteria by using the text contained in developmental evaluations. The 86.6% algorithm-clinician agreement is somewhat lower than the 90.7% inter-clinician agreement observed for the 2010 ADDM Network. While there are many logistical issues to explore (such as whether performance would be similar at other ADDM sites), this approach has the potential to improve the efficiency of ASD surveillance. In addition, classification algorithms trained on the ADDM surveillance data may ultimately be useful to other studies or activities that seek to ascertain ASD from electronic information.

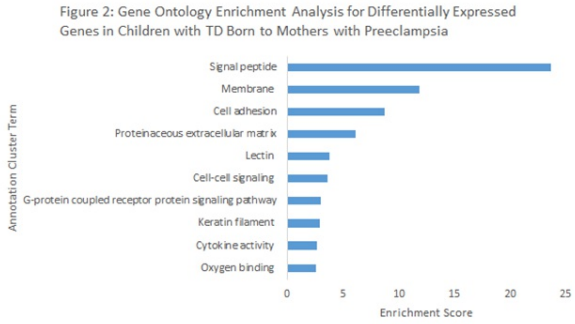
197 **166.197** Differential Gene Expression in Children with Autism Spectrum Disorder Born to Mothers with Preeclampsia

Y. Mukhtar[1], *I. Hertz-Picciotto*[2], *B. Durbin-Johnson*[3], *S. Letovsky*[4] *and C. Walker*[5], *(1)UC Davis MIND Institute, Sacramento, CA, (2)Dept of Public Health Sciences, School of Medicine, UC Davis MIND Institute, Davis, CA, (3)Public Health Sciences, School of Medicine, University of California, Davis, Davis, CA, (4)SynapDx Corp, Milton, MA, (5)University of California, Davis, Sacramento, CA*

Background:
While autism spectrum disorder (ASD) is one of the most heritable neurobehavioral conditions, the heterogeneity of ASD-concordant twins supports a role for alternative mechanisms in its etiology. Maternal physiology and environmental factors can modify gene expression in-utero independent of the genes inherited and thus can influence neurogenesis and brain development. Preeclampsia is a pregnancy condition associated with poor placentation, progressive maternal inflammation and insulin resistance, and increased odds for ASD. Global gene expression profiling of children with ASD may illuminate underlying metabolic and signaling alterations that may be relevant to the pathobiology of ASD.
Objectives:
1) To identify genes that are differentially expressed in children with ASD born to mothers with preeclampsia, and 2) To determine how preeclampsia expression profiles differ between children with ASD and typical development (TD).
Methods:
This study involved 2-5 year-old children enrolled in the CHildhood Autism Risk from Genetics and the Environment (CHARGE) population-based case-control study. Maternal preeclampsia diagnoses were abstracted from medical records. ASD diagnosis was confirmed with ADI-R and ADOS. Typically-developing controls were assessed using the Mullen Scales of Early Learning, Vineland Adaptive Behavior Scales, and Social Communications Questionnaire. RNA sequencing of peripheral blood obtained from child participants was performed on the Illumina HiSeq 2000 platform. Sequences that failed quality control or had fewer than 30 million reads were discarded, leaving 147 ASD and 70 TD samples. Reads were aligned to hg19 using Bowtie and converted to a counts table using HTSeq. To address differences in sequencing depth between samples, the counts table was normalized using binomial down-sampling. Within child diagnostic categories, we assessed whether presence of a preeclampsia diagnosis versus the absence of PE was associated with child gene expression using a negative binomial generalized linear model in the Bioconductor package edgeR with Benjamini-Hochberg FDR correction with adjustments for maternal education, child gender and ethnicity, and time from previous meal to blood draw. Gene ontological analyses were performed by the DAVID bioinformatics tool.
Results:

Hundreds of genes were differentially expressed in children exposed to preeclampsia in-utero. Ontological analyses performed on genes with a log2 fold change over 1 and under -1 indicated significant enrichment of pathways involved in nervous system development, immune function, and inflammation in children with ASD. While there was some overlap in children with TD exposed to maternal preeclampsia, interesting differences included enhancement of cell-cell signaling and oxygen binding pathways.
Conclusions:
Fetal exposure to maternal preeclampsia is associated with differential expression of many pathways. Heightened maternal systemic inflammation has been suggested as a possible factor influencing ASD susceptibility mediated through an oxidative stress response in the fetus. These processes may be enhanced by genes involved in immunity and inflammation in children with ASD and moderated by pathways involved in oxygen binding in children with TD. Exploration of these biological pathways and potentially-alterable upstream environmental gene influences may elucidate the complex interplay between maternal gestational environment and child gene expression in ASD etiology.





198 **166.198** Do Women with Polycystic Ovary Syndrome (PCOS) and Their Children Have Elevated Rates of Autism? an Electronic Health Records Study in the UK

A. Cherskov[1], *A. L. Pohl*[1], *C. Allison*[1], *R. A. Payne*[2] *and S. Baron-Cohen*[1], *(1)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (2)Primary Care Unit, Institute of Public Health, University of Cambridge, Cambridge, United Kingdom*

Background: Elevated levels of prenatal testosterone may increase the risk for autism spectrum conditions (autism). There is also an association between autism and polycystic ovarian syndrome (PCOS) in women with autism and mothers with a child with autism, although the extent of this association remains obscure. Given that PCOS is also associated with elevated prenatal and circulating testosterone, hyperandrogenism in PCOS may be implicated in the development of autistic traits in women with PCOS and their children.
Objectives: **1.** To examine the prevalence of autism in women with PCOS, and conversely, PCOS in women with autism. **2.** To calculate the odds of developing autism in first-born children of women with PCOS.
Methods: Using electronic health records obtained from the Clinical Practice Research Datalink (CPRD) in the UK, we conducted two matched case-control studies. **1.** We examined the prevalence and risk of PCOS in women with autism and vice versa in a sample of n = 791 and n = 22,263 women, respectively, compared to up to five times as many age and GP practice matched controls. Frequency tables were calculated and differences tested using Chi-Square Test for Proportions. **2.** We examined the risk of autism in first-born children of women with PCOS in a population of n = 8,611 children with mothers with PCOS matched to up to five times as many controls. Cases and controls were linked to mothers using the Mother-Baby Link within the CPRD. Controls were matched on gender, GP practice, and year of birth within ± two years. Two models adjusting for covariates were generated using conditional logistic regression. The first adjusted for maternal age, marital status, and maternal psychiatric diagnoses, while the second also included obstetric complications and metabolic conditions. Autism diagnoses were based on previously validated Read code lists (Fombonne et al., 2004; Smeeth et al., 2004). PCOS was defined according to Read code PCOS diagnoses (polycystic ovarian syndrome, C165.00, and Stein-Leventhal syndrome, C164.12), as well as by phenotypic parameters, where women with a PCO diagnosis, in addition to ovulatory dysfunction and/or hyperandrogenism, according to Rotterdam criteria, were included.
Results: **1.** We found significantly increased rates of PCOS in women with autism (2.3% vs. 1.1%, P = 0.006) and significantly elevated rates of autism in women with PCOS (0.23% compared with 0.09%, P < 0.001). **2.** The odds of having a child with autism for mothers with PCOS was also significantly increased, both in the unadjusted model and following adjustment for marital status, maternal psychiatric diagnoses, obstetric complications, and metabolic conditions (unadj. OR: 1.58, 95% CI: 1.27 – 1.98; adj. OR: 1.35, 95% CI: 1.06 – 1.71).
Conclusions: These two large-scale epidemiological studies present evidence that women with PCOS and their children have a greater prevalence of autism. Prenatal and maternal sex-steroids may be a potential source of this association.

199 **166.199** Does Breastfeeding Protect Against Autism? a Birth Cohort Study

G. Wellby[1], *J. Golding*[2], *A. L. Guyatt*[3], *A. M. Emond*[1] *and* ***D. Rai***[4], *(1)University of Bristol, Bristol, United Kingdom, (2)Centre for Child and Adolescent Health, University of Bristol, Bristol, United Kingdom, (3)University of Bristol, Bristol, United Kingdom of Great Britain and Northern Ireland, (4)University of Bristol, Bristol, England, United Kingdom*

Background: It is suggested that breastfeeding may protect against autism spectrum disorder. However, to date only a handful of epidemiological studies have examined this relationship and have reported inconsistent findings. All previous studies were based on retrospective maternal recall about breastfeeding, sometimes more than ten years after birth, which left them vulnerable to recall bias. In addition most studies did not make attempts to account for potential confounders.
Objectives: To study the associations between prospectively collected information on the intention, initiation and duration of breastfeeding and 1) a diagnosis of autism and 2) symptoms of autism in a large birth cohort study.
Methods: We used data from the Avon Longitudinal Study of Parents and Children (ALSPAC), a birth cohort study in England which recruited 14,541 pregnant women in the Bristol area who had an expected delivery date between April 1991 and December 1992, resulting in 14062 live births. We used prospectively collected data on the intention to breastfeed (collected at 32 weeks of pregnancy), and the initial and duration of breastfeeding (collected post partum at 6 and 15 months). Using these we classified these variables into no intention, less than one month, more than one month and uncertain from the beginning. Another binary variable was created for ever having breastfed versus never. Finally we used the age in months at which any breastfeeding was stopped, whether partial or exclusive, as a continuous measure of duration to test whether any associations might be cumulative. Cohort children with an ASD diagnosis were identified by record linkage with health and education records, or maternal report of having being told the child had autism (n=134). Symptoms suggestive of autism were ascertained by 4 scales that combine optimally within ALSPAC to predict ASD: the Children's Communication Checklist (coherence subscale), the Social and Communication Disorders Checklist, a repetitive behaviour measure, and the Emotionality, Activity and Sociability scale (sociability subscale). These measures were dichotomised, with approximately 10% defined on each scale as having highest autistic traits.
Results: There was no evidence for an association of ever being breastfed in relation to a diagnosis of autism (adjusted OR 1.12 [95% CI 0.64 to 1.95]) but some evidence of a protective effect on impairment in autism related measures of coherence (adjusted OR 0.73 [95% CI 0.51-0.91]) and sociability (adjusted OR 0.83 [95% CI 0.70-1.00]). Similar results were found in analyses on intention to breastfeed and the total duration of breastfeeding.
Conclusions: In this population-based prospective cohort study, we did not find evidence to support the hypothesis that breastfeeding protects against autism spectrum disorders. We did observe some associations between breastfeeding and lower scores on some autistic traits. Whether this is the result of residual confounding or a truly protective effect, and if so, the pathway of this relationship deserves further investigation.

200 **166.200** EU-AIMS Clinical Network: Building a Large Scale European Data Resource

J. E. Tillmann[1], *K. L. Ashwood*[2], *E. Loth*[3], *J. K. Buitelaar*[4], *D. G. Murphy*[5] *and T. Charman*[6], *(1)Institute of Psychiatry Psychology & Neuroscience, King's College London, London, United Kingdom, (2)Institute of Psychiatry, London, United Kingdom of Great Britain and Northern Ireland, (3)Institute of Psychiatry, King's College London, London, England, United Kingdom of Great Britain and Northern Ireland, (4)Radboud University Medical Centre, Nijmegen, Netherlands, (5)Sackler Institute for Translational Neurodevelopment, Department of Forensic and Neurodevelopmental Sciences,, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (6)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom*

Background: The complexity and heterogeneity of Autism Spectrum Disorder (ASD) makes it necessary to obtain large-scale samples which are difficult to acquire from one site alone. While North American networks such as the IAN (Interactive Autism Network) and ATN (Autism Treatment Network) are increasingly active in pooling data from multiple sites for informative analysis, similar large scale collaborative efforts have been largely neglected in Europe. In response, EU-AIMS (European Autism Interventions -

A Multicentre Study for Developing New Medications), a public-private consortium of leading research centres and industry, set up a unique platform to collaboratively pool European data. This will provide researchers with a resource to answer important questions about the prevalence, causes, and trends in the diagnosis and treatment of ASD, as well as boosting research capacity across Europe.
Objectives: A data sharing platform was set up to collect historical anonymous data from major ASD clinical and research institutions across Europe who are part of the EU-AIMS clinical network. This clinical network now includes 93 sites across 37 countries, giving unique access to a large and heterogeneous cohort of well-characterised ASD patients across different age groups, ability levels, countries and cultures.
Methods: Sites within the EU-AIMS clinical network were contacted to indicate their willingness to share phenotypic, behavioural, and cognitive data for secondary analysis. The pooled data includes information on demographic and clinical characteristics (e.g. sex, age, diagnosis, co-morbidity and ethnicity), as well as core autism symptomatology (e.g. ADI-R, ADOS, SRS, SCQ, AQ), IQ (e.g. WASI, WISC) and behavioural measures (e.g. VABS, CBCL). Item level data for each measure was collected where possible.
Results: Whilst data sharing with sites is still on-going, 20 sites situated in 9 different European countries have already completed the data sharing process. A total of 4118 individuals (males = 3220, females = 898) with a diagnosis of an ASD are currently in the database. Of those, 2226 are children (0-11 years), 1026 are adolescents (11-17 years), and 648 are adults. In addition, 672 individuals across all age groups (males = 344, females = 328) that did not meet a formal diagnosis of ASD are also characterised using these core measures.
Conclusions: Pooling datasets across European clinical and research sites as part of EU-AIMS will help to establish a valuable resource for ASD research in Europe. In the future, this resource will not only boost research capacity, but also improve transparency, openness and research efficiency of autism research in Europe.

201 **166.201** Food Selectivity and Taste/Smell Sensitivity in Children with Autism Spectrum Disorder

L. T. Chistol[1], *A. Must*[2], *S. M. Phillips*[2], *C. Curtin*[3] *and L. G. Bandini*[3,4], *(1)College of Health & Rehabilitation Sciences, Sargent College, Boston University, Boston, MA, (2)Public Health and Community Medicine, Tufts University School of Medicine, Boston, MA, (3)Eunice Kennedy Shriver Center, University of Massachusetts Medical School, Charlestown, MA, (4)Department of Health Sciences, Boston University, Boston, MA*

Background: Food selectivity is a common feeding problem in children with autism spectrum disorder (ASD) and is associated with increased risk of nutrient deficiencies. Children with ASD exhibit varying degrees of food selectivity, which may reflect differences in sensory processing, specifically taste/smell sensitivity (TSS). Studies on the association between atypical sensory characteristics and food selectivity in children with ASD compared to children without ASD are lacking.
Objectives: We compared the sensory profiles of children with and without ASD. Among children with ASD we further examined the association of TSS and food selectivity, as well as the relationship between TSS and fruit and vegetable repertoire.
Methods: The Children's Activity and Meal Patterns Study, a cross-sectional study conducted in 2007-2008, enrolled 53 children with ASD and 58 children without ASD, ages 3-11 years. Children's TSS scores were determined by parent-report on the Sensory Profile and analyzed as typical/atypical and as a continuous variable. TSS scores were derived from a subset of items from the oral sensitivity score and are equivalent to the TSS subset on the Short Sensory Profile. Food selectivity was operationalized as food refusal and limited food repertoire. Food refusal was assessed using a modified FFQ completed by one parent and expressed as the proportion of indicated foods refused by their child of those offered. Food repertoire, defined as the absolute number of unique foods and beverages the child consumed, was quantified from 3-day food records. Fruit and vegetable repertoire was determined by the number of unique fruits and vegetables consumed on the FFQ, which lists 13 fruits and 20 vegetables.
Results: Compared to children without ASD, children with ASD had significantly lower scores on all nine sensory factors of the Sensory Profile (all $p<0.05$), indicating atypical sensory characteristics. More children with ASD were classified as atypical on TSS compared to children without ASD (66% vs. 6%, $p<0.001$). Among children with ASD, TSS scores were significantly correlated with food refusal ($r=-0.67$, $p<0.001$), food repertoire ($r=0.33$, $p=0.03$), number of unique fruits consumed ($r=0.45$, $p<0.01$), and number of unique vegetables consumed ($r=0.55$, $p<0.001$). Compared to children with ASD classified as typical TSS, those atypical for TSS had significantly higher levels of food refusal (52% vs. 25%, $p<0.001$). In addition, the number of unique fruits (5.3 vs. 8.2, $p<0.01$), unique vegetables (4.2 vs. 8.9, $p<0.001$), and total food repertoire (17.9 vs. 20.7, $p=0.08$) were lower among children with ASD classified as atypical TSS compared to those typical for TSS.
Conclusions: More children with ASD present with atypical sensory characteristics compared to children without ASD. Atypical taste/smell sensitivity is associated with higher rates of food refusal and consumption of fewer unique fruits and vegetables. These findings suggest that children with ASD who have elevated taste/smell sensitivity may benefit from interventions to address their sensory challenges in order to increase food variety, to help ensure that they consume a diet that will meet their nutritional needs for growth and development.

202 **166.202** From Epi to Decisions: Use of Navigation Guide Systematic Review Methodology to Summarize the Evidence for Decision-Making

J. Lam[1], *P. Sutton*[1], *A. Halladay*[2], *A. Kalkbrenner*[3], *G. C. Windham*[4], *L. Davidson*[5], *C. Lawler*[6], *C. J. Newschaffer*[7], *N. Daniels*[1], *S. Sen*[8] *and T. Woodruff*[1], *(1)Program on Reproductive Health and the Environment, University of California, San Francisco, San Francisco, CA, (2)Autism Science Foundation, New York, NY, (3)University of Wisconsin-Milwaukee, Milwaukee, WI, (4)California Department of Public Health, Richmond, CA, (5)University of California at San Francisco, San Francisco, CA, (6)National Institute of Environmental Health Sciences, RTP, NC, (7)A.J. Drexel Autism Institute, Philadelphia, PA, (8)University of California, San Francisco, San Francisco, CA*

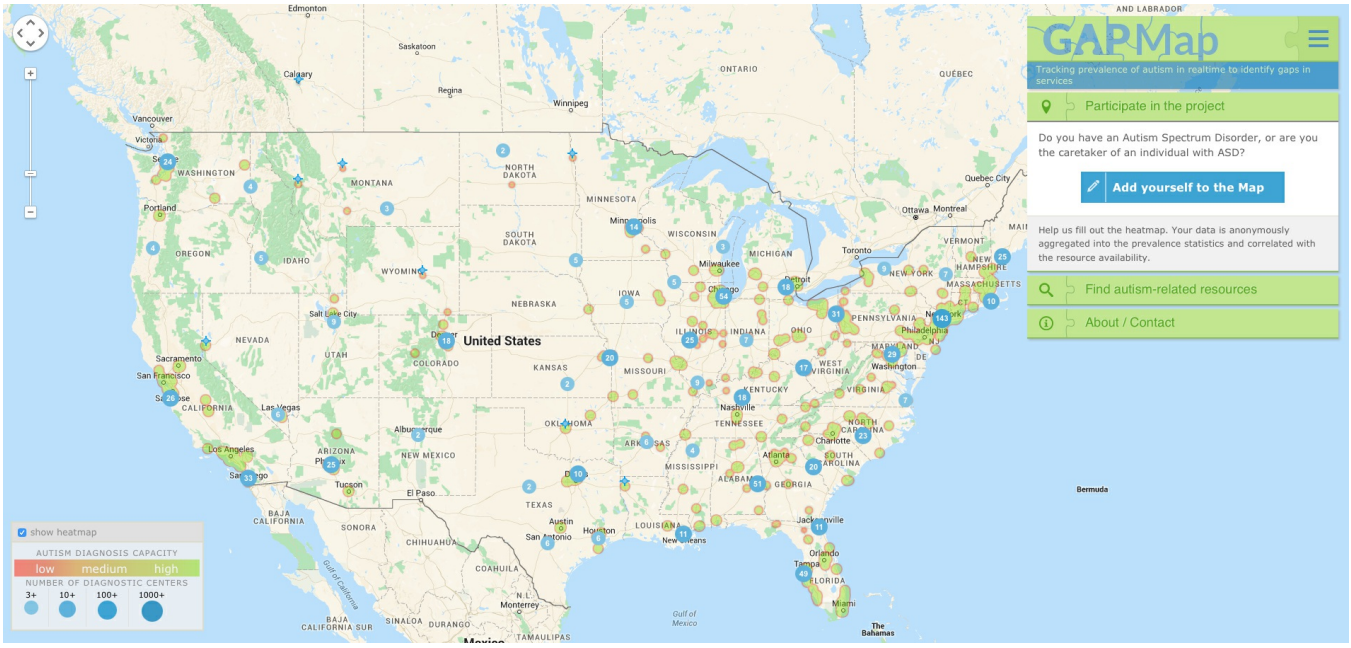
Background: Evaluating the toxicological and epidemiological literature and determining the quality and strength of evidence are critical for informing health and policy recommendations, including risk of air pollution to ASD. The Navigation Guide was developed through a collaboration of 22 clinicians and scientists to improve methods of research synthesis in environmental health. This systematic and transparent approach is modeled after best practices in evidence-based medicine but accounts for the differences in the evidence and decision context of environmental health.
Objectives: To support proof-of-concept of the method, we applied the Navigation Guide methodology to answer the question: Does developmental exposure to air pollution affect diagnosis of Autism Spectrum Disorder (ASD)? Our intent was to identify and evaluate the relevant body of evidence from human studies and come to a final bottom-line conclusion regarding the quality and strength of evidence to support our study question.
Methods: We gathered a panel of experts with expertise relevant to the study question, developed a protocol, conducted a systematic search of the epidemiology literature, and identified relevant studies using pre-specified criteria. Summary effect estimates from studies were synthesized both qualitatively and quantitatively. We adapted empirically-based clinical medicine quality and risk of bias tools to assess individual studies and to rate the quality and strength of the entire body of evidence for toxicity.
Results: We identified 23 relevant human studies. The human body of evidence was rated as "moderate" quality. Through this case study, we identified several challenges hindering the ease of integrating evidence from different sources of information. In particular, evaluating exposure assessment of air pollution was done using various methods and sources of data (for instance, monitoring, modeling, biomarkers, or a combination of several of these) and reliability of these methods may vary by chemical contaminant. As such, current tools available for evaluating the internal validity of individual studies (i.e., risk of bias) are insufficient for addressing these nuances. Therefore, as part of this case study we modified our current risk of bias tool in a novel attempt to address exposure assessment of air pollution. Furthermore, additional study design and reporting challenges were identified and addressed as potential hindrances to the integration of evidence from different epidemiology studies.
Conclusions: We concluded that there was moderate evidence from the human epidemiology evidence to support an association between developmental exposure to air pollution and diagnosis of ASD. This case study demonstrated that the Navigation Guide can be used to apply the rigor of systematic review methodology to reach actionable conclusions in environmental health decision-making. As part of this case study we also developed a novel risk of bias tool for evaluating the air pollution exposure measurement techniques as well as identified further research limitations potentially hindering the incorporation of epidemiology literature to decision making to protect the public.

203 **166.203** Gapmap: Enabling Comprehensive Autism Resource Epidemiology

D. Wall, ***J. Daniels*** *and N. Albert, Stanford University, Palo Alto, CA*

Background:
ASD has been attracting more interest recently as a result of skyrocketing prevalence rates of 1 in 68 children. Comprehensive regional autism prevalence rates would be extremely helpful for determining the true prevalence of autism and correlating genetic and environmental factors with higher standards of significance. In particular, comparing geographic trends in prevalence rates to autism resource epidemiology would be invaluable in invaluable in revealing patient care deficits. Finding these *resource gaps*, regions in which there exist limited diagnostic or treatment resources with respect to the demand, can back up pushes for congressional change with hard data, allocate resources more efficiently, and provide information to emerging organizations and businesses to let them know where their services are most needed. These efforts can help reduce the time to diagnosis and increase the chances that speech and behavioral therapies are started during critical periods when they are maximally impactful.
Objectives:
The specific aims of this study were to: 1) obtain an early approximation of the disconnect between autism resources and diagnosed individuals by determining the average distance between an individual with autism and the nearest diagnostic center, 2) define useful metrics that can be used to determine if a center is overloaded or if a region is underserved, and 3) create an online tool to collect information pertaining to geographic variations of autism prevalence and the geographic resource utilization of autism resources.
Methods:
The Wall Lab created an application, GAPMap, to collect locational, diagnostic, and resource use information from individuals with autism in order to compute accurate prevalence rates and better understand autism resource epidemiology. The metrics *resource load, resource gap,* and *resource availability* were defined to aid in this purpose, and estimates were calculated with limited datasets.

Results:
The average distance from an individual in the United States to the nearest diagnostic center is approximately 182 kilometers (50 miles), with a standard deviation of 235 kilometers (146 miles). The dataset for the United States was comprised of 47,622 individuals with autism and 840 developmental and diagnostic medical centers.
Conclusions:
While these analyses and metrics highlight the lack of resources in much of the United States and the overburdening of many centers, they are not enough. We have built GAPMap as a tool to collect important information and visually display the results. The collected location information, diagnosis, diagnostic tools, and co-morbid conditions will be used obtain both widespread and highly localizable autism prevalence rates. Date of diagnosis and age will be aggregated and used to obtain localizable average age of diagnosis, a measure that correlates with difficulty obtaining a diagnosis and can be used to help approximate geographic differences in resource accessibility. Ratings and local services will be used to estimate resource usage trends with respect to geography and resource density. Prevalence rates and local service usage will also be used to calculate resource load and availability for different resource types, such as behavioral therapy.



204 **166.204** Gestational Age and the Risk of Autism Spectrum Disorders: Findings from the Stockholm Youth Cohort

L. Xie[1], C. Magnusson[2], D. Rai[3], C. Dalman[2] and B. Lee[4], (1)Drexel University School of Public Health, Philadelphia, PA, (2)Karolinska Institutet, Stockholm, Sweden, (3)University of Bristol, Bristol, United Kingdom, (4)Drexel University, Philadelphia, PA

Background: The rising prevalence of autism spectrum disorders (ASD) is mainly driven by the increase in high-functioning ASD (i.e. ASD without intellectual disability (ID)). Gestational age at birth (GA) has been identified as a risk factor of ASD. However, the question of how the specific length of gestation might increase the risk of ASD remains unanswered.
Objectives: We investigated the relationship between GA and high- vs. low-functioning ASD, by quantifying the risk of ASD by each week of gestation in individuals with and without co-occurring ID.
Methods: A sample of 483,843 non-adopted, singleton live births between 1984 and 2007 was derived from the Stockholm Youth Cohort, a register-based cohort in Stockholm County, Sweden. Case status was ascertained using national and regional registers covering all pathways to ASD diagnosis and care in Stockholm County. A total of 9,325 ASD (2,319 ASD with ID, 7,006 ASD without ID) cases were included in the study sample. Splines in generalized additive models were used to model the non-linear relation of GA with ASD, adjusting for sex, birth year, parity, parental ages, gestational diabetes, gestational hypertension, maternal BMI at first antenatal visit, maternal history of depression, family income, maternal educational attainment and maternal country of origin.
Results: The prevalence of both high- and low-functioning ASD was increased in pre- and post-term births. There were approximately 17 individuals with ASD per 1,000 live births at term (GA = 40 weeks). This measure was 43 per 1,000 among very preterm births at 28 weeks of GA, and 25 per 1,000 among post-term births at 43 weeks of GA. The risk of high-functioning ASD monotonically decreased as GA increased. Odds ratios (95% confidence interval) of ASD without ID among those born at 28 and 43 weeks of GA was 2.0 (1.6–2.4) and 0.9 (0.9–1.0), respectively, compared to the risk of ASD in term births. On the other hand, the risk of low-functioning ASD was elevated in both pre- and post-term births. Odds ratios for co-occurring ASD and ID were 4.2 (3.0–5.9) and 1.3 (1.1–1.6) in infants born at 28 and 43 weeks of GA, with respect to the same referent group. Causal mediation analyses are underway to determine what factors may explain these observed associations.
Conclusions: We confirmed previous reports that both shortened and prolonged gestation were associated with higher risk of ASD and demonstrated that this relationship may be more complex than previously thought. In high-functioning ASD, each additional week of gestation lowers the risk incrementally, yet in a non-linear fashion. In low-functioning ASD, the risk associated with gestational length exhibits a U-shaped pattern. Our mediation analyses will elucidate how gestational length may play distinct roles on the causal pathways to ASD in the presence or absence of co-occurring ID.

205 **166.205** Hazardous Air Pollutants in Relation to Autism Diagnosis and Phenotype in a US Family-Based Study

***A. Kalkbrenner**[1], G. C. Windham[2], N. L. Lee[3], R. S. McConnell[4] and H. E. Volk[5], (1)University of Wisconsin-Milwaukee, Milwaukee, WI, (2)California Department of Public Health, Richmond, CA, (3)Drexel University School of Public Health, Philadelphia, PA, (4)Department of Preventive Medicine, Keck School of Medicine, University of Southern California, Los Angeles, CA, (5)Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD*

Background: Determining modifiable risk factors for Autism Spectrum Disorder (ASD) is important given the well-supported theory that autism results from genetic liability combined with exogenous exposures during brain development. Several studies have reported associations with perinatal exposure to hazardous air pollutants (HAPs), including some metals and volatile organic compounds.
Objectives: To expand the consideration to a larger set of HAPs across the US, and to explore whether prior findings hold in a family-based study design with information on autism phenotype and severity, we examined the association of perinatal HAP exposures with autism in a national study of multiplex families.
Methods: We determined the geographical location of the residence at birth for 1,873 participants (1,435 with ASD and 438 unaffected siblings) from the Autism Genetics Resource Exchange (AGRE) born 1994-2007 across the US, using self-reported residential history or computerized search of historical addresses. We assigned ambient concentrations of HAPs from an annual census-tract emissions-based model, the National-scale Air Toxics Assessment (NATA) from 1996, 1999, 2002, and 2005. We included 124 HAPs meeting our exposure variability criteria, linking to participants using census tract and closest birth year. We included 3 measures of autism: a broad ASD diagnosis based on report of autism, ASD, or PDD-NOS from the Autism Diagnostic Interview- Revised (ADI-R), a calibrated severity score created from individual items from the Autism Diagnostic Observation Schedule (ADOS) (range 1-10), and the total t-score of the Social Responsiveness Scale (SRS) (mean of 50) among all participants. For each HAP, we modeled an association across the interquartile range, using each individual's deviance from the family mean concentration, using hierarchical regression models (SAS hpmixed), including a family term to account for social and family factors and non-independence, family mean HAP concentration and birth year.
Results: Only a few associations between HAPs and autism measures had 95% confidence intervals (CIs) that indicated statistically significant associations: Protective associations with autism diagnosis included ethylene dibromide (odds ratio (OR)=0.5, CI: 0.3, 0.9) and ethylene dichloride (OR=0.4, CI: 0.2, 0.9). Elevated associations with higher SRS score included formaldehyde (+5.1 points, CI: 1.1, 9.0) and methylene chloride (+3.0 points, CI: 0.1, 5.8). Autism severity scores were elevated among children with ASD for chlorobenzene: (+0.3, CI: 0.0, 0.6). Other associations lacked statistical significance but showed consistent patterns across autism measures. For example, 1,1,1-trichloroethane (methyl chloroform) associations were elevated for all 3 measures of autism. Associations with benzene, carbon disulfide, methylene chloride, and propionaldehyde were elevated for the SRS and autism severity score. Protective associations for ethylene dibromide were found for autism diagnoses and the SRS score.
Conclusions: In these models, some HAPs showed associations with autism diagnosis and more severe autism phenotype. Chlorinated solvents were disproportionately represented among the positive associations, consistent with previous studies. Additional statistical approaches to these data, including accounting for the correlation

structure among pollutants, are planned. Although limited in statistical power and by multiple comparisons, this study combining environmental data with genetic repository data adds to the evidence suggesting that some HAPs may be ASD risk factors.

206 **166.206** Homogeneous Subgroups of Autism Spectrum Disorder Based on Behavioral, Developmental, and Medical Phenotypes

L. D. Wiggins[1], *W. Thompson*[2], *L. H. Tian*[2], *L. A. Schieve*[2], *J. L. Daniels*[3], *J. Pandey*[4], *L. C. Lee*[5], *C. E. Rice*[6], *S. Hepburn*[7], *R. Edmondson Pretzel*[8], *L. Blaskey*[4] *and S. E. Levy*[4], *(1)Centers for Disease Control and Prevention, Atlanta, GA, (2)National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention, Atlanta, GA, (3)University of North Carolina, Chapel Hill, NC, (4)Children's Hospital of Philadelphia, Philadelphia, PA, (5)Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (6)Emory Autism Center, Decatur, GA, (7)University of Colorado / JFK Partners, Aurora, CO, (8)Carolina Institute for Developmental Disabilities, University of North Carolina Chapel Hill, Carrboro, NC*

Background:
Autism spectrum disorder (ASD) is a complex developmental disorder characterized by deficits in social communication and interaction skills, and the presence of restricted interests and repetitive behaviors that manifest in early childhood. Children with ASD present with remarkable heterogeneity in symptom presentation that ranges from severe impairments that require substantial supports to less noticeable impairments that require fewer supports. Defining the phenotypic complexity among those with ASD may help elucidate distinct etiologies that contribute to symptom development.
Objectives:
The current study explores ASD subgroups based on behavioral, developmental, and medical phenotypes along the ASD continuum.
Methods:
The Study to Explore Early Development (SEED) is a case-control study designed to examine ASD phenotypes and etiologies. Children 2-5 years old were ascertained through birth certificate records and multiple sources that serve children with developmental problems. All children were screened for ASD upon enrollment. After an in-person developmental evaluation, children were classified into one of the following groups based on degree of ASD symptomology noted on the ASD screen and developmental assessments: ASD, developmental delay or disorder (DD) with ASD symptoms, DD without ASD symptoms, and population comparison.
Phenotypic characteristics and behaviors hypothesized to be associated with ASD were obtained via the Autism Diagnostic Observation Schedule, Mullen Scale of Early Learning (MSEL) and child's birth certificate record, and parent report on the Autism Diagnostic Interview – Revised, Child Behavior Checklist, Child Sleep Characteristics Questionnaire, Early Development Questionnaire, Gastrointestinal Questionnaire (created for SEED), Social Responsiveness Scale, and a structured interview that obtained information on demographics and health conditions previously diagnosed by a healthcare provider.
Subgrouping variables were identified via a multi-stage process. Members of the author group first reviewed subgrouping variables used in previous studies and discussed aspects of the ASD phenotype that best characterized children with ASD. Twenty seven variables were selected based on the literature review, clinical and epidemiological expertise, and availability of data in SEED. Subgroups of children with ASD were identified via latent class analysis.
Results:
There were 707 children classified as ASD and 305 children classified as DD with ASD symptoms included in the analyses. The sample was 79.9% male, and 54.8% White, 22.2% Black, 12.3% Multiracial, 5.1% Asian, and 5.6% other or unreported race. Children with ASD had a mean MSEL score of 66.9 whereas children defined as DD with ASD symptoms had a mean MSEL score of 79.0 ($p<.01$).
Data analyses, discussion, and interpretation are underway. Preliminary results reveal a 4-class model distinguished by phenotypic characteristics beyond MSEL scores (e.g., age at first social smile, aggressive and anxious behaviors, developmental regression, diet restrictions, emotional reactivity, repetitive behaviors, restricted interests, self-injurious behaviors, and somatic complaints). Detailed results will be available at the time of presentation.
Conclusions:
Due to its comprehensive data collection and inclusion of children with a range of ASD symptoms, SEED represents a distinct opportunity to explore ASD subgroups based on behavioral, developmental, and medical phenotypes. Consequently, the results of this study will likely inform future studies on the etiology, trajectory, and treatment of ASD.

207 **166.207** Injuries in Children with Autism Spectrum Disorder: Study to Explore Early Development (SEED)

C. G. DiGuiseppi[1], *S. E. Levy*[2], *G. N. Soke*[3], *S. Rosenberg*[4], *K. Sabourin*[5], *L. C. Lee*[6], *E. Moody*[5] *and L. A. Schieve*[7], *(1)University of Colorado Anschutz Medical Campus, Aurora, CO, (2)Children's Hospital of Philadelphia, Philadelphia, PA, (3)Centers for Disease Control and Prevention, Atlanta, GA, (4)University of Colorado Anschutz Medical Campus, Aurroa, CO, (5)University of Colorado Anschutz Medical Campus, Aurora, CO, (6)Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (7)National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention, Atlanta, GA*

Background: Studies examining injury risk among children with autism spectrum disorder (ASD) have shown conflicting results.
Objectives: We examined medically-treated injuries in children with ASD compared to population (POP) controls.
Methods: The Study to Explore Early Development (SEED) is a multi-site ASD case-control study of children aged 30-68 months. ASD cases (n=693) were determined using established ASD-specific diagnostic instruments. POP controls (n=882) were ascertained from birth certificates. Each child's primary caregiver reported if the child ever had a medically-treated injury, and described each such injury. Injuries resulting in an emergency department visit or hospitalization were defined as "serious." We determined the nature and cause of each child's first reported injury. Associations between ASD and having at least one medically-treated injury and at least one serious injury were examined using multivariable logistic regression models adjusted for child sex, age, and IQ; maternal race/ethnicity and education, and family income, with a random intercept for site.
Results: Among children with ASD, 33% ever had a medically-treated injury and 25% ever had a serious injury; the most commonly specified injuries were laceration (41%), fracture (22%) and abrasion/contusion (12%). Among POP children, 30% had a medically-treated injury and 22% a serious injury; the most commonly specified injuries were laceration (46%), fracture (23%) and dislocation/sprain (12%). In both groups, the cause most often specified was a fall (56%). ASD cases and POP controls did not differ in their odds of having a medically-treated injury (crude odds ratio [cOR] = 1.1 [95%CI: 0.9, 1.4]; adjusted OR [aOR] = 1.2 [0.9, 1.7]) or a serious injury (cOR = 1.1 [0.9, 1.4]; aOR = 1.2 [0.9, 1.6]).
Conclusions: Children with ASD and population control children had similar odds of having a medically-treated injury and having a serious injury. Sociodemographic and IQ differences did not influence these results. We plan to further explore and compare specific injury types and causes, and additional injury outcomes, between the two groups.

208 **166.208** Intellectual Disability Risk in Children Born to Women with Perinatal Psychiatric Diagnoses

ABSTRACT WITHDRAWN

Background: Recent studies suggest that up to 20% of women suffer from mood or anxiety disorders during pregnancy. Although there is evidence that psychiatric disorders are more common in mothers of children with intellectual disability (ID), few have assessed maternal mental health diagnosis while pregnant and the possible effect on a fetus.
Objectives: We investigated the extent to which maternal psychiatric diagnoses during pre- and peri-natal hospitalizations were associated with offspring ID in a large, socio-demographically diverse 18-year statewide birth cohort.
Methods: This retrospective cohort study linked hospital discharge records for 8,951,763 California singleton births occurring 1/1/91-12/31/08 from the office of Statewide Health Planning and Development with neurodevelopmental diagnostic and treatment service records from the Department of Developmental Services (DDS). Pre- or perinatal inpatient maternal psychiatric diagnoses - schizophrenia, bipolar disorder, major depressive disorder, dissociative and factitious disorders, somatoform disorder, dysthymic disorder, and depressive disorder-NOS - were culled from delivery discharge diagnoses via ICD-9 codes. DDS diagnosis of ID was the outcome in 53,000 children. Logistic regression models explored the relationship between maternal psychiatric disorders and ID adjusting for maternal education, race, country of birth, and parental age
Results: California children with ID were similar to those in other studies, with inflated risk for males, older parents, lower maternal education and Black race. In adjusted analysis, mothers diagnosed with *any* psychiatric condition during pregnancy – mood and anxiety disorders as well as schizophrenia – were 73% more likely compared to women without psychiatric conditions to have child diagnosed with ID (Figure 1). Mothers diagnosed with *each*specific individual psychiatric condition were 1.48- 2.39 times more likely to have a child with ID (Figure 2), with higher risk in women with psychoses than in those with anxiety and depressive disorders. The correlation between maternal mental health diagnoses and ID varied minimally by severity of ID, with more severe variants less common and confidence intervals widened, and was consistent across all categories of co-morbidity except for seizures (Figure 2). Compared to mothers without mental health issues, those with schizophrenia had a four-fold increased chance that their child's ID would be severe with an IQ of 25-40, and that the child would be diagnosed with cerebral palsy as well.
Conclusions: Women diagnosed with a psychiatric disorder during pregnancy were 73% more likely compared with women without such diagnoses to have a child diagnosed with ID. Mechanisms that may explain these associations involve genetic predisposition, maternal stress, fetal exposure to certain psychiatric medications, and variations in early formal and information support for the child. These findings emphasize the need for routine prenatal screening for psychiatric conditions and timely interventions directed to optimization of maternal wellbeing as well as fetal and early postnatal neurodevelopment. Further, these results underscore the need for targeted developmental monitoring of children born to women with psychiatric conditions to detect early signs of ID and implement early intervention at the earliest possible opportunity.

Figure 1)

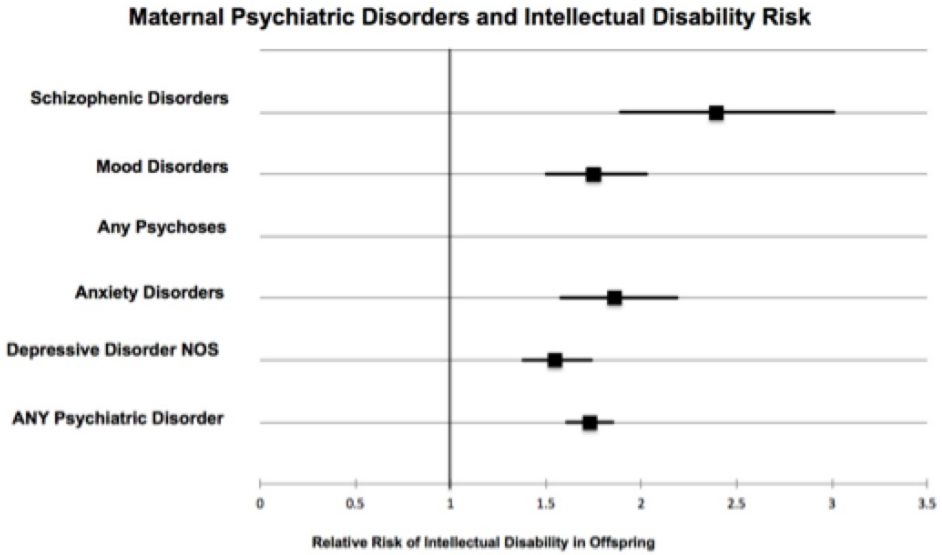
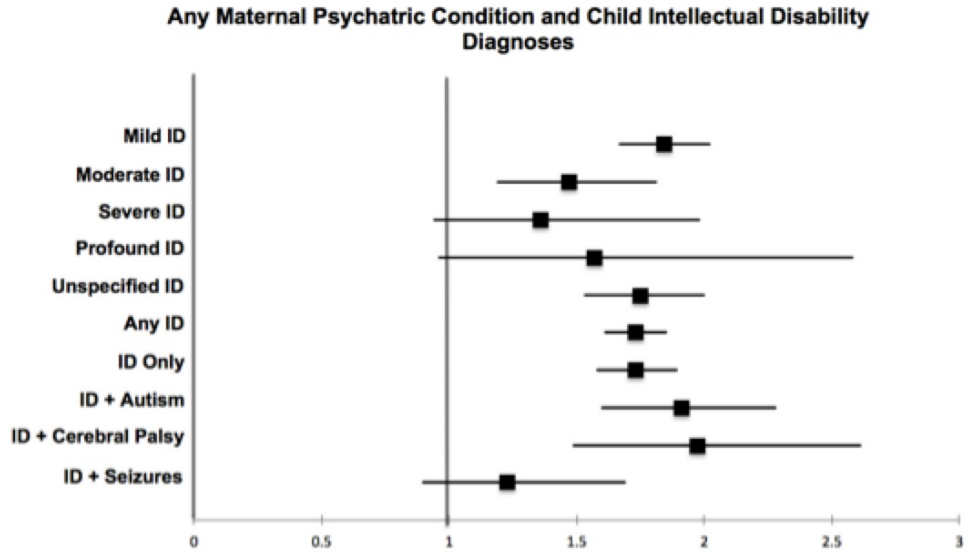


Figure 2)



209 **166.209** Investigating Prenatal Exposure to Groups of Air Toxics and Autism Spectrum Disorder Using Exploratory Factor Analysis

S. L. Stacy[1], *E. Talbott*[2] *and J. Rager*[3], *(1)Epidemiology, Brown University School of Public Health, Providence, RI, (2)University of Pittsburgh, Pittsburgh, PA, (3)University of Pittsburgh GSH, Pittsburgh, PA*

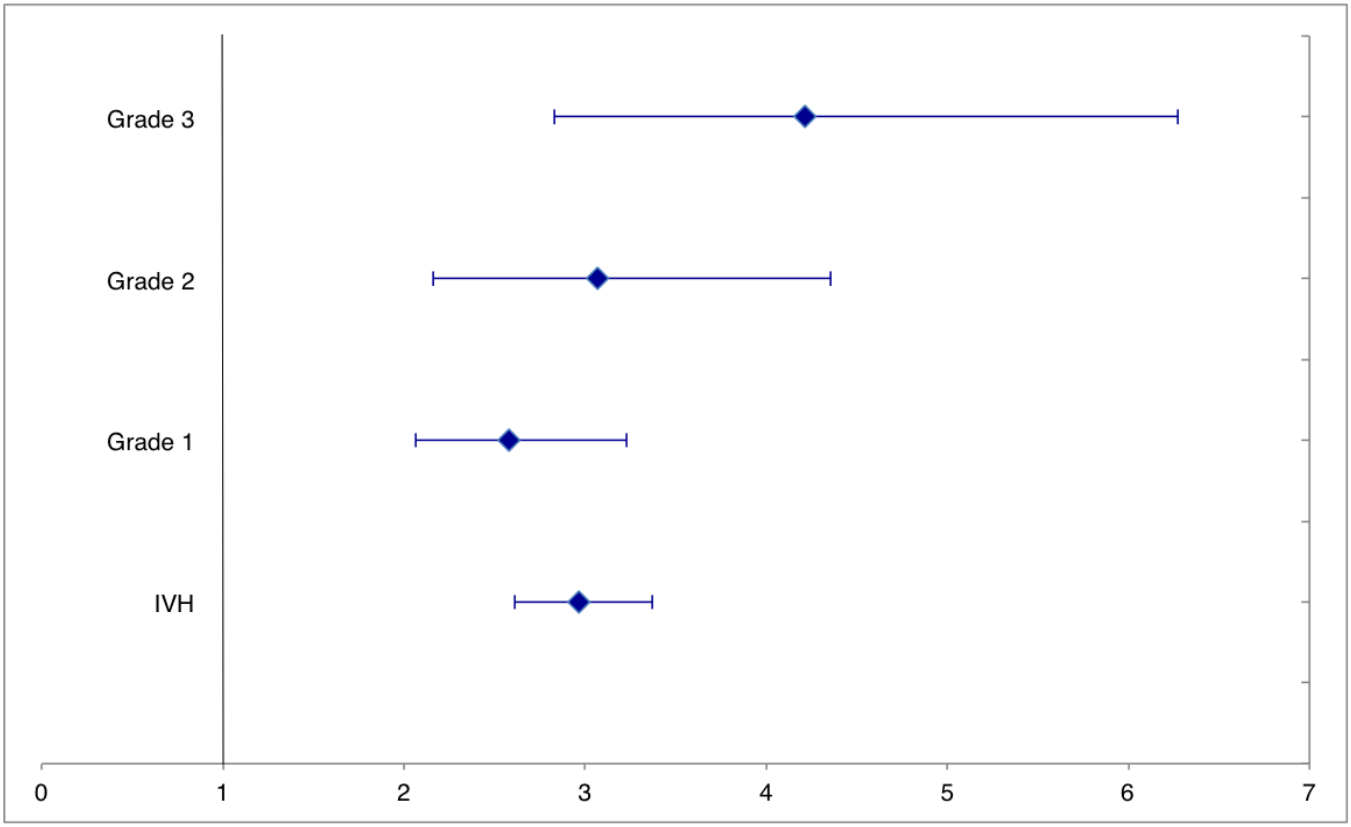
Background: Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by impaired social interaction and rigid behaviors and routines. The prevalence of ASD has increased markedly over the last several decades, motivating investigations into possible causes and risk factors. One area of interest is the role of groups of ambient air pollutants on the development of ASD.
Objectives: N/A
Methods: Estimates of 30 ambient air toxics from the 2005 National Air Toxics Assessment, modeled at the census tract level, were linked to 217 cases of ASD and 224 controls born in southwestern Pennsylvania from 2005 to 2009. An exploratory factor analysis (varimax rotation) was conducted to reduce these 30 pollutants to a set of key predictors. Factor scores were calculated using two methods: index scores based on sums of quartiles of exposure and least squares regression. These scores informed two sets of logistic regression models of ASD risk, adjusted for mother's age, race, education, smoking, child's year of birth and sex. The results of each method for calculating factor scores were compared.
Results: The air toxics loaded onto 7 main factors. Regardless of the method used to calculate the scores, the factors with the most elevated odds ratios appeared to represent traffic, combustion sources, and plastic and rubber manufacturing.
Conclusions: This type of approach can be used in future studies of ASD and environmental risk factors to identify groups of potentially harmful contaminants and pollution sources.

210 **166.210** Is Intraventricular Hemorrhage Associated with Autism?

M. B. Murphrey[1], *C. Walker*[2,3] *and G. Xing*[4], *(1)School of Medicine, Creighton University, Omaha, NE, (2)MIND Institute, University of California, Davis, Sacramento, CA, (3)Department of Obstetrics & Gynecology, University of California, Davis, Sacramento, CA, (4)Center for Healthcare Policy and Research, University of California, Davis, Davis, CA*

Background: Autism has been associated with perinatal cerebral white matter complications; however, many white matter diseases have yet to be studied. We examined the relationship between autism and intraventricular hemorrhage (IVH).
Objectives: To determine whether children whose neonatal course is complicated by IVH are more likely to develop autism, and whether the relationship is influenced by prematurity or gender.

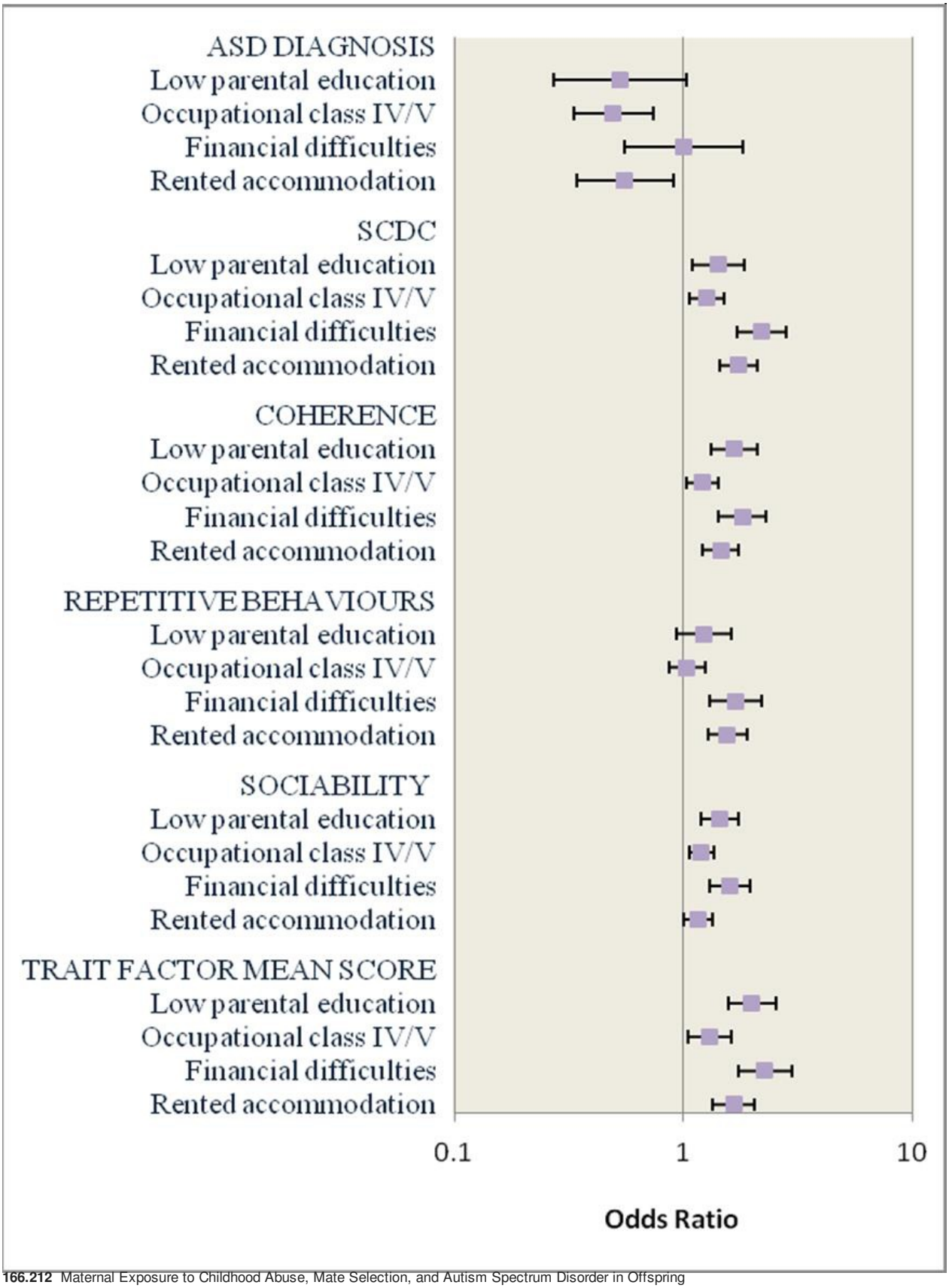
Methods: This retrospective cohort study includes births drawn from the Office of Statewide Health Planning and Development PDD-Birth files from 01/01/1991-12/31/2008 that survived their first year of life. Children diagnosed with autism between 1991 and 2012 by the California Department of Developmental Services (DDS) were identified (n=42,423). The remainder of the birth cohort served as controls (n= 8,909,340). ICD-9-CM codes for IVH were identified with grade sub-categories available from 2001. A step-wise linear regression evaluated the relationship between IVH and autism, controlling for maternal age, race/ethnicity, delivery payer and birth year. Preeclampsia and birth mode did not alter the relationship.
Results: IVH incidence was highest in infants with birthweight <1500 g or gestational age <31 weeks (16% and 20%, respectively). In adjusted analyses, children with IVH who survived their first year of life were 3 times more likely to develop autism (RR 2.97, 95% CI 2.61, 3.37). For those born in 2001-2008, the relative risk of autism increased proportional to severity for grades I-III (Figure 1). Girls with IVH were slightly more likely to develop autism compared with boys (RR 3.5,1, 95% CI 2.62, 4.71 vs RR 2.71, 95% CI 2.35, 3.13) and autism risk rose proportional to gestational age.
Conclusions: The 3-fold increased autism risk in children whose neonatal course was complicated by IVH is concerning, as are the paradoxical findings of increased autism risk in IVH-affected girls and infants born later in gestation. IVH screening in infants born <30 weeks and in others with elevated risk improves early therapeutic potential. Our results underscore the importance of ASD screening in children with IVH and present considerable opportunity for interventions aimed at maximizing neurocognitive development and functional attainment.



211 **166.211** Is 'Autism' a Socioeconomically Biased Diagnostic Label? a Birth Cohort Study

D. Rai[1], *A. M. Emond*[2], *G. Davey Smith*[3], *C. Magnusson*[4], *G. Lewis*[5] *and J. Golding*[6], *(1)University of Bristol, Bristol, England, United Kingdom, (2)University of Bristol, Bristol, United Kingdom, (3)MRC Integrative Epidemiology Unit, University of Bristol, Bristol, United Kingdom, (4)Karolinska Institutet, Stockholm, Sweden, (5)UCL, London, United Kingdom, (6)Centre for Child and Adolescent Health, University of Bristol, Bristol, United Kingdom*

Background: Epidemiologic studies, particularly in USA consistently report autism spectrum disorders (ASD) to be overrepresented in high socioeconomic status (SES) families. It has been argued that such associations are observed because high SES families may have better access to autism services for their child. At least one study also reported biases in the diagnostic labelling of autism by clinicians- with professionals preferring an autism diagnosis in children of high SES families, but preferring other diagnostic labels for children from low SES families with similar symptoms. Whether or not there is a socioeconomic bias in the diagnostic labelling of autism can be directly tested in studies which have information on the receipt of an autism diagnosis as well as symptoms suggestive of autism.
Objectives: To study the associations between measures of parental socioeconomic status (education, financial difficulties, tenure of accommodation and occupational class) and 1) a diagnosis of autism and 2) symptoms of autism
Methods: We used data from the Avon Longitudinal Study of Parents and Children (ALSPAC), a birth cohort study which recruited pregnant women in Bristol, England who had an expected delivery date between April 1991 and December 1992, resulting in 14062 live births. Cohort children with an ASD diagnosis were identified by record linkage with health and education records, or maternal report of having being told the child had autism (n=134). Symptoms suggestive of autism were measured using 4 scales that combine optimally within ALSPAC to predict ASD: the Children's Communication Checklist (coherence subscale), the Social and Communication Disorders Checklist, a repetitive behaviour measure, and the Emotionality, Activity and Sociability scale (sociability subscale). These measures were dichotomised, with approximately 10% defined on each scale as having highest autistic traits. To account for selective attrition, we also used an imputed measure of autistic traits derived from factor analysis, defining scores 2 standard deviations below the mean as having higher autistic symptoms. The measures of lower socioeconomic status we defined included: lowest or no educational qualification, financial difficulties, living in rented accommodation and having a manual occupation. We used logistic regression models to assess the relationship between each measure of low socioeconomic status and a diagnosis of autism and higher traits of autism. Models were mutually adjusted for the SES measures and for sex, parity and parental ages.
Results: Although some associations had wide confidence intervals, a consistent trend was observable in the results (see Figure). Children of parents of lower SES were more likely to have higher symptoms of autism, but appeared less likely to have received a diagnosis of autism.
Conclusions: These findings from a large birth cohort study indicate that there may be a socioeconomic bias in the diagnostic labelling of autism- those who appeared to have higher symptoms appeared least likely to receive a diagnosis. The implications of these findings will be discussed.



212 **166.212** Maternal Exposure to Childhood Abuse, Mate Selection, and Autism Spectrum Disorder in Offspring

A. L. Roberts[1], *K. Lyall*[2] *and M. Weisskopf*[3], *(1)401 Park Drive, Harvard School of Public Health, Boston, MA, (2)California Dept of Public Health, Richmond, CA, (3)Harvard School of Public Health, Boston, MA*

Background: Maternal experience of childhood abuse is associated with offspring ASD, but mechanisms are unknown. Biological effects of abuse are one possibility, and genetics is another. Prior research indicates that girls with autistic traits may be targeted for childhood abuse, inducing an association between maternal genetics and maternal experience of childhood abuse. Additionally, women who experienced abuse in childhood may select as mates men with high levels of autistic traits, and paternal autistic traits predispose to ASD in offspring. Experience of childhood abuse may be an indicator of genetic risk for ASD.
Objectives:
To examine possible reasons for the association between childhood abuse and ASD by addressing three questions: 1) Are women who experienced childhood abuse more likely to select mates with high levels of autistic traits? 2) If so, is this association independent of women's own autistic traits? 3) Is the association of maternal abuse and offspring ASD explained by parents' autistic traits?
Methods: A nested case-control study in the Nurses' Health Study II (N= 222 cases, N=854 controls). ASD based on maternal report, validated with the Autism Diagnostic Interview-Revised in a subset. Parental autistic traits assessed with the Social Responsiveness Scale (SRS). Odds ratios (OR) and 95% confidence intervals (CI) of paternal high autistic traits and ASD estimated with logistic regression.
Results:
Maternal childhood abuse was strongly associated with high paternal autistic traits (severe sexual abuse, OR=3.98, 95% CI=1.29, 12.27; severe physical/emotional abuse, OR=2.24, 95% CI=1.30, 3.88). Maternal childhood abuse predicted offspring ASD (severe combined abuse, RR=3.62, 95% CI=1.80, 7.28). Paternal autistic traits accounted

for 21% of the association between maternal childhood abuse and offspring risk of ASD (adjusted RR=2.97, 95% CI=1.45, 6.09).
Conclusions:
Childhood abuse may affect women's mate selection. At the same time, parental autistic traits alone do not account for the association of maternal childhood abuse with offspring ASD, as these explained only a small portion of the association of maternal abuse with offspring ASD.

213 **166.213** Maternal Metabolic Determinants of Neurodevelopmental Compromise

P. Krakowiak[1], *D. J. Tancredi*[2], *G. Xing*[3] *and C. Walker*[4], *(1)UC Davis, Sacramento, CA, (2)Pediatrics, UC Davis School of Medicine, Sacramento, CA, (3)Center for Healthcare Policy and Research, University of California, Davis, Davis, CA, (4)University of California, Davis, Sacramento, CA*

Background: A growing number of studies have shown associations between autism and intellectual disability (ID) and several conditions characterized by metabolic dysfunction, including obesity, gestational diabetes, and preeclampsia. Although these conditions often co-occur, few studies have explored combinations of metabolic conditions in relation to autism or ID risk.
Objectives: We studied the relationships between clusters of maternal metabolic risk factors to identify women whose metabolic dysfunction places them at greatest risk for autism and ID.
Methods: We used a large population-based cohort of California births from 1991 to 2008 with linked information on ASD and ID diagnosis from the California Department of Developmental Services. Diabetes (type 2, gestational) and hypertensive disorders (chronic and gestational hypertension, preeclampsia, eclampsia) were identified by ICD-9-CM codes. Prepregnancy body mass index (BMI) was calculated using maternal weight and height information from birth files (available for birth years 2007 and 2008 only) and then categorized into obese (BMI ≥30), overweight (BMI 25-29.9), and healthy weight (BMI <25). Combinations of MCs were based on the presumed level of metabolic disruption, with the highest level of disruption expected for T2DM with any hypertensive disorders (HTN/PE). We conducted log-binomial regression models adjusted for birth year, maternal age, race, delivery payer, and parity to estimate risk ratios (RR) and 95% confidence intervals (CI) using the entire cohort of 1991-2008 births and a subset of 2007-2008 births with BMI data.
Results: Women whose pregnancies were complicated by diabetes or hypertension were at highest risk for ASD relative to GP in the full cohort. Specifically, T2DM with HTN/PE was associated with a 52% increase in risk for ASD, followed by a 40% increase for T2DM without HTN/PE, and 37% increase for GDM with HTN/PE. Similarly, in our subset of 2007-2008 births, we observed varying magnitudes of association across combinations of MCs that included BMI categories compared to healthy weight without MCs. Mothers with T2DM irrespective of other MCs were at the highest risk for ASD, followed by GDM with either HTN/PE or obesity, and then PE with obesity. We did not find significant differences in risk for autism vs. ID in children born to mothers with diabetes or hypertension in the full cohort or our subset.
Conclusions: Our findings suggest that greater levels of metabolic disruption as evidenced by combinations of clinical diagnoses increase the risk of having a child with autism. Given that we did not observe differences in risk for autism relative to ID, the detrimental neurodevelopmental effects of metabolic disruption are not specific to autism alone.

	Autism vs. GP			
	crude RR	95% CI	adj RR*	95% CI
Metabolic conditions, any BMI (all birth years)				
No diabetes or hypertensive disorders [referent]	1.000	--	1.000	--
Preeclampsia, no diabetes	**1.356**	**1.299, 1.416**	**1.236**	**1.184, 1.291**
Chronic hypertension ± preeclampsia, no diabetes	**1.471**	**1.361, 1.591**	**1.185**	**1.096, 1.281**
Gestational diabetes, no hypertensive disorders	**1.474**	**1.414, 1.538**	**1.174**	**1.125, 1.225**
Gestational diabetes with hypertensive disorders	**1.863**	**1.681, 2.064**	**1.368**	**1.234, 1.516**
Type 2 diabetes, no hypertensive disorders	**1.564**	**1.391, 1.759**	**1.398**	**1.244, 1.572**
Type 2 diabetes with hypertensive disorders	**2.051**	**1.695, 2.481**	**1.520**	**1.257, 1.840**
Metabolic conditions with BMI (birth years 2007/08)				
BMI<25, no metabolic conditions [referent]	1.000	--	1.000	--
BMI 25-29.9, no metabolic conditions	**0.953**	**0.887, 1.024**	1.040	0.967, 1.119
BMI ≥30, no metabolic conditions	**1.167**	**1.080, 1.260**	**1.324**	**1.223, 1.434**
Preeclampsia, no diabetes, BMI <25	**1.304**	**1.083, 1.570**	**1.237**	**1.027, 1.490**
Preeclampsia, no diabetes, BMI 25-29.9	**1.292**	**1.030, 1.619**	**1.276**	**1.018, 1.600**
Preeclampsia, no diabetes, BMI ≥30	**1.378**	**1.111, 1.710**	**1.404**	**1.131, 1.742**
Chronic hypertension ± preeclampsia, no diabetes, any BMI	**1.399**	**1.155, 1.695**	**1.270**	**1.047, 1.540**
Gestational diabetes, no hypertensive disorders, BMI <25	**1.344**	**1.136, 1.590**	1.146	0.968, 1.358
Gestational diabetes, no hypertensive disorders, BMI 25-29.9	**1.310**	**1.087, 1.579**	**1.265**	**1.048, 1.527**
Gestational diabetes, no hypertensive disorders, BMI ≥30	**1.429**	**1.208, 1.691**	**1.477**	**1.246, 1.751**
Gestational diabetes with hypertensive disorders, any BMI	**1.633**	**1.297, 2.055**	**1.446**	**1.148, 1.822**
Type 2 diabetes, no hypertensive disorders, any BMI	**1.805**	**1.366, 2.385**	**1.769**	**1.338, 2.340**
Type 2 diabetes with hypertensive disorders, any BMI	**2.331**	**1.657, 3.278**	**2.068**	**1.469, 2.912**

*Adjusted for birth year, age, race, payer, and parity

214 **166.214** Maternal Pre-Pregnancy BMI and Pregnancy Weight Gain in Relation to Autism Spectrum Disorder (ASD) in Offspring

G. C. Windham[1], *M. Anderson*[2], *K. Lyall*[3], *J. L. Daniels*[4], *T. V. Kral*[5], *L. A. Croen*[6], *S. E. Levy*[7], *C. B. Bradley*[8], *L. Young*[9] *and L. A. Schieve*[10], *(1)California Department of Public Health, Richmond, CA, (2)Impact Assessment, Inc., Richmond, CA, (3)A.J. Drexel Autism Institute, Philadelphia, PA, (4)University of North Carolina, Chapel Hill, NC, (5)Biobehavioral Health Sciences, University of Pennsylvania School of Nursing, Philadelphia, PA, (6)Division of Research, Kaiser Permanente, Oakland, CA, (7)Children's Hospital of Philadelphia, Philadelphia, PA, (8)Epidemiology, University of North Carolina at Chapel Hill, Chapel Hill, NC, (9)School of Nursing, PA-SEED, CADDRE, Philadelphia, PA, (10)National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention, Atlanta, GA*

Background: A handful of studies have examined the relationship of maternal pre-pregnancy weight or body mass index (BMI) and weight gain during pregnancy to ASD in offspring, producing inconsistent results. Further examination is important for distinguishing associations and teasing apart potential mechanisms.
Objectives: Examine the relationship of maternal pre-pregnancy BMI and weight gain during pregnancy, as well as their combination, with a diagnosis of ASD in the offspring.
Methods: The Study to Explore Early Development (SEED) is a multi-site, case-control study of children born in 2003-2006 designed to characterize ASD and examine a variety of risk factors. Children were enrolled at ages 2-5 and classified based on pre-study diagnosis, a maternal screening questionnaire (SCQ), and in-person developmental evaluations of the child, into three study groups; 1) children with ASD (n=696), 2) children with other developmental delays (DD) (n=987), and 3) a population-based control group selected from birth certificates (POP) (n=887). Maternal height, pre-pregnancy weight, and gestational weight gain were obtained from maternal interview conducted 2-5 years post-partum, as measured weights were not available. Three primary weight "exposures" were examined: 1) Pre-pregnancy BMI classified as

underweight (<18.5 kg/m^2), normal weight (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2), and obese (≥30 kg/m^2). Weight gain assessed by 2) comparing upper and lower deciles to the middle 60%, and by 3) a combined variable using IOM/ACOG weight-gain-by-initial BMI recommendations, which are categorized as "Below", "Meets" or "Exceeds" recommendations. Chi-square values were used to assess the distributions across the study groups. Odds ratios adjusting (AOR) for maternal age, race/ethnicity, education, and parity were calculated by multivariable logistic regression models for these weight variables separately, comparing the ASD or DD groups to the POP group.
Results: The distribution of all three maternal weight variables varied significantly across study groups; about 19% of mothers of children with ASD or DD were obese pre-pregnancy, compared to 13% of POP mothers (p<0.001), and more mothers of children with ASD exceeded IOM weight gain recommendations (47%) than DD or POP mothers (42%), while more mothers of DD children gained below recommendations (21% vs. 16% of ASD or POP) (p=0.006). After adjustment, associations for ASD vs. POP were not significant for maternal obesity (AOR 1.29, 95%CI 0.95-1.74), but were for weight gain in the upper decile (≥55 lbs.; AOR=1.57, 95%CI 1.10-2.24) and in the Exceeds IOM-recommended weight gain (AOR=1.27, 95%CI=1.01-1.61). Examining DD (vs. POP), maternal overweight and obesity were significantly associated after adjustment (AORs =1.37, 95%CI 1.08-1.73 and 1.50, 95%CI 1.14-1.98, respectively), but neither weight gain variable was significantly associated.
Conclusions: To our knowledge, ours is the first study of ASD to examine pregnancy weight gain categories taking pre-pregnancy BMI into account. Results indicate ASD was associated with such weight gain measures, but only marginally associated with maternal obesity, while DD was associated with both maternal obesity and overweight but not weight gain. Additional sensitivity analyses will determine whether differences persist. They might yield clues to the influence of timing of excess weight, which may affect neurodevelopment via metabolic/hormonal or immunologic pathways.

215 **166.215** Oral Health and Dental Needs in Adolescents with ASD: An Italian Study

E. Grossi[1], *M. Gangale*[2], *C. Sciessere*[2], *D. R. Dunca*[1] *and L. Levrini*[3], *(1)Autism Unit, Villa Santa Maria Institute Neuropsychiatric Rehabilitation Center, Tavernerio, Italy, (2)Research Centre Cranio Facial Disease and Medicine, School Dental Hygiene, University of Insubria, Como, Italy, (3)Research Centre Cranio Facial Disease and Medicine, School Dental Hygiene,University of Insubria, Como, Italy*

Background: There are few studies that investigate oral health and dental needs of children with autism. Many ASD subjects experience great difficulties in performing oral hygiene due to their limited manual dexterity, sensory and intellectual disabilities and thus are prone to poor oral health. Different studies conducted on caries prevalence and oral inflammation in ASDs have shown contradictory results. Some studies report lower caries prevalence in autistic children, however this finding seems somewhat surprising. To date, there are no studies addressing this phenomenon in Italy
Objectives:
The aim of this study is to determine the prevalence of caries and overall oral hygiene in ASD adolescents and compare them to adolescents belonging to the general population in Italy.
Methods:
Thirty one (26 male-5 female) adolescents with ASD with a mean age of 15. 35 years diagnosed according to DSM V and ADOS-2 criteria and treated at our Institute as permanent residents were selected for the study. . All subjects were checked by one examiner for oral hygiene status and dental caries while seated in a standard dental chair. The examiner used a standard dental mirror, an explorer and periodontal probe with William's markings. The examination of the soft and hard tissues was done under both a flash light and regular room light. The DMFT index was used, with codes and criteria established by the WHO. The gingival status, evaluated according to the gingival index of Loe and Silness, was then recorded as generalized or localized gingival inflammation, depending on the amount of gingival redness and bleeding during the examination.
Results:
Both teeth-brushing time and technique were incorrect in 31/31 and in 28/31 cases respectively. Gingival status was assessable in 30/31 cases and the DMFT index in 23/31 cases due to insufficient cooperation. Mean age and mean ADOS total score of cooperative and un-cooperative subjects was not statistically different (8.36 vs 8.28; 14.95 vs 16.5). In this subset, the overall prevalence of dental caries was 34.7% and the mean DMFT index was 1.43. The corresponding values in the general population control group (made up of 805 adolescents from the surrounding area) was 54.5% and 2.04 respectively. The difference in the carious prevalence and DFMT index was significant (p<0.05) between the two groups. The prevalence of moderate/severe gingivitis was 78.2%, with the corresponding value in the control group being 60%. In this case the difference was also statistically significant (p>0.05). However, there was no significant correlation between the ADOS severity total score and gingivitis degree (r = 0.10; NS)
Conclusions:
The oral hygiene status in autistic adolescents observed in this study is indeed poor, but does not appear to be directly correlated to autism severity. The prevalence of caries is in fact lower in ASD adolescents than in the general population. Further investigation is required to explain this rather counterintuitive finding.

216 **166.216** Population-Based Registries in Autism Research

D. E. Schendel*, Aarhus University, Aarhus, Denmark*

Background:
Understanding of the epidemiology of autism spectrum disorder (ASD) is benefited by eclectic approaches, study designs and data sources. Contributions to the ASD epidemiologic literature from studies based on Nordic and other population-based registries have increased in recent years, but the strengths and limitations of the registry approach is best understood in the broader context of epidemiologic studies over all.
Objectives:
Describe the population-based registry approach in the broader context of ASD registries overall and illustrate the kinds of epidemiologic research gaps they can and cannot fill, with reference to published and ongoing studies.
Methods:
The objectives are achieved in three steps: 1) a general overview of registries, with specific ASD examples, and including a description of key epidemiologic features that distinguish the research utility of individual registries; 2) a description of epidemiologic characteristics of Nordic and other population-based registry systems; and 3) a description of select studies based on the Nordic and other population-based registry-system approach that have contributed to ASD epidemiologic questions, including geographic and temporal prevalence variation, quantitative studies of sources of variation in prevalence, mortality, perinatal risk, medical contact patterns during the years of transition from adolescent to adult care settings and multi-generation family morbidity patterns in association with ASD. Each example is described in terms of its registry-based design, results, strengths and limitations, highlighting both published findings and new findings in ongoing studies.
Results:
Registries are widely used in ASD research and service provision but their research utility varies depending on the source of new cases, mechanism of inclusion of new cases and data collection. The limitations of individual registries have been mitigated, in part, in the Nordic and other countries by the creation of registry systems. Multiple, single data bases containing limited individual data are linked together using stable unique identifiers to create research data sets that greatly expand the available data per individual. Rigorous data harmonization and data federation approaches have been applied to further expand the research utility of individual national- or state-level registry systems. Registry-system studies have documented geographic and temporal ASD prevalence trends based on harmonized data analyses; quantified effects of systematic registry data collection changes on observed ASD prevalence trends; and elucidated ASD mortality risks considering comorbidity, fine-grained patterns of common perinatal risks, medical contact perturbations during the transition years, and family-wide morbidity patterns that may reflect heritable ASD risk from underlying liability across other morbidities.
Conclusions:
Registry-systems have limited data breadth and complexity, however, their robust sample sizes, population representativeness and time depth make them well suited to derive reliable patterns of risk from routinely collected factors, against which results from smaller studies with more in depth, sophisticated data collection can be calibrated.

217 **166.217** Prebiotic and Probiotic Consumption during Pregnancy and Autism Observational Scale for Infants (AOSI) Score at 12-Months in the Early Autism Risk Longitudinal Investigation (EARLI)

C. Holingue[1], *L. A. Croen*[2], *I. Hertz-Picciotto*[3], *J. Pandey*[4], *C. J. Newschaffer*[5] *and M. D. Fallin*[6], *(1)Wendy Klag Center for Autism and Developmental Disabilities and Center on Early Life Origins of Disease, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (2)Division of Research, Kaiser Permanente, Oakland, CA, (3)Dept of Public Health Sciences, School of Medicine, UC Davis MIND Institute, Davis, CA, (4)Children's Hospital of Philadelphia, Philadelphia, PA, (5)A.J. Drexel Autism Institute, Philadelphia, PA, (6)Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD*

Background:
Children with Autism Spectrum Disorder often have co-occurring gastrointestinal symptoms and abnormalities. The microbiome has been suggested as an important driver or mediator of this co-morbidity. Research suggests that dysregulation of the microbiome can lead to behavioral changes as well as gastrointestinal symptoms. Probiotics are live bacteria and yeasts that are beneficial to the gut and overall health. Prebiotics are compounds that probiotics use for nutrition. In the framework of a dysregulated microbiome, a prebiotic and probiotic rich diet is theorized to improve gastrointestinal and behavioral symptoms. There is limited evidence that prebiotic/probiotic supplementation during pregnancy and the postnatal period may be beneficial for physical and mental health. However, little research has yet examined the association between prebiotic and probiotic consumption and development of behavioral symptoms in an autism cohort.
Objectives:
Our objective was to test the association between maternal prebiotic and probiotic consumption during pregnancy and child development performance at 12 months.

Methods:
In an ASD-enriched birth cohort, the Early Autism Risk Longitudinal Investigation (EARLI), pregnant mothers were interviewed about the frequency and amounts of eating/ingesting/consuming certain foods during the first half of pregnancy (weeks 1-20) and the second half of pregnancy (weeks 21 - birth+). Dietary questions regarding the following prebiotic or probiotic-rich foods were extracted from the data: oatmeal, bran, bananas, strawberries, cooked and raw greens, cabbage, beans, asparagus, onions, fresh tomatoes, rice or other cooked grains, whole-wheat bread, sourdough bread, tofu, tempeh and other soy products, yogurt, kefir, miso soup, pickles and pickled vegetables or fruit. For each of the 214 mothers, a score was created by taking the product of the frequency and amount of each food and summing across all foods (possible range: 0-2448). Child development was measured at 12 months via the Autism Observational Scale for Infants (AOSI), a measure shown to be correlated with later diagnosis of ASD. Linear regression was used to predict the effect of the maternal prebiotic/probiotic score on child 12-month AOSI score on the natural log scale.
Results:
Maternal pregnancy prebiotic/probiotic scores were available for 214 women, and ranged from 0 to 488 with a median of 139. The 12-month AOSI score ranged from 0 to 20 with a median of 4. The prebiotic/probiotic score was not significantly associated with child 12-month log AOSI score (effect estimate= 0.0006 for a 1 unit increase in the prebiotic/probiotic score, p-value=0.15, n=214).
Conclusions:
Maternal prebiotic/probiotic consumption during pregnancy was not significantly associated with 12-month AOSI performance in the child. However, further research is needed to further explore this question. Future analyses would benefit from a larger sample size and a more refined variable representing prebiotic and probiotic consumption.

218 **166.218** Predictors of Emergency Department Usage Among Children Ever Diagnosed with Autism Spectrum Disorder

L. I. Black *and B. Zablotsky, National Center for Health Statistics, Hyattsville, MD*

Background: Children with autism spectrum disorder (ASD) have high rates of healthcare utilization (Kogan et al., 2008), potentially a product of the high co-occurrence of ASD and other medical and psychiatric conditions (Levy et al., 2010). Many families of children with ASD have difficulty accessing specialty medical and related services (Warfield & Gulley, 2006) and may depend on emergency department services. Previous research has indicated an increased use of the emergency department for psychiatric crises (Kalb et al., 2012) and injury (McDermott, Zhou, & Mann, 2008) among children with ASD, but little is known about predictors of emergency department services. This study explores predictors and parent-reported reasons of emergency room (ER) visits among a national population of children with ASD.
Objectives: Compare the likelihood of any ER visits in the last year between children with and without ASD. Examine reported reasons for last ER visit.
Methods: Data come from the 2011-2014 National Health Interview Survey (NHIS). NHIS is a nationally representative household survey that collects data continuously throughout the year of the noninstitutionalized US population. Respondents (usually the parent) answer on behalf of one randomly selected child in the family. Children aged 2-17 years were included in this analysis (n=46,316), which included children ever diagnosed with ASD (n=689) and children never diagnosed with ASD (n=45,602). Estimates were calculated using SUDAAN to account for the NHIS complex sample design. Logistic regressions were used to examine the association between ASD and any ER visits in the past year. Model 0 was an unadjusted model, Model 1 adjusted for survey year, child and family demographics, and Model 2 additionally adjusted for co-occurring child conditions (seizures, food/digestive allergies, asthma, attention-deficit/hyperactivity disorder, frequent diarrhea/colitis), as well as survey year and demographics.
Among those who had any ER visits in the past year, parents endorsed multiple reasons (up to eight) for the child's most recent ER visit. Children were assigned to mutually exclusive categories summarizing their reason for their last ER visit; seriousness of the medical problem or access to healthcare. If a parent endorsed both a seriousness and access reason, the reason was coded as being due to the seriousness of the medical problem.
Results: Children ever diagnosed with ASD (23%) were significantly more likely than children without ASD (17%) to have had an ER visit in the past year ($p<0.05$) (Model 0). This association remained significant after adjusting for survey year and demographics (Model 1). However, after adjusting for co-occurring child conditions (Model 2) this association was no longer significant. Approximately 70% of parents of children ever diagnosed with ASD reported that the most recent ER visit was due to the seriousness of the medical problem and approximately 27% of parents reported reasons only related to healthcare access.
Conclusions: Differences between ER use of children with and without ASD may be explained by differences in the presence of co-occurring medical and psychiatric conditions. Parents of children with ASD were most likely to report their child's most recent ER visit was due to the seriousness of the medical problem.

219 **166.219** Prenatal Exposures As Measured By Routine Placental Histopathology in a Community Cohort of ASD

ABSTRACT WITHDRAWN

Background:
Autism Spectrum Disorder (ASD) is a set of neurodevelopmental disorders expressed in early life as stereotypic behaviors and language and social-emotional deficits. Exposure to inflammation and oxidative stress have each emerged as prenatal risk factors. These processes can be identified at birth in the baby's placenta by routine histologic methods.
Objectives: We will study a unique contemporary population based birth cohort for which placental examination was performed at birth for all newborns. Does histologic evidence of prenatal exposure to acute, chronic or both acute and chronic inflammation and evidence of maternal underperfusion of the placenta, a condition that may involve oxidative stress, correlate with subsequent ASD diagnosis?
Methods: Our case-control sample was drawn from a broad population based sample of nearly all births occurring at a large urban community based hospital (New York Methodist Hospital, NYMH) from 2007 to 2013, during which time there was universal placental examination of births at NYMH. Coupled with access to links to billing data for children who remain in the system for pediatric care has yielded a unique population based cohort with (currently) 55 population based cases (42 males, 13 females) and 199 controls (150 males, 49 females). Pathology diagnostic reports reviewed by a single observer at birth were extracted for coding of markers of AI, CI and maternal underperfusion as "present/absent". Conditional logistic regression accounted for our matched case-control design.
Results: As expected with matched data, there were no significant differences in genders or gestational ages between ASD cases and controls. There were substantial significant differences in several measures of inflammation between cases and controls. Placentas of cases were much more likely to have acute fetal chorionic vessel inflammation (23.6% cases vs. 6.5% controls; conditional logistic regression odds ratio (COR), 95% CI: 4.88, 1.99, 11.96). There was a higher risk of chronic inflammation as measured by uteroplacental chronic vasculitis in the placentas of cases (7.3% cases vs. 1.5% controls; COR, 95% CI: 6.36, 1.13, 35.90). There was also a higher risk of chronic choriodeciduitis but this difference was not statistically significant (p=0.14). Finally, the finding of histologic evidence of poor maternal perfusion (villous fibrosis, hypovascularity and Tenney-Parker changes of trophoblast (considered to reflect local hypoxia) was also much more likely in cases (7.3% cases vs. 0.5% controls; COR, 95% CI: 13.54, 1.51, 121.6).
Conclusions: Children who eventually are diagnosed with ASD have significantly more histologic placental evidence of prenatal exposures to both acute and chronic inflammation, and features that are typically attributed to chronic maternal perfusion pathology and oxidative stress. These diagnoses are gleaned from routine histopathology slide preparations that can be performed in any hospital laboratory. These findings may point to a universally available and inexpensive screen for ASD risk at birth.

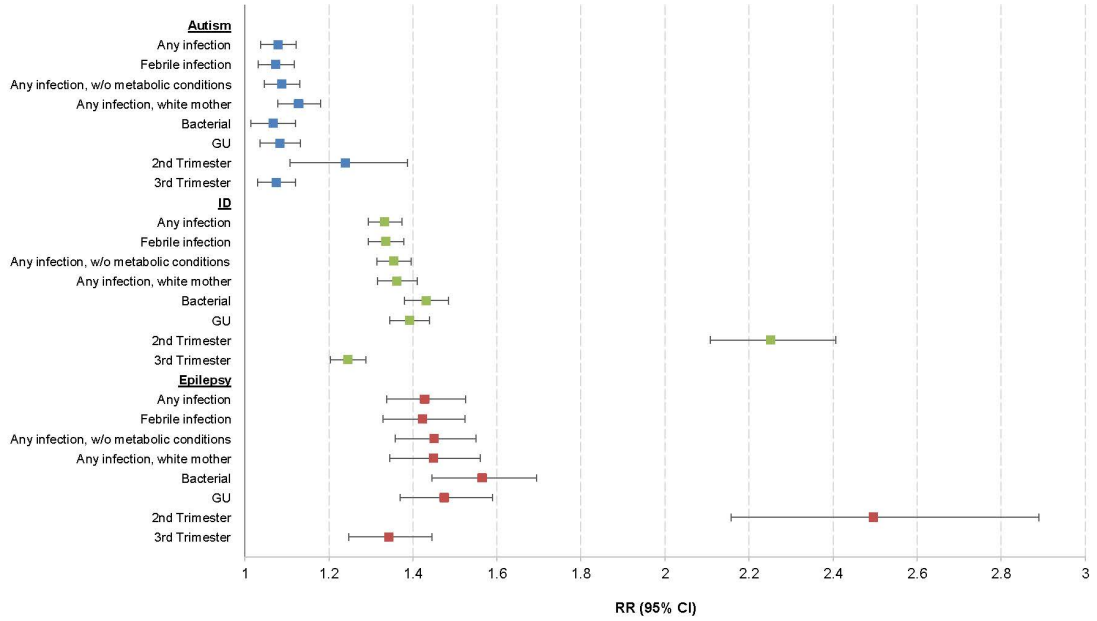
220 **166.220** Prenatal Infections and Risk of Autism, Intellectual Disability and/or Epilepsy

H. R. Haber[1]*, G. Xing*[2] *and C. Walker*[3]*, (1)School of Medicine, University of California, Davis, Sacramento, CA, (2)Center for Healthcare Policy and Research, University of California, Davis, Davis, CA, (3)University of California, Davis, Sacramento, CA*

Background: Although epidemiologic studies have reported associations between infections and febrile episodes during gestation and offspring autism and co-morbid intellectual disability (ID), results are mixed and limited to specific populations.
Objectives: In a demographically-heterogeneous population-based retrospective birth cohort, we examined the association between maternal inpatient diagnosis of infection and offspring risk of autism, ID and epilepsy. Specifically, we studied whether type of infection (by anatomic site, microbe category, fever propensity, or timing) was associated with autism, ID, or epilepsy risk.
Methods: We included births in California from 1/1/1991-12/31/2008 and limited our analysis to singletons born at gestational ages 23-43 weeks with birthweights 500-6000 grams who survived the first year of life (n=8,618,171). Infection during pregnancy was defined using ICD-9-CM codes from any maternal hospitalization; codes with fewer than 50 observations were excluded. Birth files were merged with records from the California Department of Developmental Services (DDS) for children receiving care between 1/1/1991-12/31/2012, including 42,998 with autism, 45,546 with ID, and 2,507 with epilepsy. Outcomes were defined by standardized assessments and ICD-9-CM codes, and were not mutually exclusive. Multinomial logistic regression models controlling for maternal age, race/ethnicity, educational attainment, payer, parity, and birth year – with or without gestational and pregestational forms of diabetes and hypertension – examined relative risks (RRs) and 95% confidence intervals (CIs) for pregnancies complicated by infection for offspring autism, ID, or epilepsy. Additional models using sub-categories of the predictor explored the effect of type, site, fever propensity, and timing of infection on outcomes of interest.
Results: Demographic features of mothers and children with autism resembled published data, including predilection for white race, higher maternal age and educational attainment, and lower parity. Parous women were more likely to have children with ID and/or epilepsy than their nulliparous counterparts. Maternal infection was associated with an 8-43% increased risk for autism, ID, and/or epilepsy in adjusted analyses (Figure 1). Effects did not differ by infection febrile potential. Although women with metabolic conditions were more likely to have children with adverse neurodevelopmental outcomes, correlations between infection and adverse outcomes persisted when

metabolic conditions were removed from statistical models. While increased risk of ID or epilepsy was sustained across all racial and ethnic groups, increased risk for autism was seen solely among white women with infections. Stronger associations were observed between sub-categories of infection and ID and epilepsy, including bacterial etiology (increased by 43% and 57%, respectively), and GU site (39% and 48%, respectively). Outcome risk differed by timing of infection, with second trimester infections conferring a 24% increased risk for autism and a greater than two-fold risk for ID and epilepsy, and third trimester timing elevating risk to a lesser degree.
Conclusions: This study adds to the growing body of evidence implicating immune-mediated exposures during fetal development, particularly second trimester infections, in the etiology of autism, ID, and epilepsy. Our findings highlight the need for targeted investigation into the mechanisms underlying these fetal exposures and immunologic responses resulting in distinct patterns of neurodevelopmental compromise.

Figure 1. Maternal Inpatient Diagnosis for Infection and Risk of Autism, ID or Epilepsy



221 **166.221** Prenatal Organophosphate Pesticide Exposure and Social Cognition Among Adolescents in an Agricultural Community

S. K. Sagiv[1], *M. H. Harris*[1], *K. G. Harley*[2], *K. Kogut*[3], *J. Deardorff*[3], *K. Parra*[3], *A. Bradman*[4] *and B. Eskenazi*[3], *(1)Epidemiology, University of California, Berkeley, Berkeley, CA, (2)School of Public Health, University of California, Berkeley, Berkeley, CA, (3)University of California, Berkeley, Berkeley, CA, (4)university of California, Berkeley, Berkeley, CA*

Background: Organophosphate (OP) pesticides are cholinesterase-inhibiting insecticides used primarily in agriculture. Low-dose exposure to OPs could adversely impact human neurodevelopment, particularly if exposure occurs during the prenatal period when the fetal brain is undergoing rapid development and the ability to detoxify OPs is not yet mature. The CHAMACOS (Center for Health Assessment of Mothers and Children of Salinas) longitudinal birth cohort study, designed to investigate pesticide exposure and the health of pregnant women and their children living in a predominantly Mexican-American agricultural community, has previously reported associations of prenatal OPs with lower IQ, poorer attention and parental report of behaviors at 24 months related to pervasive developmental disorder (PDD), which includes symptoms consistent with ASD. Social cognition, a measure of how individuals perceive and respond to social interaction, is a central trait impaired in individuals with an autism spectrum disorder (ASD).
Objectives: To investigate the association of prenatal exposure to OP pesticides with social cognition among adolescents in CHAMACOS.
Methods: We estimated exposure to OPs using measures of dialkyl phosphate (DAP) metabolites in maternal urine collected during the first and second half of pregnancy. When the CHAMACOS children were age 14 years parents were asked to assess their children using the Social Responsiveness Scale (SRS), a rating scale quantifying the frequency of traits related to social behavior and stereotypic behavior/restricted interests. We estimated associations of maternal DAP concentrations (average of the 2 pregnancy measures) with SRS scores using linear regression models, adjusting for maternal age, education, country of birth, years in the United States, marital status, depression, child's age at assessment, sex and quality of the home environment.
Results: For the 247 children with prenatal DAPs and a completed SRS, the median (25%ile, 75%ile) DAP concentration was 130.5 (61.9, 279.7) nmol/L. Prenatal DAPs were associated with poorer 14-year SRS scores, represented by a higher score (β=7.3; 95% Confidence Interval (CI): 2.6, 12.1 per 10-fold increase in average maternal DAP concentration). We found a linear, monotonic dose-response relationship between DAPs and SRS score, confirmed by splines and by categorical analysis, where we detected a 10.8 point increase (95% CI: 4.6, 17.1) in SRS score for the 4^{th} vs. 1^{st} quartile of DAP concentration. Associations were consistent across males and females and across the 5 subscales of the SRS (social awareness, cognition, communication, motivation and restricted interests and repetitive behaviors).
Conclusions: We found that prenatal exposure to OP pesticides was associated with poorer parent-reported social cognition among adolescents in the CHAMACOS cohort. Prenatal DAP concentrations in CHAMACOS mothers were high, though in range with concentrations in the general U.S. population. Associations are consistent with CHAMACOS findings at earlier ages as well as with other epidemiologic studies showing associations of OPs with poorer neurodevelopment. Examination of continuously distributed traits, such as social cognition, offers a statistically powerful approach to studying modifiable environmental risk factors for ASDs.

222 **166.222** Prenatal Triclosan or Triclocarban Product Use and Autism Observational Scale for Infants at 12 Months

B. Park[1], *B. Lee*[2], *L. Tabb*[3], *I. Burstyn*[2], *M. D. Fallin*[4], *I. Hertz-Picciotto*[5], *L. A. Croen*[6] *and C. J. Newschaffer*[7], *(1)Mental Health Department, 1. Department of Mental Health, Johns Hopkins Bloomberg School of Public Health,, Baltimore,, MD, (2)Drexel University, Philadelphia, PA, (3)Department of Epidemiology and Biostatistics, Drexel University, Philadelphia, PA, (4)Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD, (5)Dept of Public Health Sciences, School of Medicine, UC Davis MIND Institute, Davis, CA, (6)Division of Research, Kaiser Permanente, Oakland, CA, (7)A.J. Drexel Autism Institute, Philadelphia, PA*

Background:
The antimicrobial agents triclosan (TCS) and triclocarban (TCC) have androgen disrupting potential and are widely used in household and personal care products. An increase in prenatal testosterone level has been associated with autistic traits. However, the roles of prenatal TCS and TCC exposures in this context have not been

explored.
Objectives:
The goal of this analysis is to examine whether triclosan and triclocarban containing antimicrobial use during pregnancy is associated with early autistic traits.
Methods:
The EARLI (Early Autism Risk Longitudinal Investigation) cohort follows mothers of a child with autism spectrum disorders (ASD) at the start of a subsequent pregnancy through to ASD assessment in the subsequent child. Home walk-through surveys conducted during pregnancy and postpartum were used to estimate dichotomized "early prenatal" and "late prenatal/early postpartum" TCS or TCC product use among 170 pregnancies in the EARLI study. Linear regression models were used to determine the association between dichotomized exposures during early prenatal and late prenatal/early postpartum period and autistic traits at 12 months using AOSI (Autism Observational Scales in Infants) scores.
Results:
During the early prenatal period, 89% of mothers reported using at least one personal care product potentially containing TCS/TCC. In the late prenatal/early postpartum period, 73% of mothers reported using personal care products potentially containing TCS/TCC. Among the four categories of personal care products examined, the largest proportion of mothers (67%) reported using TCC/TCS-containing dish soap, followed by antibacterial soap (49%), toothpaste (45%) and body/face soap (19%) during the early prenatal period. The total AOSI scores did not differ by TCS or TCC product use and the results did not differ by sex of the child.
Conclusions:
Findings from this study do not support an association between use of TCS or TCC-containing products during pregnancy and total AOSI scores. Product use based TCS/TCC exposure estimate and small sample size may have affected our results and should be considered in future investigations of TCS/TCC exposure and ASD.

223 **166.223** Prevalence of Autism Spectrum Disorder in a Japanese Community-Based Population Sample of Five-Year-Old Children

M. Saito[1], *N. Takayanagi*[2], *M. Adachi*[2], *A. Osato*[3], *S. Yasuda*[2], *T. Masuda*[4], *M. Tanaka*[4], *S. Yoshida*[2], *M. Kuribayashi*[2] *and K. Nakamura*[5], *(1)Hirosaki University, Hirosaki, Aomori, Japan, (2)Research Center for Child Mental Development, Hirosaki University, Hirosaki, Japan, (3)Graduate School of Medicine, Hirosaki University, Hirosaki, Japan, (4)Faculty of Education, Hirosaki University, Hirosaki, Japan, (5)Hirosaki University Graduate School of Medicine, Aomori, Japan*

Background: In Japan, local governments perform pregnant women and infants' health check-up as a fundamental maternal-and-child-health service. However, it cannot completely pick up developmental disabilities, especially ASD. A further problem is that the children with ASD who were undetected by the checkup tend to show secondary problems because of maladjustment after entering a school. Psychiatric disorders are common and frequently multiple in children with ASDs (Simonoff, 2008). Therefore, we conducted five-year-olds developmental health check-up on about 1,300 children per a year in a local city, where the number of citizens is approximately 180,000, and directly diagnosed developmental disorders. It allows investigating the prevalence of ASD, and proposing early identification and intervention.
Objectives: The purpose of this study is to investigate the prevalence of Autism Spectrum Disorder (ASD) in a community-based population sample of five-year-old children. We also clarify the difference of clinical data between children with ASD or other developmental disorders and healthy controls.
Methods: This study was conducted as Hirosaki Five years check-up (HFC) study-assessing mental health among children in Hirosaki. Subjects are 1919/2571 children who become 5 year old between April 2013 and March 2015 in Hirosaki city. After primary screening was performed, 405 children were selected to undergo secondly developmental health examination. Finally 282 children and their parents visited to the developmental health check-up. Pediatricians and psychiatrists diagnosed neurodevelopmental disorder directly using DSM-5 criteria, ASD, ADHD, DCD (Developmental coordination disorder), and ID/BID (Borderline Intellectual Disability). We calculated the prevalence and comorbidities. In addition, clinical data were statistically analyzed by multiple comparisons with Bonferroni correlation between groups of ASD (comorbid with other disorders), other developmental disorders and healthy control.
Results: 59 children were diagnosed as ASD. The prevalence of ASD was 3.31% (95% CI: 2.48 –4.14). The comorbidities of ASD were ADHD (55.9%), DCD (59.3%) and ID/BID (44.1%). 46/88 ADHDs were ADHD without any comorbidity. 43/59 ASDs (73%) had not been diagnosed with ASD until this health checkup. Mean birth weight of ASDs was significantly lower than other developmental disorders and control groups. In mean CSHQ (Children's Sleep Habit Questions) scores, Bedtime Resistance of ASDs was significantly higher than other groups. In mean Conners3 scores, 'Anxiety' of ASDs was significantly higher than other groups. In mean the child side scores of PSI (Parenting Stress Index) , ASD group was significantly higher than other groups.
Conclusions: This is the first epidemiological study of a community-based population sample in Japan. These findings suggest that ASD children and their caregivers have more difficulties than other developmental disorders and healthy children and 40% of them have not yet received any support.

224 **166.224** Prevalence of Autism in China: A Mainstream-School Population National Study in 3 Cities

X. Sun[1], *C. Allison*[2], *L. Wei*[3,4], *F. E. Matthews*[5], *B. Auyeung*[6], *Y. Y. Wu*[7], *M. Jia*[8], *S. Baron-Cohen*[2] *and C. Brayne*[9], *(1)ä¸å›½åŒ—äº¬å¸‚æœé˜³åŒºïz½ïz½ æˆé¦¨å›å°åŒº104æ¥¼äºŒå•å…ƒ501, University of Cambridge, Beijing 100023, China, (2)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (3)Center for Bioinformatics, School of Life Sciences, Peking University, Beijing, China, (4)National Institute of Biological Sciences, Beijing, Beijing, China, (5)MRC Biostatistics Unit, Cambridge, United Kingdom, (6)University of Edinburgh, Edinburgh, United Kingdom, (7)YuNing Psychiatry Clinic, Taiwan, Taiwan, (8)Peking University 6th Hospital, Beijing, China, (9)University of Cambridge, Cambridge, United Kingdom*

Background:
Our previous study utilising a Mandarin Chinese translation of the Childhood Autism Spectrum Test (CAST) in mainstream schools reported a prevalence of Autism Spectrum Conditions (ASC) in Beijing of 119 per 10,000 (95%CI: 53, 265). The results from the Beijing study suggested an under-diagnosis of autism in a mainstream-school population, which laid the groundwork for the current large population-based prevalence study of ASC in mainland China.
Objectives:
(1) To conduct a pilot study in one city in China to test the feasibility of the measures for the main study. (2) To compare these results to two other cities in China.
Methods:
Pilot Study: We sampled one school district in the urban area of Jilin city. All students in Grades 1 to 4 (6-10 years old) in 13 mainstream primary schools and two special schools in the district were invited to participate. Each screening package included the Mandarin CAST and questions on parents' background. After screening, the children were divided into 3 groups according to their CAST score: 1) the high-score group, also known as screen-positive group: CAST score≥15; 2) the borderline group: CAST score 12-14; and 3) the low-score group: CAST score ≤11. *Study in Two Cities*: We repeated the same process in Shenzhen city, Guangdong province, in the south of China, and Jiamusi city, Heilongjiang Province, in the north of China. Children were given diagnosis of ASC after clinical assessments and research diagnostic assessments using the ADOS and the ADI-R.
Results:
Pilot Study: Seventy-seven cases were identified among a total study population of 7,258 in the district in the urban area of Jilin City, resulting in a prevalence estimate for autism of 108 per 10,000 (95% CI: 89, 130). *Study in Two Cities*: Shenzhen city: Of 21,420 children screened in mainstream primary schools (age 6-10), 122 children were given a clinical diagnosis of "ASC" or "suspected ASC". After research diagnosis, the direct raw prevalence estimate for the population was 42.3 per 10,000 children (95% CI 20.1-88.6). Jiamusi city: 16,358 questionnaires were distributed to 27 mainstream primary schools, with 100% response. 24 children were given a clinical diagnosis of "ASC" or "suspected ASC". The direct raw prevalence estimate for the population was 19.0 per 10,000 children age 6-10 (95% CI 9.7-37.5). The differences between the two regions were not significant either as a crude effect (OR=0.45 95% CI 0.16-1.23, p=0.12) or after adjusting for age, sex, income and education differences between the two regions (OR=0.39, 95% CI 0.12-1.30, p=0.13).
Conclusions:
This study shows that screening and diagnostic instruments developed in the West can be adapted for use in non-Western countries. In particular, the CAST can be used for a national prevalence study in China. Our results confirmed the under-diagnosis of ASC in the mainstream-school population in China. The current results will be compared to results from ongoing screening studies in seven other provinces. This type of epidemiological survey is essential for the assessment of service needs and the choice of the best model of service delivery.

225 **166.225** Prospective Vs. Retrospective Report of Indoor Pesticide Use during the Perinatal Period

J. Barkoski[1], *R. J. Schmidt*[2], *P. C. Chen*[1], *D. J. Tancredi*[3], *C. Walker*[4], *I. Hertz-Picciotto*[5] *and D. Bennett*[1], *(1)Public Health Sciences, University of California, Davis, Davis, CA, (2)University of California at Davis, Davis, CA, (3)Pediatrics, UC Davis School of Medicine, Sacramento, CA, (4)MIND Institute, University of California, Davis, Sacramento, CA, (5)Dept of Public Health Sciences, School of Medicine, UC Davis MIND Institute, Davis, CA*

Background: Questionnaires can help advance research when biomarker sample collection and analyses are too expensive or invasive, but only for exposures that can be reliably reported.
Objectives: Compare the reliability of maternal report of product use in and around her home on the ELEAT (Early Life Exposure Assessment Tool) administered retrospectively with her responses regarding the same products reported prospectively during pregnancy.
Methods: Participants (n=130) from the MARBLES (Markers of Autism Risk in Babies-Learning Early Signs)prospective study underwent structured interviews during pregnancy and then again with the ELEAT, a shorter instrument derived from the one utilized longitudinally, 2 or more years postpartum. The ELEAT environment module has questions about interior paint, pet flea and tick treatments, personal care products, and indoor/outdoor pesticide use. Agreement was assessed with Cohen's Kappa statistic (K), sensitivity, specificity and Youden's index (YI=Sensitivity+Specificity – 1).

Results: We found excellent agreement (K= 0.61, YI=0.59) for mothers reporting professional outdoor pesticide use during the index time (3 months before pregnancy through the child's 1st year). Questions about freshly painted walls, pet flea and tick pouch products, antibacterial soap, and indoor pesticide foggers had moderate agreement (K=0.41-0.60,YI=0.42-0.63). Other pesticide questions, professional indoor applications and, indoor and outdoor sprays, had fair agreement (K=0.21-0.40, YI=0.19-0.38). Report of pet flea treatments; such as, soap, collars, and skin products showed fair agreement. Differences in wording of the questions may have contributed to these findings of only fair agreement. Responses to specific time points over the index period did not perform as well and generally had fair agreement.
Conclusions: In this study population, responses on environmental questions at 2 years postpartum or later had very good to fair agreement when compared to answers given prospectively during the perinatal period. Studies relying on retrospective reporting need to take misclassification into account.

226 **166.226** Reliability of Self-Reported Lifestyle Exposures before, during, and after Pregnancy in Autism Studies

R. J. Schmidt[1], *P. C. Chen*[2], *C. Walker*[3], *I. Hertz-Picciotto*[4] *and D. J. Tancredi*[5], *(1)Public Health Sciences and MIND Institute, University of California at Davis, Davis, CA, (2)Public Health Sciences, University of California, Davis, Davis, CA, (3)MIND Institute, University of California, Davis, Sacramento, CA, (4)Dept of Public Health Sciences, School of Medicine, UC Davis MIND Institute, Davis, CA, (5)Pediatrics, UC Davis School of Medicine, Sacramento, CA*

Background:
Questionnaires can help advance research on environmental risk factors for autism when biomarker sample collection and analyses are too expensive or invasive, but only when exposures can be reported reliably.
Objectives:
To compare agreement of maternal retrospective report of lifestyle exposures in and around pregnancy on the ELEAT (Early Life Exposure Assessment Tool) with prospectively collected responses regarding the same exposures.
Methods:
Participants (n=130) from the MARBLES (Markers of Autism Risk in Babies-Learning Early Signs) prospective cohort study of high-risk siblings of children with autism completed structured telephone interviews during pregnancy and then again with the ELEAT, a shorter instrument administered 2 or more years postpartum. Agreement was assessed with Cohen's Kappa statistic (K), sensitivity (Se), specificity (Sp) and Youden's index (Y=Se+Sp-1) for each exposure ever during the index period (3 months before pregnancy until the end of breastfeeding) and during six time periods: 3 months before pregnancy, pregnancy, each trimester of pregnancy, and during breastfeeding (if a maternal exposure) or the child's first year of life (if an exposure to the child).
Results:
Retrospective reporting of maternal cigarette smoking (K=0.60, Y=0.54), other smokers within the home (K=1, Y=1), coffee drinking (K=0.64, Y=0.67), energy drinks (K=0.55, Y=0.75), alcohol (K=0.54, Y=0.63), illicit drugs (K=0.72, Y=0.57), and teeth clenching (K=0.87, Y=0.92) agreed substantially with prospective reports for the index period, but weakly to modestly agreed when taking into account timing (K/Y=0.05-0.60). Caffeinated soda (K=0.24, Y=0.42) and tea (K=0.32, Y=0.40), and sunscreen use (K=0.25, Y=0.26) during the index period had fair to moderate agreement. Sauna, hot tub and Jacuzzi use (K=0.04, Y=0.03) and maternal dental amalgam fillings (K=-0.08, Y=0.24) did not agree. Several exposures were rarely reported during pregnancy.
Conclusions:
Retrospective reports of most lifestyle exposures were reliable; future studies need to assess validity.

227 **166.227** Socioeconomic, Racial and Ethnic Disparities in the Prevalence of Autism Spectrum Disorder Among US Children

M. S. Durkin[1], *M. J. Maenner*[2], *D. Christensen*[3], *L. C. Lee*[4], *R. Fitzgerald*[5], *M. Wingate*[6], *J. L. Daniels*[7], *C. L. Arneson*[1], *K. Van Naarden Braun*[8] *and M. H. Yeargin-Allsopp*[2], *(1)University of Wisconsin-Madison, Madison, WI, (2)Centers for Disease Control and Prevention, Atlanta, GA, (3)Centers for Disease Control (CDC), Atlanta, GA, (4)Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (5)Washington University School of Medicine, St. Louis, MO, (6)University of Alabama, Birmingham, AL, (7)University of North Carolina, Chapel Hill, NC, (8)National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention, Atlanta, GA*

Background: Population-based studies in the US published during the past decade have reported persisting racial and ethnic differences in the prevalence of autism spectrum disorder (ASD), with prevalence estimates being significantly higher for white non-Hispanic relative to both black non-Hispanic and Hispanic children. Some US studies have also found a socioeconomic status (SES) gradient in ASD prevalence, with prevalence increasing with increasing SES. These findings point to potential under-ascertainment of ASD in disadvantaged groups, and raise the question of whether the racial and ethnic disparities in ASD prevalence are due to confounding by SES.
Objectives: Using data from the Autism and Developmental Disabilities Monitoring (ADDM) Network for surveillance year 2010, the objectives of this study were to: (1) replicate findings from a previous study based on data for surveillance years 2002 and 2004, which showed a SES gradient in ASD prevalence and prevalence nearly 70% higher in children of high versus low SES (prevalence ratio 1.69, 95% confidence interval [CI] 1.55, 1.83); and (2) evaluate whether racial and ethnic differences in ASD prevalence persist after controlling for SES.
Methods: A cross-sectional study was implemented combining data from the 11 2010 ADDM Network sites. The ADDM Network is a multiple source surveillance system that incorporates abstracted data from health and/or school records to determine the number of 8-year-old children meeting diagnostic criteria for ASD (for 2010, this included *Diagnostic and Statistical Manual of Mental Disorders, fourth edition, text revision* criteria for autistic disorder or pervasive developmental disorder). The population base included 363,749 8-year-old children, of whom 5,338 met criteria for ASD in 2010. Census tract-level measures of poverty from the 2006-2010 American Community Survey were used to create SES tertiles of the population.
Results: The prevalence of ASD in the combined study area in 2010 was 14.7 per 1,000 children (95% CI 14.3, 15.1) and was higher in white non-Hispanic than both black non-Hispanic (prevalence ratio 1.22 [95% CI 1.13, 1.30]) and Hispanic children (prevalence ratio 1.47 [95% CI 1.35, 1.59]). Prevalence increased stepwise with increasing SES, from a low of 10.9 (95% CI 10.3, 11.5) per 1,000 children in the lowest SES tertile to a high of 19.7 (95% CI 18.9, 20.5) in the highest SES tertile (high to low SES prevalence ratio 1.81 (95% CI 1.69, 1.94). In stratified analyses, the SES gradient and significantly elevated SES prevalence ratios were present among all sub-groups examined. Racial and ethnic differences in ASD prevalence were also present in children of low SES, among whom the white non-Hispanic to black non-Hispanic and white non-Hispanic to Hispanic prevalence ratios (95% CI) were 1.34 (1.17, 1.53) and 1.46 (1.28, 1.68), respectively.
Conclusions: The SES disparity in ASD prevalence based on US surveillance data persisted between 2002 and 2010, and this disparity, according to SES measures available for this study, does not appear to fully explain the observed racial and ethnic disparities in ASD prevalence in the US.

228 **166.228** Stressful Life Events during Pregnancies Related to Children with ASD, Their Siblings and Typically Developing Children

E. Grossi[1], *F. Veggo*[1,2], *A. Narzisi*[3], *F. Muratori*[3], *I. Rolla*[4] *and L. Migliore*[4], *(1)Autism Unit, Villa Santa Maria Institute Neuropsychiatric Rehabilitation Center, Tavernerio, Italy, (2)Child and Adolescent Neuropsychiatry, University of Milan- Bicocca, Monza, Italy, (3)IRCCS Stella Maris Institute, Pisa, Italy, (4)Human Genetics, Pisa University, Pisa, Italy*

Background: The role of stressful events in contributing to increased autism risk deserves special attention since very few studies have attempted to collect this kind of information. Adverse experiences during the prenatal period (a time of rapid growth and of heightened brain plasticity) have been demonstrated to induce significant effects on neurobiology, metabolism, and physiology that can persist across the lifespan. Generally, the more variable the stressor and the earlier the stressors occur in the pregnancy, the more profound the effect on offspring development. A number of basic science studies indicate that a family history of stress may program central and peripheral pathways regulating gestational length and newborn health outcomes in the maternal lineage. Epigenomic programming related to hypothalamic-pituitary-adrenal (HPA) axis responses to chronic stress may be an important mechanism involved in autism development.
Objectives: The aim of this study was to assess the frequency and impact of different stressful life events. Data was collected from careful interviewing during pregnancies of the following three groups: mothers of children with ASD, of their typically developing siblings (internal controls) and of only typically developing children (external controls) in two Italian provinces, Como and Pisa.
Methods:
The clinical sample included a cases group of 73 ASD children and adolescents – group 1 (mean age 8.2; S.D. 6.35) compared to an internal control group formed by 45 healthy siblings – group 2 (mean age 8.9 years; S.D. 6.66) and to an external control group formed by 96 typically developing children – group 3 (mean age 7.8; S.D 5.67). It is important to note that the second group represented all the siblings available. Mothers of ASD children who met the inclusion criteria were invited to an individual structured interview about stressful life events after having signed an informed consent form. Stressful events considered in the survey were: death or severe disease of a relative, divorce, separation or conjugal conflict, loss of house or eviction or relocation, abuse or violence and job strain.
Results:
A statistically higher prevalence of the mean number of stressful events per pregnancy was recorded in the ASD group when compared to the internal and external control groups. The mean number stressful events (range) was = 0.45(0-5), 0.29(0-3) and 0.11(0-2) in the three groups respectively. Group 1 vs group 2: $p < 0.05$; Group 1 vs group 3: $p < 0.001$; Group 2 vs group 3 $p < 0.01$.
Conclusions: Stressful life events during pregnancy are more frequent in mothers of children with autism than mothers of typically developing children. The rate observed in sibling pregnancies lies exactly in the middle, pointing out a possible threshold effect in women predisposed to suboptimal pregnancies.

229 **166.229** The Association Between Prenatal Exposure to Maternal Infection and Autism Spectrum Disorder in the Boston Birth Cohort

M. Brucato[1], *C. Ladd-Acosta*[2], *M. Li*[3], *D. M. Caruso*[4], *X. Hong*[5], *X. Wang*[6] *and M. D. Fallin*[7], *(1)Epidemiology, Johns Hopkins University School of Public Health, Baltimore, MD, (2)Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (3)Johns Hopkins School of Public Health, Baltimore, MD, (4)Center on the Early Life Origins of Disease, Department of Population, Family, Reproductive Health, JHBSPH, Baltimore, MD, (5)Johns Hopkins University School of Public Health, Baltimore, MD, (6)Center on Early Life Origins of Disease, Department of Population, Family, Reproductive Health, JHBSPH, Baltimore, MD, (7)Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD*

Background: ASD is phenotypically and etiologically heterogeneous, with evidence for genetic and environmental contributions to disease risk. Research has focused on the prenatal period as a time where environmental exposures are likely to influence ASD development. There is evidence from animal models and human epidemiologic studies that prenatal exposure to maternal infection may lead to an increased risk of neurodevelopmental disabilities, including autism, in the offspring.
Objectives: We aim to estimate the association between prenatal exposure to maternal infections, including influenza and genitourinary infections, and ASD in a prospective birth cohort of an understudied urban minority population in the United States.
Methods: We used data from the Boston Birth Cohort (BBC), a prospective birth cohort with pregnancy exposure, early life factors, and phenotypic data available for over 8,000 mother-child dyads recruited at the Boston Medical Center. The BBC enrolls predominantly urban, low-income minority mothers and their children (approximately 38% self-identify as black/African American, 22% Hispanic, 19% Haitian, 8.5% white). We performed a nested case-control analysis including 109 children with ASD and 833 children with typical development. ASD information was obtained from electronic medical record data, based on the presence of relevant ICD-9-CM hospital diagnosis codes from pediatric outpatient, inpatient, and emergency room visits. Information on maternal history of infection during a child's gestation was obtained from postpartum maternal questionnaires, given 24-72 hours after delivery, years prior to any ASD diagnosis. Analyses were adjusted for socioeconomic status as represented by educational attainment, marital status, and race. Sensitivity analyses further included adjustment for child sex, maternal age, birth year, parity, and maternal smoking during pregnancy.
Results: No association was found between self-reported maternal history of influenza, fever, or genitourinary (GU) infections and risk of ASD development in the offspring in either unadjusted (flu, OR of 1.03 [95% CI 0.60-1.68]; fever, 1.38 [0.71-2.52]; GU infection, 0.63 [0.39-1.00]) or adjusted analyses (flu, 1.05 [0.62-1.73]; fever, 1.39 [0.71 - 2.54]; GU infection, 0.67 [0.41-1.06]). Further adjustment for child sex, maternal age, birth year, parity, and maternal smoking during pregnancy did not alter these null associations.
Conclusions: In contrast to the results from several large studies of European registries or predominantly white American populations, the Boston Birth Cohort, a large urban, minority prospective birth cohort does not provide evidence for an association between history of exposure to infection during gestation and later development of Autism Spectrum Disorder.

230 **166.230** The Association Between Trimester Specific Daily Average PM2.5 and Autism Spectrum Disorder: A Large-Scale Multi-Source Linked Analysis

N. Connolly and ***K. A. Bowers****, Cincinnati Children's Hospital Medical Center, Cincinnati, OH*

Background: Data integration allows one to take advantage of the vast amounts of data available in various sources in order to gleam new insights into the etiology of ASD. This presentation presents the results of a large-scale data integration analysis, combining electronic medical records (EMR) from a premier ASD diagnosis and treatment center with Ohio state birth records, as well as with an environmental toxin exposure dataset released by the Environmental Protection Agency (EPA).
Objectives: Our objective was to assess the applicability of big data analytics to integrate multiple data streams and conduct epidemiologic analyses using multiple environmental exposures as a model.
Methods: In order to produce our integrated dataset, we first queried the EPIC-hosted EMR of Cincinnati Children's Hospital Medical Center (CCHMC) to identify all patients with a diagnosis of ASD. We included all patients with a 299.* ICD9 diagnostic code in their EMR from 2009-2014 that was recorded by CCHMC's Division of Developmental Disabilities and Behavioral Pediatrics (DDBP). In addition, we employed natural language processing (NLP) techniques to gleam clinical concepts (including diagnoses) from free-text office visit notes. We manually reviewed approximately 100 clinical notes to ascertain the agreement between the NLP-extracted assessment of ASD status in the clinical notes, and the presence or absence of the corresponding ICD9 code in the encounter diagnosis list.
We then matched the EMR data with Ohio state birth records in order to 1) identify the pre-birth residence of mothers who gave birth to offspring with ASD; and 2) have access to a large number of locale- and age- matched controls unaffected by ASD. To link the data sources, we wrote custom software (based on the PERL scripting language) that matched patients by birthdate, and first and last names, allowing for minor misspellings.
Having geocoded the addresses where mothers of ASD cases and controls resided immediately prior to giving birth, we estimated prenatal exposure to environmental factors by linking addresses with two public datasets released by the EPA. The first dataset estimates green scape coverage within 400 m of an address; the second uses a Bayesian space-time fusion model [1-3] to estimate daily $PM_{2.5}$ (daily average) and O_3(daily 8-hr maximum) on a 12km x 12km grid for the conterminous United States, for years 2001-2008.
Using logistic regression to control for birth year and additional covariates, we will determine the association between ASD and green space, as well as trimester-specific association with $PM_{2.5}$ and O_3.
Results: We have found that NLP techniques successfully abstract clinical concepts from free text. We found integration of Ohio state birth records with EMR can be conducted with high accuracy. However, due to sparsity of environmental monitors in our geographical area, extrapolation of environmental data to a wide range of geocoded location is associated with uncertainty.
Conclusions: Using novel EMR data extraction methods and data linkage with multiple source/databases, we will efficiently evaluate the association between prenatal exposure to $PM_{2.5}$, O_3 and access to green space, and ASD.

231 **166.231** The Effects of in Vitro and In Vivo Exposure of Persistent Organic Pollutants on Immune Function in Children with ASD

J. Van de Water[1], *M. E. Akintunde*[2], *Y. Lin*[3], *B. Puschner*[3], *P. Ashwood*[4], *I. Hertz-Picciotto*[5] *and P. Krakowiak*[4], *(1)University of California at Davis MIND Institute, Davis, CA, (2)University of California Davis, Davis, CA, (3)University of California, Davis, Davis, CA, (4)UC Davis, Sacramento, CA, (5)Dept of Public Health Sciences, School of Medicine, UC Davis MIND Institute, Davis, CA*

Background: It has been previously demonstrated that some children with autism (AU) have a dysregulated immune profile that often correlates with behavioral deficits. We postulate that such dysregulation might be the result of an increased susceptibility to environmental toxicants, such as the congener polybrominated diphenyl ether-49 (BDE-49).
Objectives: We sought to examine the relationship between blood levels of PBDE and the differential sensitivity of the immune cells following *ex vivo*PBDE exposure using banked plasma and activated peripheral blood mononuclear cell (PBMC) supernatants from children with ASD, and age- and geographically- matched typically developing control (TD) children enrolled through the CHARGE (CHildhood Autism Risks from Genetics and the Environment) study.
Methods: Using banked plasma from children with ASD, and age- and geographically-matched typically developing control (TD) children enrolled through the CHARGE (CHildhood Autism Risks from Genetics and the Environment) study, we determined blood levels of 11 major PBDE congeners using mass spectrometry. We analyzed cytokine/chemokine levels in activated peripheral blood mononuclear cell (PBMC) supernatants with and without ex vivo BDE-49. We then correlated total body burden as well as individual congener levels with T cell cytokine/chemokine production.
Results: We found that despite no difference in overall body burden between the two subject populations, increased body burden of PBDE correlates with a suppressed immune response, especially in children with ASD. There was a differential effect of total PBDE body burden on baseline (no activation) immune function between ASD and TD children whereby T cell function was more negatively affected in ASD than in TD, as measured by lower levels of IL-2, IL-13 and IFN-gamma**.** Higher plasma levels of PBDE were also negatively correlated with production of the adaptive T-cell cytokines IL-2 and IL-13 after activation of PBMCs. Further, higher plasma levels of PBDE negatively correlated with the production of inflammatory (IL-17) and regulatory (IL-10) T-cell cytokines after PBMC activation. Finally, baseline production levels of T cell cytokines IL-2 and IFN-gamma are significantly negatively impacted by several individual BDE congeners in children with ASD compared to TD controls at baseline; this was highly significant for the congener BDE-49 ($p=0.001$). Further, when PBMC from children with ASD and TD controls were exposed *ex vivo* 50nM BDE-49 without stimulation (media control), we noted a significant increase in the production of the inflammatory cytokines IL-6, TNF-alpha, IL-1, and the chemokines MIP-1a and MCIP-1 in ASD cases compared to the TD controls ($p<0.05$). Finally, an increase in IL-6 ($p=0.01$) and GM-CSF ($p=0.03$) was noted following pre-treatment with 250nm of BDE49, and this was significantly positively correlated with higher body burden of BDE-49, but not BDE-47 or BDE-95.
Conclusions: We have found that despite a nearly identical body burdens of the flame-retardant PBDE in ASD and TD children, there is a differential impact of PBDE exposure on immune system function in children with ASD compared to little or no impact on the TD control children. This suggests an underlying susceptibility to environmental toxicant exposure in children with ASD that could relate to immune anomalies reported in these children.

Baseline production levels of T cell cytokines IL-2 and IFN-gamma are significantly negatively impacted by several BDE congeners in children with ASD compared to TD controls at baseline

AU

	IL-2		IFN-gamma		IL12-p40		IL12-p70		IL-13		IL-17		IL-10	
PBDE	r	P=	r	P=	r	P	r	P=	r	P=	r	P=	r	P=
100	-0.118	0.040*	-0.031	0.018*	-0.129	0.051	-0.004	0.017*	-0.431	0.139	0.010	0.953	0.103	0.538
136	-0.205	0.017*	-0.091	0.012*	-0.164	0.024*	0.104	0.925	-0.187	0.261	0.330	0.043*	0.125	0.456
153	-0.157	0.290	-0.094	0.045*	-0.151	0.117	0.000	0.300	-0.318	0.052	0.007	0.964	0.095	0.570
154	-0.150	0.104	-0.113	0.075	-0.259	0.043*	-0.062	0.528	-0.115	0.491	0.222	0.181	0.101	0.545
17	-0.168	0.135	-0.027	0.035*	-0.080	0.222	-0.128	0.039*	-0.313	0.056	0.071	0.671	-0.09	0.553
183	-0.001	0.457	0.163	0.486	0.021	0.379	-0.018	0.305	-0.051	0.763	-0.09	0.570	0.034	0.840
28	-0.185	0.025*	-0.069	0.456	-0.047	0.767	0.038	0.944	-0.219	0.186	0.051	0.760	-0.06	0.688
47	-0.215	0.009*	-0.048	0.010*	-0.077	0.248	0.017	0.069	-0.224	0.177	0.133	0.424	-0.05	0.741
49	-0.171	0.001*	-0.078	0.002*	-0.156	0.071	0.054	0.350	-0.239	0.149	0.166	0.319	0.039	0.814
85	-0.094	0.007*	0.003	0.009*	-0.116	0.126	0.079	0.873	-0.200	0.228	0.334	0.041*	0.132	0.430
95	-0.111	0.176	-0.043	0.014*	-0.174	0.009*	0.075	0.655	-0.195	0.241	0.255	0.122	0.175	0.293
99	-0.210	0.002*	0.000	0.021*	-0.116	0.408	-0.014	0.074	-0.196	0.240	-0.07	0.665	0.034	0.837

TD

	IL-2		IFN-gamma		IL12-p40		IL12-p70		IL-13		IL-17		IL-10	
PBDE	r	P=	r	P=	r	P	r	P=	r	P=	r	P=	r	P=
100	-0.001	0.996	0.149	0.257	-0.077	0.559	0.117	0.372	0.193	0.139	0.142	0.278	0.174	0.183
136	-0.117	0.375	-0.003	0.984	-0.175	0.181	0.073	0.579	0.155	0.238	0.046	0.726	0.096	0.463
153	-0.176	0.179	-0.016	0.906	-0.148	0.259	-0.040	0.763	0.109	0.409	0.044	0.736	0.118	0.367
154	0.013	0.919	0.089	0.497	-0.247	0.057	-0.043	0.744	-0.038	0.774	0.184	0.158	0.117	0.375
17	-0.141	0.282	0.109	0.407	-0.046	0.728	0.015	0.908	-0.036	0.786	-0.035	0.791	-0.06	0.649
183	-0.041	0.753	0.252	0.052	-0.039	0.768	0.071	0.592	0.271	0.037*	0.103	0.433	0.270	0.037*
28	-0.032	0.807	0.048	0.717	-0.016	0.903	0.100	0.449	0.099	0.450	0.258	0.047*	0.138	0.293
47	-0.110	0.401	0.180	0.168	0.007	0.960	0.140	0.286	0.118	0.370	0.030	0.822	0.109	0.409
49	0.064	0.629	0.167	0.203	-0.177	0.177	0.167	0.203	0.335	0.009*	0.281	0.029*	0.254	0.050*
85	0.090	0.495	0.191	0.143	-0.151	0.251	0.025	0.848	0.360	0.005*	0.222	0.089	0.146	0.266
95	-0.052	0.693	0.062	0.640	-0.196	0.134	0.083	0.526	0.155	0.237	0.066	0.615	0.130	0.323
99	-0.026	0.845	0.222	0.088	-0.091	0.488	0.085	0.519	0.157	0.231	0.019	0.886	0.119	0.365

232 **166.232** The Hidden Disorder: Undiagnosed Autism Spectrum Disorder in Women

H. L. Belcher[1], *S. D. Stagg*[2] *and R. M. Ford*[2], *(1)Anglia Ruskin University, Cambridge, England, United Kingdom, (2)Psychology, Anglia Ruskin University, Cambridge, United Kingdom*

Background:
Autism Spectrum Disorder (ASD) is thought to be more prevalent in males than females, and this is especially true at the higher end of the spectrum. However, females are often diagnosed later than males, suggesting that rather than females being less likely to have the disorder, it is possible they are more likely to be missed; either going undiagnosed or being misdiagnosed with a mental health condition.
Objectives:
The current study aimed to determine the rate of undiagnosed autism in males and females in a large sample of individuals responding to an online survey. The study also aimed to evaluate the number of mental health diagnoses among participants who met the cut-off on an ASD screening tool as a function of gender and diagnostic status.
Methods:
A screening survey was distributed to all UK universities and advertised to the general public via radio and TV. Participants were not informed about the nature of the survey until after completion. Amongst other measures, the survey consisted of the Autism Quotient (AQ) and a simple self-report mental health checklist. The survey received 7,537 respondents (mean age = 32 years, SD 13.77, range 16 - 88). Responses were grouped according to their AQ scores and current diagnostic status (e.g., meets the AQ cut off for concern/diagnosed, meets cut off/undiagnosed, does not meet cut off).
Results:
A significantly higher number of female respondents met the AQ cut off without a diagnosis than male respondents fulfilling the same criteria (22% of females v. 17% of males). These women had significantly fewer mental health conditions (M = 1.20) than women who met the cut off and were diagnosed (M = 1.70), but a similar number to males who met the cut off and had a diagnosis (M =0.90).
Conclusions:
Our findings suggest that there is a large proportion of women who may meet the criteria for autism but do not have a diagnosis. Our findings further suggest that women may require more mental health problems prior to a diagnosis of ASD. This would support the Female Masking Effect theory of ASD, which suggests that females need to reach a higher threshold of difficulties before being noticed or diagnosed. Females with ASD may only arouse suspicion after seeing numerous professionals and presenting with a complex symptom history.

233 **166.233** The New Jersey Autism Registry: Development and Impact

S. Howell[1] *and N. Scotto Rosato*[2], *(1)NEW JERSEY DEPT OF HEALTH, Milford, NJ, (2)New Jersey Dept of Health, trenton, NJ*

Background: The rise in the prevalence of Autism Spectrum Disorders (ASD) rates over the past 15 years has spurred a number of national endeavors by the CDC, NIH, and other organizations to better understand the increase, what causes autism, and what services are needed. In 2007, New Jersey enacted a mandated an Autism Registry for all children (0-21) in response to its CDC prevalence rate of 1:94. Today, over 18, 000 children have been registered and referred for case management services. The data has provided a wealth of information on demographic differences, risk factors, and Early Intervention (EI) service use.
Objectives: This presentation provides an overview of how a mandated state-based autism registry was developed and can yield information regarding age of diagnosis, symptoms, demographics, and other vital information for policy makers and service planners.
Methods: A descriptive overview is provided regarding the development and key components of the Registry. Data were analyzed in terms of race/ethnicity, age of diagnosis, comorbidities, difference in subtypes, maternal and paternal age, birthweight, and plurality. Data were matched to Birth Certificate and EI data.
Results: Over 3000 children per year have been registered since 2009. 60.8% of children were classified with Autistic Disorder, 23.3% Pervasive Developmental Disorder (PDD)-NOS, and 15.3 Asperger Syndrome. The mean and median age of first diagnosis was significantly different by subtype: Autistic Disorder=4.25 and 3.2; PDD-NOS=4.6 and 3.6; and Asperger Syndrome=8.2 and 7.8. The race/ethnicity analysis (see Table 1) shows Hispanics represented 24.5% of the children in the Registry, while 18.9% of all children in NJ and 17.1% in the US are Hispanic. Black Non-Hispanics and Asians were less likely to be in the Registry. Age of diagnosis by race shows that Hispanics are more likely to be diagnosed earlier (38.6% by age 3) than Whites (32.8%) and Blacks (35.2%). While most children were diagnosed after the age of 3, the EI data showed that about 60% of children registered had been enrolled in EI (see Table 2). As expected, children in the Registry are more likely to born to older mothers, born prematurely and have lower birth weights. Interestingly, the percent of mothers over 35 is much higher in New Jersey (22.1%) than the US (15.3%) which may help explain why the rates of autism appears to be higher in NJ than the other states in the CDC surveillance studies.
Conclusions: Using a state-law to mandate the reporting of Autism, NJ designed a registry with three main goals: link individuals to services and resources; plan services; provide prevalence and epidemiological information. The system was designed to include newly and previously diagnosed children, collect maternal, birth, and diagnosis-

specific information, and refer all children to case management services. The Autism Registry has also produced important information for policy makers about the age of diagnosis, the impact of race on the age of diagnosis, and the population risk factors that may exist in New Jersey.

Table 1. Race/Ethnicity of Children in the Autism Registry

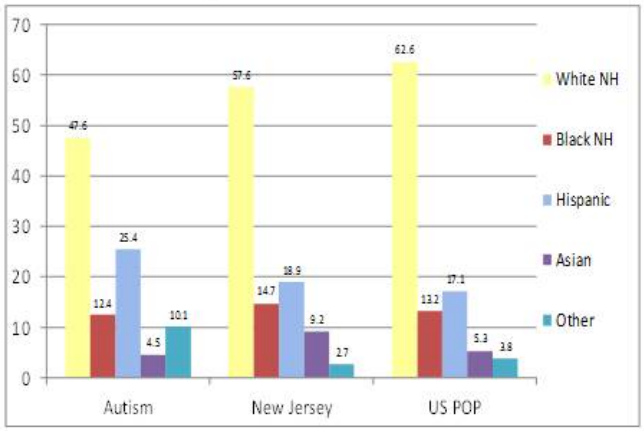
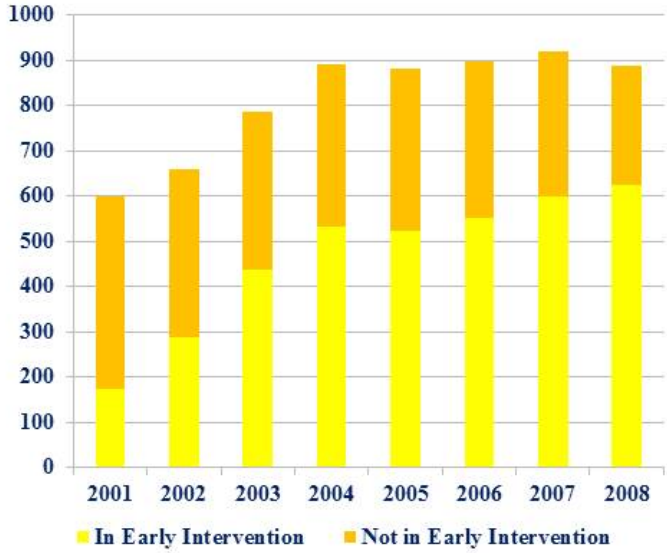


Table. 2 How Registry Data are used for Planning: Children in the Autism Registry who were in NJEIS for Birth Years 2001-2008



234 **166.234** The Relationship Between Use of Maternal Anesthesia during Delivery and Child Development at 12 Months in the Enriched Risk EARLI Pregnancy Cohort

S. C. Brown[1], *M. D. Fallin*[2], *C. J. Newschaffer*[3], *L. A. Croen*[4], *M. Stacy*[5], *M. Landrum*[6], *C. Walker*[7], *M. L. Massolo*[4], *R. Landa*[8], *J. Feinberg*[9], *K. M. Bakulski*[6], *I. Hertz-Picciotto*[10], *D. M. Caruso*[11], *X. Hong*[12] *and X. Wang*[13], *(1)Mental Health, Johns Hopkins University Bloomberg School of Public Health, Baltimore, MD, (2)Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD, (3)A.J. Drexel Autism Institute, Philadelphia, PA, (4)Division of Research, Kaiser Permanente, Oakland, CA, (5)Southern Illinois University- Carbondale, Carbondale, IL, (6)Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (7)MIND Institute, University of California, Davis, Sacramento, CA, (8)The Kennedy Krieger Institute, Baltimore, MD, (9)Johns Hopkins University, Baltimore, MD, (10)Dept of Public Health Sciences, School of Medicine, UC Davis MIND Institute, Davis, CA, (11)Center on the Early Life Origins of Disease, Department of Population, Family, Reproductive Health, JHBSPH, Baltimore, MD, (12)Johns Hopkins University School of Public Health, Baltimore, MD, (13)Center on Early Life Origins of Disease, Department of Population, Family, Reproductive Health, JHBSPH, Baltimore, MD*

Background: Many pre- and perinatal risk factors have been reported to increase the risk of ASD, including obstetric complications, antidepressant and anti-seizure medications, maternal infection, and pre-pregnancy BMI. The rate of maternal anesthesia use has tripled over the past 35 years and it is estimated that approximately 60% of US women receive some form of anesthesia during labor. Many of the anesthetics have been shown to move rapidly through the placenta, but research on the effects has focused mainly on short term outcomes.

Objectives: To evaluate the relationship between maternal anesthesia use during delivery and child development at 12 months based on the AOSI (Autism Observation Scale for Infants), in an ASD high-risk pregnancy cohort. To also evaluate the relationship between the specific types and doses of anesthetics used during delivery and child development and ASD diagnosis in an urban medical system.

Methods: Data are from the Early Autism Risk Longitudinal Investigation (EARLI) study and the Boston Birth Cohort (BBC). EARLI is an ASD high-risk pregnancy cohort that follows mothers of children with ASD from the start of a subsequent pregnancy through age 3 of the child. Available data include self-reported maternal medical, dietary, and health behaviors histories; labor and delivery; biological samples; and autism and other behavioral assessments. The AOSI is a play-based observational evaluation for children aged 6-18 months that has been correlated with later diagnosis of ASD. Of 259 live births in the EARLI cohort, 176 had both maternal labor and delivery records and AOSI scores available. The association between maternal use of anesthesia (all, epidural, spinal) and AOSI score parameterized as continuous and dichotomous (total AOSI>7) outcomes was estimated using multiple linear and logistic regression, respectively, while adjusting for potential confounders. The BBC is a prospective birth cohort of approximately 8,500 mother infant pairs. Available data include labor and delivery records, hospital and medical records. At this time there are approximately 107 children in the BBC with an ICD9 code indicating ASD. As a replication, BBC data will be analyzed to evaluate the relationship between specific anesthetics and the doses used during delivery and an ASD diagnosis.

Results: Twelve month AOSI score was significantly associated with the use of epidural (β = 2.3., p =0.005) and spinal (β = 2.6., p =0.002) anesthesia in the EARLI cohort with adjustment for gender, gestational age and father's ethnicity. After adjusting for cesarean delivery only epidural anesthesia (β = 2.5., p =0.002) was significantly associated with AOSI score. Similar results were seen whether AOSI was parameterized as dichotomous (top quartile) or continuous. No significant associations were found with AOSI score and other labor and delivery or maternal medical history risk factors examined. Replication analyses in the BBC sample are underway.
Conclusions: The use of maternal epidural anesthesia during delivery was associated with an increase in the 12 month AOSI score in 176 children in the EARLI cohort. BBC data will be analyzed to assess the drug and dose specific relationships between maternal anesthesia and a diagnosis of ASD.

236 **166.236** The Utility of Traditional Epidemiologic Designs in ASD Research

***M. D. Fallin**, Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD*

Background: Autism epidemiology can be informed through many design choices. For example, registry-based data have very large samples sizes and increased precision. However, they often lack detailed information about presentation, subtypes, exposures, and biosamples. More traditional case-control and cohort designs sacrifice precision given the typically much smaller sample sizes, but can capture deep phenotype and biomarker information.
Objectives: To describe the advantages and disadvantages of traditional case-control and cohort designs that include direct enrollment and participation, and to show the utility of such designs in ASD research.
Methods: We work primarily with three epidemiology studies of autism: a national population-based case-control study, an enriched risk pregnancy cohort, and a hospital system-based birth cohort. The Study to Explore Early Development (SEED) is a 6-site case-control study that recruits ASD cases, non-ASD developmentally disabled children (DD), and typical children (POP) aged 3-5 years via medical and education service providers (ASD and DD), and vital records (POP). The Early Autism Longitudinal Risk Longitudinal Investigation (EARLI) recruits pregnant women from 4 sites who already have a child with ASD and follow them through the pregnancy and the baby's first 3 years. The Boston Birth Cohort (BBC) recruits women 1-3 days post-delivery and follows the babies through childhood via direct contacts at routine clinic visits and via electronic medical records.
Results: SEED includes extensive interview-based information on peri-natal risk factors, maternal and child medical records, extensive clinical assessment, and biosamples of children and parents, enabling examination of environmental, genetic, epigenetic, and gene-environment hypotheses. While the case-control design allows relatively large sample sizes, it precludes biosample and exposure assessment in the perinatal risk period and is subject to recall bias. The EARLI study collects home environmental samples, parental, ASD case, and new sibling biosamples longitudinally beginning in pregnancy, extensive prospective questionnaire/interview data, and developmental phenotypes from 6 – 36 months. This allows very detailed analysis of exposures, genetics, and epigenetics at relevant time windows in different tissue types, as well as examination of ASD and related quantitative and longitudinal phenotypes. It is necessarily enriched risk to enable enough accumulated cases for study, but nevertheless is limited in total sample size. Finally, the BBC collects birth biosamples on mothers and babies, as well as later childhood biosamples, in addition to access to complete medical record information combined with prospective questionnaire data and neurodevelopmental screening. It has the advantage of large sample size and nearly exhaustive medical record access.
Conclusions: Studies that involve direct contact offer advantages to registry and HMO-based research that passively use data collected for other purposes. These include deep phenotyping data, biomarker availability, and a diversity of biosamples from relevant time windows. However, such studies are limited by design challenges and sample size. All design choices inform ASD epidemiology, services, and policy research in complementary ways and cross-collaboration between them can help to maximize that complement.

237 **166.237** Title: Investigation of Parental Priorities for Research in Children with Neurodevelopmental and Genetic Disorders: A National Irish Study

***N. Mc Devitt**[1], L. Gallagher[2] and R. B. Reilly[3], (1)Trinity College Dublin, Dublin, Ireland, (2)Psychiatry, Trinity College Dublin, Dublin, Ireland, (3)Department of Engineering, Trinity College Dublin, Dublin, Ireland*

Background: Very little research exists that investigates the opinions of people affected by neurodevelopmental disorders on a daily basis. The current research investigates what parents consider most important in terms of research for their children. This information my help to inform how funding is allocated and what areas need funding. Collaboration between families and the scientific community will create a research environment that is more structured and patient based.
Objectives: To conduct a consultation with the community of individuals impacted by neurodevelopmental disorders particularly Autism Spectrum Disorders (ASD) to better understand critical issues that the community might identify as priorities for research.
Methods: This research consisted of a 30 question survey, the aim was to collect both quantitative and qualitative responses from a significant number of parents. The survey was divided into several categories including; background, research priorities and motivations and barriers to research. A number of question types were utilised e.g Likert scale, multiple choice and answer boxes. The survey was distributed via www.surveymonkey.com, to parent advocacy groups and parent groups all over Ireland.
Results: 260 parents successfully completed the survey. 80% of Participants were parents of people with ASDs. Of all participants 33% said they had been approached to take part in research before and 22% of this group had taken part. The types of research that these participants took part in were mostly surveys (56%) and Interview Assessments (33%), with only one participant having taken part in a drug trial. The main research priorities for participants are development of services for adults and development of therapies/programs that aid day to day life (>90% Very Important). Development of methods for earlier/easier diagnosis was also deemed to a priority for research with (83% Very Important). Development of medicines is showing to be of least priority for parents. Parents indicated that if a therapeutic intervention was offered as part of the research" they would be more motivated to participate. Parents also reported that factors such as the location of the research centre and likelihood of causing distress to their child as reasons for them not to participate.
Conclusions: This research is particularly novel and timely due to the fact that there is very little research, which involves investigating research priorities for people who are affected by intellectual and developmental disabilities day to day. It was notable that only 22% of the people approached to take part in research ultimately participated. At a minimum this illustrates that researchers are challenged to communicate adequately regarding research methods to alleviate these concerns where these are unfounded. The survey clearly illustrated that parents prioritised clinical services research and interventions over basic scientific questions. Development of medicines was consistently reported to be of least importance to parents. Utilising the information gained from this research correctly may help to create a more friendly research environment which could increase research participation, develop research studies that aim to meet the needs of affected individuals and create more balanced allocation of research funding.

238 **166.238** Validation of the Spanish Version of the M-CHAT-R/F within the Public Health System

***M. Magan Maganto**[1], A. Aranz-Hernandez[1], M. Martinez-Velarte[1], S. Manso[1], A. De Pablos De La Morena[1], P. Garcia Primo[2], M. Posada[3], A. B. Sanchez-Garcia[1] and R. Canal-Bedia[1], (1)University of Salamanca, Salamanca, Spain, (2)Institute of Rare Diseases Research, IIIER, Carlos III National Health Institute, Madrid, Spain, (3)Carlos III National Health Institute, Madrid, Spain*

Background:
Different studies have shown that the M-CHAT is among the best screening tools for ASD in general populations studied so far (McPheeters et al., 2015), while the proportion of recognizing that identified ASD cases in the studies remains lower than the prevalence estimated by the CDC. Besides the M-CHAT can have a high rate of cases with suspected ASD initially requiring subsequent telephone follow-up.
A new version of the M-CHAT questionnaire, the M-CHAT-R / F is available (Robins et al., 2014) which includes a structured monitoring and referral and to apply a risk-based algorithm system levels, reducing the number of cases that require follow-up phone call. The M-CHAT-R / F seems to have better psychometric properties, but information about the feasibility and validity of this tool in a general population-based study is still necessary.
Objectives:
The main objective of this work is to validate the Spanish version of the M-CHAT-R/F. Furthermore, to describe the possibility of integrating the ASD screening practice, that has up till now been focused on research, into the national health system, as a standard practice for pediatricians who are responsible for well-child visits.
Methods:
The M-CHAT-R/F was translated into Spanish and a cross-cultural adaptation was performed. A population-based ASD screening programme using MCHAT-R/F Spanish version was established in two Spanish regions. Parents of 18 months and/or 24 months aged children were asked to fill in this questionnaire at the outpatient public health services (compulsory vaccination programme and well-child check-up programme respectively). The original MCHAT-R/F criteria and a refining procedure for the phone call were adopted after agreement with the MCHAT authors. The identification of false negatives is coordinated with the ASD early intervention centres, and the Hospital diagnosis units in both regions.
Results:
A total of 2970 questionnaires were administered to 2560 children from April 2014 to October 2015. Of the positive screening cases, 7 children have been diagnosed with ASD; 8 with non ASD disorders following the DSM-5 criteria; 3 with typical development; and 13 children that have not yet been evaluated. Only 10 families of the 62 positive cases from the questionnaire were unreachable during the item verification stage. The sensitivity and specificity obtained were 0.857 and 0.997, respectively. Positive predictive value was 0.429 and negative 0.999. Updated results will be presented in May 2016.
Conclusions:
The M-CHAT-R/F shows promise as a screening tool for developmental disorders in the general population. This work is an important contribution to ongoing research into identification of ASD at a young age. Although there have been many advances in the screening process, the tools used, and strategies to detect false negatives and reduce

false positive rates, ongoing study is needed to continue improving the early detection of autism.

239 **166.239** Variance in Autism Prevalence Across States: Links with Insurance Policy, Availability of Clinical Resources, Proximity to Research Institutions, and Presence of Awareness-Raising Organizations

*J. S. Kester[1], **T. L. Hill**[1], L. B. Swineford[2] and C. N. Baker[1], (1)Department of Psychology, Tulane University, New Orleans, LA, (2)Department of Speech and Hearing Sciences, Washington State University, Spokane, WA*

Background:
Not only are prevalence estimates of autism spectrum disorders (ASD) increasing, but marked variability in prevalence rates also exists across US states. While specific reasons for this variability remain unknown, previous studies have highlighted the influence of sociodemographic characteristics (e.g., maternal education), availability of educational and medical records, and variation in service models. However, variables related to state infrastructure such as healthcare and insurance policy, availability of clinical resources, location of federally-funded research institutions, and the presence of advocates and non-profit organizations dedicated to raising awareness about ASD have not yet been examined. Given that prevalence rates underlie policy, research, and practice decisions, understanding state infrastructure differences that impact ASD prevalence has important implications.
Objectives:
To determine if variation in ASD prevalence estimates across US states can be linked to between-state differences in policy, clinical resources, research institutions, and awareness.
Methods:
Data for independent variables were abstracted per standardized coding schemes from publically available databases such as those on the Autism Speaks and NIH RePORTER websites. States received a 0-6 score for healthcare and insurance policy based on number of insurance mandates providing coverage for ASD. States received a clinical resource score based on the total number of diagnostic resources, intervention resources, and board certified behavior analysts present in the state. Research institution scores were based on the number of institutions with active federal funding for autism research. Finally, states received an awareness summary score based on the number of advocates and non-profit organizations dedicated to raising awareness about ASD. The dependent variables were the published CDC/ADDM Network and IDEA Part B Child Count prevalence rates for ASD.
Results:
States had on average 3.18 (*SD*=1.42) of the attributes of comprehensive healthcare and insurance policy. Clinical resources (*M*=519.42, *SD*=774.84), the number of research institutions performing autism research (*M*=5.58, *SD*=6.87), and the number of groups that aim to raise awareness (*M*=51.34, *SD*=61.03) varied considerably across states. Policy, clinical, research, and awareness composites were not related to CDC/ADDM prevalence rates of autism (*rho*s=.26-.44, all *p*s>.10). States with and without CDC/ADDM data were also compared. States that provided CDC/ADDM prevalence rates had better policy than those that did not (*U*=86.5, *p*=.002); no significant differences were found for clinical, research, and awareness scores between states that did and did not provide CDC/ADDM estimates (*U*s=151.5-192.5, all *p*s>.10), In contrast to the CDC/ADDM prevalence rates, higher scores on policy (*rho*=.28, *p*=.05), clinical resources (*rho*=.90, *p*<.001), research institutions (*rho*=.76, *p*<.001), and awareness (*rho*=.88, *p*<.001) were all strongly related to higher IDEA prevalence rates. See Table 1 for descriptive statistics of resource summaries by state subgroup.
Conclusions:
Prevalence rates vary by state depending on the number of resources within that state focused on ASD. However, the relationship between prevalence estimates and resources also vary between the two main sources of prevalence estimates of ASD. Study implications for policy, research, and practice will be discussed.

Table 1

Descriptive Statistics of Resource Summaries by State Subgroup

	States with CDC/ADDM Prevalence Data (n = 11)			All States (n = 50)		
Variable	*M*	*SD*	Range	*M*	*SD*	Range
Policy	4.27	1.27	[1,6]	3.18	1.42	[1,6]
Insurance Mandate	.91	.30	[0,1]	.82	.39	[0,1]
Age Limit	.73	.47	[0,1]	.44	.50	[0,1]
Financial Limit	.55	.52	[0,1]	.45	.50	[0,1]
Mental Health Parity Law	.64	.50	[0,1]	.36	.48	[0,1]
ASD Waiver	.55	.52	[0,1]	.30	.46	[0,1]
HCBS Waiver	.91	.32	[0,1]	.92	.27	[0,1]
Clinical Resources	443.64	380.73	[39,474]	519.42	774.84	[6,3240]
Diagnostic	31.45	18.95	[8,66]	27.22	33.16	[1,164]
Intervention	134.27	108.26	[31, 408]	125.56	162.55	[4,784]
BCBA	277.91	262.40	[40,1021]	366.64	593.87	[6,3240]
Research Institutions	4.64	3.26	[1,12]	5.58	6.87	[0,30]
Awareness	51.36	25.41	[14,87]	51.34	61.03	[5,355]
Advocates	29.64	17.01	[5,54]	31.64	44.81	[2,262]
Non-Profits Organizations	21.73	10.44	[6,43]	19.70	18.32	[3,93]

Oral Session -
171 - Welcome Address
8:45 AM - 8:50 AM - Hall B

8:45 Welcome Address

Oral Session -
172 - Simons Foundation Update
8:50 AM - 9:00 AM - Hall B

Simons Foundation Update

8:50 Simons Foundation Update

Keynote Address
173 - "Moving the Needle" with Life Course Research on Autism
9:00 AM - 10:00 AM - Hall B

Speaker: P. Shattuck, A.J. Drexel Autism Institute, Drexel University, Philadelphia, PA

There have been many calls to “move the needle” on adult outcomes. What kinds of research might influence population-level outcomes and build the “gauges” that will let us see if the adult outcomes needle is moving over time? A life course perspective on autism has roots in sociology, public health and ecological models of human development. I will selectively describe some major tenets from this perspective. Then I will illustrate ways the AJ Drexel Autism Institute’s Life Course Outcomes research team has sought to examine specific topics and our attempts to connect research to policy and practice. Poor young adult outcomes are occurring despite historic record-setting levels of expenditures on research and interventions. My talk aims to stimulate discussion about how our field can tighten the linkage between research and improved outcomes that are observable at a population level.

9:00 “Moving the Needle” with Life Course Research on Autism

***P. Shattuck**, A.J. Drexel Autism Institute, Drexel University, Philadelphia, PA*

There have been many calls to “move the needle” on adult outcomes. What kinds of research might influence population-level outcomes and build the “gauges” that will let us see if the adult outcomes needle is moving over time? A life course perspective on autism has roots in sociology, public health and ecological models of human development. I will selectively describe some major tenets from this perspective. Then I will illustrate ways the AJ Drexel Autism Institute’s Life Course Outcomes research team has sought to examine specific topics and our attempts to connect research to policy and practice. Poor young adult outcomes are occurring despite historic record-setting levels of expenditures on research and interventions. My talk aims to stimulate discussion about how our field can tighten the linkage between research and improved outcomes that are observable at a population level.

Panel Session
174 - Life Course and Ecological Perspectives on Autism
10:30 AM - 12:30 PM - Hall B

Panel Chair: Paul Shattuck, *Suite 560, A.J. Drexel Autism Institute, Drexel University, Philadelphia, PA*

This panel’s purpose is to illustrate a range of types of questions and methods informed by life course and ecological perspectives. In general, these perspectives emphasize the social context of development and interventions, how social role attainment and performance intersect with social institutions, and a longitudinal perspective on individual development that pays particular attention to transitions and turning points. How life turns out is not solely a function of one’s behaviors, symptoms and individual abilities. Studies reported as part of this panel will examine topics including social networks and the social dynamics of intervention, barriers to positive outcomes during the transition to adulthood, stigma, and advocacy preparedness as a target of intervention.

10:30 **174.001** Out in the Cold: Adults with Autism Spectrum Disorders Post High School

***C. Anderson**[1] and A. Lupfer[2], (1)Department of Interprofessional Health Studies, Towson University, Towson, MD, (2)Towson University, Towson, MD*

Background: National data have revealed that adults with autism spectrum disorder (ASD) are not faring well as a group in the years post high school. Few live independently, many are disengaged from services, and participation in post-secondary education and the world of work is often restricted.
Objectives: To move beyond national statistics and determine why so many young adults with ASD are disengaged from services and educational or vocational opportunities in the years post high school.
Methods: Utilizing a qualitative, grounded theory approach, 90 minute interviews were conducted with twenty parents of young adults with ASD who were 1-15 years post high school. These young adults had been either “certificate-bound,” exiting high school around age 21 (n=7), or “diploma-bound,” exiting around age 18 (n=13). Inclusion of both groups yielded experiences from across the autism spectrum. Parents shared information about their young adult’s experiences surrounding transition. Interviews were transcribed and de-identified. We used Atlas.ti to apply the *constant comparative method*. First, key themes based on participants’ experiences and beliefs were identified (e.g. a number of families described how services provided to their adult child were inappropriate and did not meet the adult child’s needs). Second, material associated with each theme was divided into meaningful categories (e.g. “inappropriate services” was subdivided into access, program, and staffing issues). Finally, statements of relationship were developed to link key themes, categories, and outcomes. An example would be the linking of one theme – the fact that ASD is misunderstood by people in many institutions and settings – to another – services that don’t meet the needs of people with ASD.
Results:
You walk outside the public school system, you hear the doors slam behind you. They are iron, steel doors. They are not letting you in. That money’s over. And you’re in a world of like what just happened? – mother of a 30 year old man with autism.
School transition processes were frequently judged inadequate. Youth crises surrounding transition were common and sometimes severe. Families often found adult services inaccessible or inappropriate, forcing the “round peg” of ASD into the “square hole” of a program developed for people with other disabilities. Social-emotional delay and lack of independent living skills hindered success at college while the interview process and social complexity of the workplace presented barriers to those seeking employment. When other systems failed to meet young adults’ needs, families struggled to do so with substantial emotional and financial consequences. Success stories and imagined solutions provided insight into programs and approaches that may yield more encouraging outcomes.
Conclusions: This qualitative study takes the initial steps necessary to generate insight into the mechanisms and experiences behind dismal national statistics on outcomes for young adults with ASD. It identifies major challenges and successes, and begins to categorize these based on individual, family and community characteristics. It therefore provides a preliminary conceptual model of disengagement that illustrates what is going wrong (or right), and for whom – a necessary precursor to developing effective strategies to improve outcomes.

11:00 **174.002** Toward Social Acceptance of Autism: Listening to Autistic People

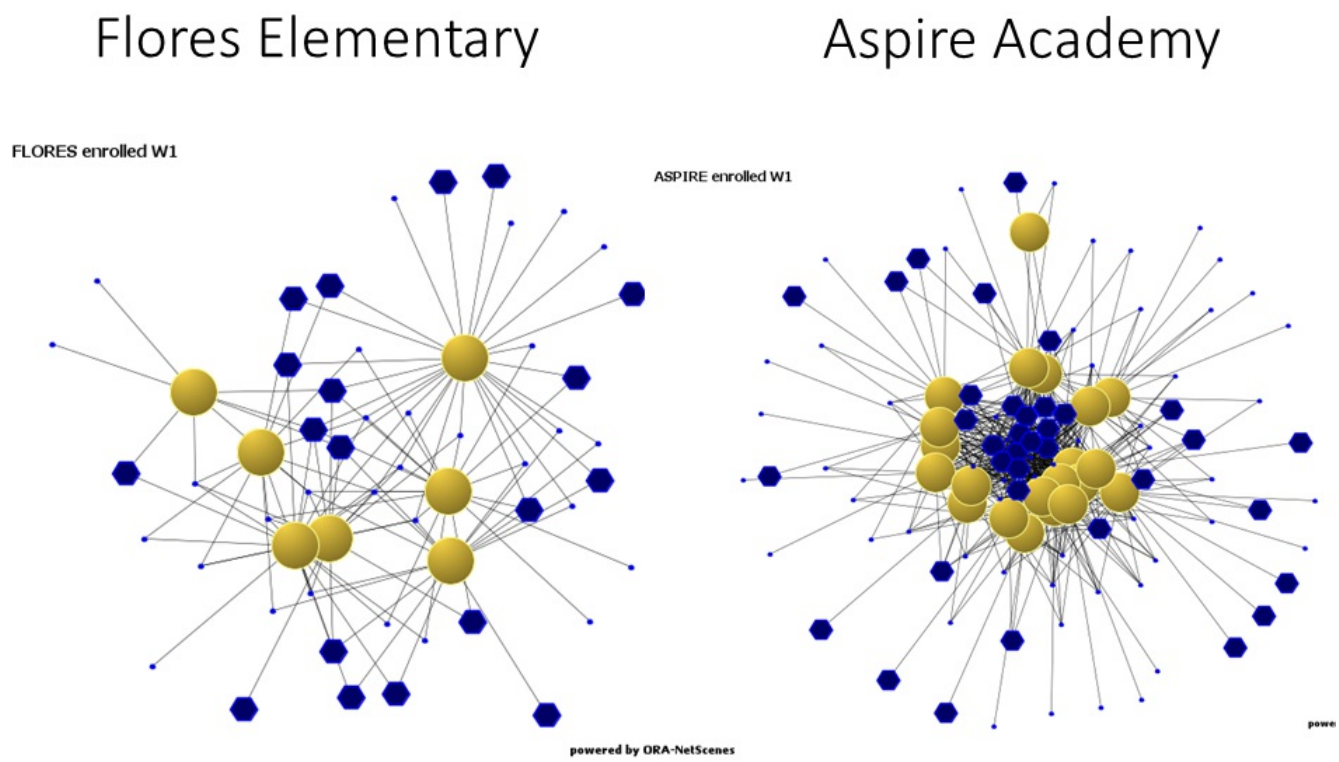
***S. K. Kapp**[1] and K. Gillespie-Lynch[2], (1)University of California, Los Angeles, Los Angeles, CA, (2)City University of New York, College of Staten Island, Staten Island, NY*

Background: In the first study to compare knowledge and stigma toward autism among autistic adults, family members, and the public, we found that autistic adults exhibited significantly more knowledge of autism than the public, especially in terms of strengths (Gillespie-Lynch, Kapp et al., 2015). Autistic adults reported the least autism stigma and defined autism in the least medical terms; stigma was inversely related with knowledge. Findings challenge the clinical notion that autistic people lack perspective on autism, and suggest the need for more nuanced inquiry into possible inaccuracy and harm arising from the medical emphasis on changing autistic people rather than their environments.
Objectives:
1) Examine associations between normalization-related attitudes and autism knowledge/stigma in an online sample of autistic adults, nuclear family members, and the public.
2) Evaluate critiques of scientific knowledge about autism (an autism training and associated measures) by survey participants.
3) Compare in-person discussions of the training by autistic high school and college students to findings from the online sample.
Methods: An online survey of autistic adults ($N = 309$), nuclear relatives of autistic people ($N = 188$), and the public ($N = 139$) assessed autism knowledge, autism stigma, and related attitudes (Gillespie-Lynch et al., 2015). Participants could provide open-ended elaborations to responses. We qualitatively coded open-ended elaborations to the item from each category of questions about autism (e.g., importance of a cure/cause/normalcy, stigma, and knowledge) that yielded the highest effect size when comparing across groups. Sixteen autistic high school and college students discussed the training as part of a summer program. Their perspectives will be coded and compared to the online sample. Only $p <= .001$ are reported as significant.
Results:
Greater endorsement of the importance of normalizing autistic individuals, curing autism, and finding the cause of autism were associated with more stigma across groups. Greater endorsement of normalizing/curing autism was associated with less knowledge across groups (the association between cure and knowledge was a trend for the public; $p = .006$).
Recognition that autistic people have empathy was associated with the largest group difference for knowledge items. In elaborations, autistic adults exhibited a trend toward reporting an excess of empathy relative to family members ($p < .008$).
The stigma item yielding the largest effect size difference assessed willingness to marry an autistic person. Autistic participants more often elaborated that they would prefer an autistic romantic partner than family and the public, although the latter was a trend ($p = .002$).
The largest effect size difference in normalization-related attitudes reflected autistic adults endorsing the least interest in curing autism. In their elaborations, they most opposed the medical model and the view that autism is a disease.
Conclusions: Society may stigmatize autistic people and disadvantage their development by overlooking their perspectives and overpathologizing differences. Disinterest in normalizing autistic individuals had the most consistent relationship with knowledge of and lack of stigma toward autism. Findings question whether losing an autism diagnosis constitutes an “optimal outcome”. Individuals’ manifestations of autism may decline despite persistent adaptive impairments as they seek acceptance in an often unaccepting society.

11:30 **174.003** Measuring Changes in Collaborative Networks Among Parents and Autism Intervention Providers

E. McGhee Hassrick[1] *and K. Carley*[2]*, (1)Weill Cornell Medical College, Ossining, NY, (2)Carnegie Mellon University, Pittsburgh, PA*

Background: To manage a child's autism treatment effectively, parents need to learn specialized knowledge, skills and scientific information about autism and its treatment; master particular teaching skills; obtain information about where to find services; gain familiarity with special education laws; negotiate on behalf of their children with many different types of clinical providers and coordinate interventions with school providers, where children with autism receive many of their services. Who do parents collaborate with as they manage their child's interventions, over their child's life course? We do not currently have a systematic way of mapping the emergence and subsequent changes in collaborative networks among parents, community providers and teachers, around individual children with ASD, to examine how these emergent networks influence intervention selection and implementation and a parent's knowledge or monitoring capacity for their child.
Objectives: This research study used innovative dynamic social networks techniques to measure changes over time in the collaborative networks that emerged around 45 individual children with ASD, situated in two different urban, public schools, named "Aspire" and "Flores". For each child's collaborative network, we analyzed changes over the course of one school year in the implementation and alignment of interventions; the use of autism resources; and the completion of autism trainings. We concurrently tracked changes in the coordination, problem solving and trust networks that provided interventions for each child. Examining the social network processes that emerge around the child help us to identify interactional mechanisms that inform the ongoing treatment of children diagnosed with autism, as they develop across the life course.
Methods: We conducted 90 network surveys with school teachers, aides, clinicians and parents, at the fall, spring and summer of one school year, wherein they reported coordination, resource, training and intervention implementation for forty five children diagnosed with autism spectrum disorder. Parent and autism provider network survey data was analyzed using ORA for dynamic, multi-modal networks and network visualizations.
Results: Findings confirmed that problem solving and collaboration between parents and school staff varied across children and across schools, with most parents at Aspire frequently connected to multiple staff throughout the school year, compared with few parents at Flores. Child treatments at Aspire were more often shared among providers, with low exclusivity scores (0.2 to 4.0), while at Flores, they were idiosyncratic, with higher exclusivity scores (2.0 to 8.0). See Figure 1. Autism resource and training networks were also clustered among parents and staff at Aspire as compared with Flores. Parents and staff at both schools accessed far more general autism resources, than specific, and was more robust in fall.
Conclusions: Findings suggest that dynamic networks of children at Aspire were aligned around a particular group of treatments with related resources and trainings, making each child's map more similar, over time, at Aspire. Dynamic networks at Flores were more idiosyncratic, with lower overall levels of frequent problem solving between parents and school providers, suggesting a more individualized, less aligned approach to management.



12:00 **174.004** Ecological Approaches to Transition Interventions in ASD: Training Parents to More Effectively Navigate the Adult Service System

J. L. Taylor[1]*, R. Hodapp*[2]*, M. Burke*[3] *and C. Rabideau*[2]*, (1)Vanderbilt Kennedy Center, Nashville, TN, (2)Vanderbilt University, Nashville, TN, (3)University of Illinois, Urbana-Champaign, Urbana, IL*

Background: Although there is an increasing body of descriptive and intervention work that aims to improve the transition to adulthood for youth with autism spectrum disorders (ASD), most studies focus on characteristics of the youth themselves. Yet, the ecological contexts in which these youth are found also play critical roles in transition outcomes. In this study, we report initial findings from a small randomized-controlled trial (RCT) that intervenes at the level of the family, by training parents how to more effectively interface with the adult service system.
Objectives: The study's goal was to test whether, for parents of transition-aged youth with ASD, participating in a parent advocacy intervention led to increased knowledge about the adult service system; greater feelings of empowerment; increased advocacy skills; and increased connectedness with the disability community.
Methods: This study has two phases. In Phase 1, we recruited seven families of transition-aged youth with ASD, who participated in a pre-pilot of the 12-week parent advocacy intervention. In Phase 2, we examined the intervention using an RCT, waiting-list control design with 45 families of transition-aged youth with ASD. Families were randomly assigned to either the intervention group (Fall 2015) or a wait-list control (who will receive the intervention in Spring 2017). Participant characteristics are presented in Table 1. In Phase 2, the intervention was delivered in three locations: in person in Nashville, TN, and via webcast in Chattanooga and in Memphis. All youth had ASD diagnoses confirmed using the Autism Diagnostic Observation Schedule-2 administered by research-reliable clinicians.
The intervention group met weekly for 12 weeks; each session lasted 2.5 hours. Sessions covered aspects of the adult service system (e.g., Vocational Rehabilitation, post-secondary education programs, SSI, SSDI) and advocacy skills. Primary outcomes, measured before and after the intervention, included knowledge about the adult service system; advocacy skills and comfort, family empowerment, and connectedness to the disability community.
Results: In Phase 1, six of seven families provided data. After taking the intervention, parents reported increased advocacy skills/knowledge, paired $t(5)=-6.52$, $p<.001$, connectedness to the disability community, paired $t(5)=-3.05$, $p<.05$, and knowledge of the adult disability service system, paired $t(5)=-2.08$, $p=.09$. No significant changes

occurred in family empowerment.
For Phase 2, pre-test data collection has now been completed, with post-test data collected in December 2015/January 2016. Beyond examining changes in primary outcomes for the treatment vs. control group, we will also explore potential moderators of treatment response, including characteristics of offspring (intellectual disability vs. no intellectual disability), training (in person vs. via webcast), and family (high vs. low parent stress).
Conclusions: From initial findings, it appears that participating in the parent advocacy training can improve parents' ability to advocate for adult services for their son/daughter with ASD. In future analyses, we will examine whether improving parents' capacity to advocate also changes "broader" transition outcomes (e.g., employment, community integration) – and, if not, which barriers might be in place. More generally, discussion will highlight the continued role of the family in the lives of individuals with ASD across the lifespan.

Panel Session
175 - Towards Big Data Approaches in Eye Tracking
10:30 AM - 12:30 PM - Room 307

Panel Chair: Frederick Shic, *Yale Child Study Center, Yale University School of Medicine, New Haven, CT*

Discussant: Ami Klin, *Department of Pediatrics, Emory University School of Medicine, Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, GA*

Eye tracking has become a core research methodology for understanding human development, social cognition, and neuropsychiatric conditions. In this panel, we follow the next logical evolution of eye tracking in autism research towards large scale studies that begin to blur the line between research technique and practical tool. The thematically-linked presentations in this panel report on new eye tracking findings involving four institutions and 1,808 unique participants including 696 individuals with ASD. Weaving between the science enabled by eye tracking and the eye tracking enabled by methodological advances, the goal of this panel is to provide perspectives on (1) what eye tracking across large samples tells us about autism, (2) the potential of eye tracking as a practical tool for discovery, therapeutics, and phenotyping, and (3) the methodological issues that must be addressed to enable the next generation of big data studies using eye tracking in autism research.

10:30 **175.001** The Search for Biomarkers and Clinically Meaningful Subtypes of ASD Based on Eye Tracking Data

K. Pierce[1], *A. Moore*[2], *S. Pence*[1], *C. Carter*[1], *D. Cha*[1] *and E. Courchesne*[1], *(1)Neuroscience, UCSD Autism Center of Excellence, La Jolla, CA, (2)University of California, San Diego, La Jolla, CA*

Background: Our understanding of autism as a heterogeneous disorder and the pressing need to discover and understand potential subtypes has emerged as a high research priority. Markers that precede diagnosis or indicate ASD subtypes are extremely valuable because of their potential implications about causes, mechanisms, prognosis, and treatments. However, discovering and understanding such subtypes requires large sample sizes. In 2011 we published an eye tracking study that included 110 toddlers (Sample 1) and in 2015 examined an additional sample of 334 children (Sample 2) and raised the possibility that markers based on eye tracking, if robust, could be considered biomarkers of ASD (Pierce et al., 2011, 2015). In both studies we discovered that a percentage (~20%) of ASD toddlers showed unusually high fixation levels on geometric rather than social images, a profile not often seen in typically developing or non-ASD contrast groups (Specificity 98%, PPV 89%). Since that time we have collected data on another independent sample (Sample 3) of 387 toddlers that has not yet been published. Presumably if experience dependent mechanisms play an important role in how a child develops, the degree to which abnormal visual attention persists during early development may have some power to predict later outcome. Moreover, if a true "biological subtype" is discovered, persistent visual attention traits within an individual toddler might be in evidence across different eye tracking paradigms.
Objectives: As part of an education motivated panel, the primary objective is to discuss the ways in which such a large dataset could be examined. Topics relating to disentangling heterogeneity and the value of eye tracking indices as diagnostic and prognostic biomarkers will be considered. Other topics include examination of state and trait markers and stability of responding across time and different paradigm types to discover a true biotype.
Methods: Combining Samples 1-3, a total of 837 toddlers participated and included 242 ASD and 595 contrast toddlers (LD, DD, Typical, Typical Sibling and "Other") ranging in age from 12-48 months. Using a Tobii wireless eye tracker, all toddlers participated in the "GeoPref Test", a 1-minute movie containing both dynamic geometric and social images. Fixation duration within each area of interest and number of saccades were recorded. Toddlers were diagnostically and psychometrically evaluated at time points both proximal and distal to the eye tracking session. In order to examine stability of responding across paradigms, toddlers participated in several different eye tracking tests beyond the GeoPref Test, such as one containing complex social interactions.
Results: Data from the new unpublished sample (Sample 3), replicates the finding that overall ASD toddlers fixate more on geometric images than other diagnostic groups (e.g., ASD vs TD, $t_{212} = 8.37$, $p<.0001$, CI of the difference = 17.6%-28.5%). Other analyses will be performed to understand subtypes, examine visual attention across time and consider how a child's visual fixation patterns at ages 1-2 years might predict his outcome at ages 3-4 years.
Conclusions: Eye tracking is a powerful tool for discovering subtypes of ASD and for understanding its early course.

10:55 **175.002** Large Scale Eye Tracking in EU-AIMS Longitudinal Autism Research Project (LEAP): Methods and Preliminary Findings from a Biological Motion Task

L. Mason[1], *F. Shic*[2], *E. Loth*[3], *T. Banaschewski*[4], *S. Baron-Cohen*[5], *S. Bolte*[6], *T. Bourgeron*[7], *T. Charman*[8], *S. Durston*[9], *M. H. Johnson*[10], *A. M. M. Persico*[11], *J. K. Buitelaar*[12], *D. G. Murphy*[13] *and W. Spooren*[14], *(1)European Autism Interventions - A Multicentre Study for Developing New Medications, Basel, Switzerland, (2)Yale Child Study Center, Yale University School of Medicine, New Haven, CT, (3)Institute of Psychiatry, King's College London, London, England, United Kingdom of Great Britain and Northern Ireland, (4)University of Heidelberg, Heidelberg, Germany, (5)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (6)Department of Women's and Children's Health, Pediatric Neuropsychiatry Unit, Karolinska Institutet, Stockholm, Sweden, (7)Institute Pasteur, Paris, France, (8)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (9)Rudolf Magnus Institute of Neuroscience, University Medical Center Utrecht, Utrecht, Netherlands, (10)Birkbeck, University of London, London, United Kingdom of Great Britain and Northern Ireland, (11)Child and Adolescent Neuropsychiatry Unit, Lab of Molecular Psychiatry and Neurogenics, University Campus Bio-Medico, Rome, Italy, (12)Radboud University Medical Centre, Nijmegen, Netherlands, (13)Sackler Institute for Translational Neurodevelopment, Department of Forensic and Neurodevelopmental Sciences,, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (14)Roche, Basel, Switzerland*

Background: There are no effective treatments for the core symptoms of ASD because the underlying pathophysiology(ies) remain(s) poorly understood. Clinical trials are hampered by the profound clinical and etiological heterogeneity among individuals with ASD, as any treatment is likely only effective in some biological sub-groups. Large-scale multi-disciplinary studies and new biomarker stratification approaches are needed to identify more biologically homogeneous ASD subgroups. The EU-AIMS Longitudinal European Autism Project (LEAP) is conducted in seven European centres and will include approximately 400 individuals with ASD from 6-30 years, and 250 controls with typical development or diverse intellectual disabilities.
We present here preliminary data from a subsample (N = 197) of the LEAP dataset, focusing on one of our eye tracking tasks which measures differences in preference for biological and non-biological motion. From birth both humans and animals exhibit such a preference, suggesting that attention to biological stimuli is important for the development of effective social interaction and nonverbal communication.
Objectives: To assess preference for biological motion across adolescence and adulthood in a large international sample. We use this data to illustrate some of the processes we developed to manage the acquisition, quality control and analysis of large volumes of multi-site eye tracking data, and to discuss some of the challenges and promises of a big data approach to clinical and developmental research. We also touch on the potential for concurrent multimodal approaches to clinical and developmental research by combining behavioural, video, eye tracking, EEG and physiological (GSR, ECG) data types.
Methods: As part of a 40-minute battery of eye tracking tasks, adults (38 ASD, 51 TD) and adolescents (54 ASD, 34 TD) viewed point light displays of biological motion, paired on a trial-by-trial basis with either scrambled or rotating non-biological motion. Gaze behaviour was recorded by eye trackers and was stored, subjected to quality control, and analysed using custom-written Matlab scripts. Datasets were batch processed without manual intervention.
Results: Compared to neurotypical controls, individuals with ASD looked less at the biological motion than the control stimuli ($F=6.931$, $p=.009$, $d=.309$). The distribution of scores in the ASD group compared to the neurotypical group mean showed that 26.5% performed below 1SD (TD = 16.7%), and 2% performed below 2SD (TD = 1%). All participants looked longer at biological motion when it was paired with a rotating than a scrambled control stimulus ($F=108.895$, $p<.001$, $d=.513$) but this did not differ by diagnosis.
Conclusions: The preliminary results from the biological motion task suggest it has the potential to function as a stable biomarker in individuals with an ASD across the ages of 13-30 years. Further analyses once data collection is complete will allow us to extend this to children aged 6-12 years, and to relate these findings to ASD symptomatology and quality of life measures, in order to understand whether individuals can be stratified on this measure. The data processing pipelines developed for LEAP enabled large quantities of data to be stored and analysed efficiently in a structured and highly accessible manner.

11:20 **175.003** Children with ASD Look Less at Faces When It Really Matters

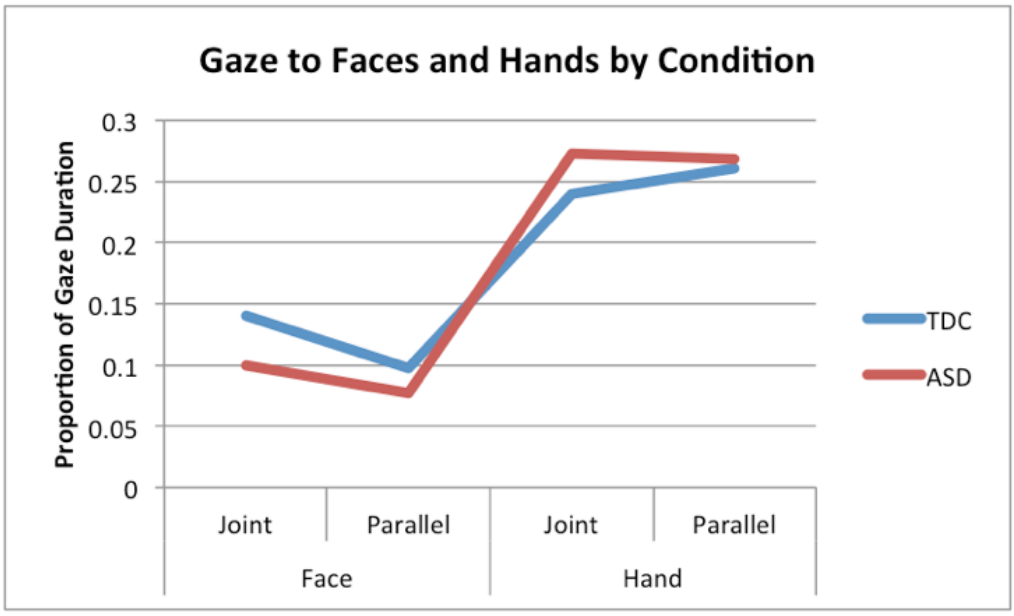
J. Parish-Morris[1], *C. Chevallier*[2], *B. E. Yerys*[3], *J. Herrington*[4], *E. S. Brodkin*[5] *and R. T. Schultz*[6], *(1)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (2)Laboratoire de Neurosciences Cognitives, INSERM, Paris, France, (3)The Center for Autism Research, Philadelphia, PA, (4)The Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (5)University of Pennsylvania, Philadelphia, PA, (6)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA*

Background: Attention to social stimuli is often evident from birth. All social stimuli are not created equal, however, nor should they be weighted the same regardless of context. Sometimes it is important to look at gestures or posture, and other times (as in the case of nonverbal communication between two people) it is especially important to look at faces. In this study, we test the hypothesis that typically developing individuals look more at faces than at other interesting stimuli (hands playing with toys) when they watch videos of children playing together versus separately. We further hypothesize that contextual modulation of social attention is diminished in individuals with Autism Spectrum Disorder (ASD), which is characterized by social impairment. Acquiring a large, heterogeneous sample aged 3-18 years allowed us to probe for subgroups within ASD that demonstrate distinct gaze patterns, and to correlate eye gaze data with diverse clinical phenotypes.
Objectives: Compare rates of looking to faces versus hands in the context of joint play and parallel play in children with ASD and typical controls, and assess whether looking patterns correlate with clinical ratings of autism severity.
Methods: Participants (ASD: N=154; TDC: N=66; Table 1) watched videos of children engaged in either joint interactive play or parallel play. A Tobii X120 infrared eye tracker recorded the direction and duration of participants' gaze to dynamic areas of interest (AOI) that were drawn around the faces and hands of actors while they played with toys. We calculated the proportion of participants' gaze to each AOI type relative to their total attention on the full screen. We used calibrated severity scores from the ADOS-2 for correlations. Groups differed on IQ and age, so we entered these variables as covariates.
Results: An analysis of covariance with condition (joint, parallel) and stimulus type (face, hands) as within-subjects factors and diagnosis (ASD, TDC) as a between-subjects factor revealed a significant 3-way interaction, $F(1,213)=14.15$, $p<.001$, $\eta_p^2=.06$. Both groups increased looking to faces in the joint vs. parallel condition ($ps<.05$), but the ASD group looked less at faces and more at hands than the TDC group in the joint condition ($ps<.001$ and .02; no differences in the parallel condition; Figure 1). Total proportion of gaze to faces in the joint condition was negatively correlated with ADOS-2 severity scores in the ASD group (*Pearson*=-.18, $p=.03$).
Conclusions: Children with ASD and control participants looked more at faces during nonverbal communication, but this effect was dampened in ASD. Reduced gaze to faces in a communicative context was associated with increased ASD symptoms. Between now and May 2016, we will assess test-retest reliability of this paradigm in 90 participants that provided 2 time points, analyze existing data from an additional 60 participants (including 30 adults with ASD), and recruit 30 typical participants to match our ASD adults, thus extending our analysis into adulthood to examine effects of age on visual attention to faces. We will discuss special challenges and rewards associated with collecting gaze data across multiple years in a heterogeneous population.

Table 1. Participant information. IQ scores are missing for 3 participants in the ASD group, and ADOS severity scores are missing for 9 participants.

	ASD	TDC	Difference
Males (females)	145 (9)	60 (6)	Chi square = .77, p = .39
Age Mean (SD)	11.79 (3.33)	12.84 (2.97)	$t = 2.22$, $p = .03$
IQ (DAS-II) Mean (SD)	93.11 (25.67)	112.15(18.03)	$t = 5.46$, $p < .001$
ADOS severity Mean (SD)	7.14 (2.15)	.	.

Figure 1. A three-way interaction between diagnosis, stimulus type, and condition emerged from the gaze data. Children with ASD looked more at hands and less at faces in the joint condition than TDC participants.



11:45 **175.004** Eye Tracking in Between: Gaze Behaviors on Structural Trial Components in Toddlers with ASD

F. Shic[1], *Q. Wang*[1], *C. A. Wall*[1], *A. Naples*[2], *S. Macari*[1] *and K. Chawarska*[1], *(1)Yale Child Study Center, Yale University School of Medicine, New Haven, CT, (2)Child Study Center, Yale School of Medicine, New Haven, CT*

Background:
Individuals with ASD look at social information atypically in multiple contexts and across their lifespan. These atypicalities have been quantified through eye tracking, typically

through repeated presentation of experimental stimuli. Trials in these paradigms often begin with (1) a central fixation (CF) simultaneously displayed with salient sound to orient participants to a consistent visual starting point, (2) followed by the stimulus of interest, (3) followed by an interstimulus interval (ISI; e.g. blank screen) to disrupt visual processing. Little is known about the behaviors of individuals with ASD during these structural components of experimental trials.

Objectives:

To examine eye tracking data metrics collected from CFs and blank screen ISIs across several years of studies on young children with ASD in order to gain insights into attentional processes associated with developmental heterogeneity. More broadly, to discuss strategies for large-scale aggregation of eye tracking data, techniques to enable long-term consistency in data acquisition, and unique opportunities for studying early typical and atypical human development.

Methods:

Data were collected from toddlers (N=554) 1 to 3 years of age with confirmatory diagnoses of ASD (N=208, age=23.3months), developmental delay (DD, N=59, 23.5m), or typically development with or without a sibling with ASD (TDHR, N=57, 24.1m, and TDLR, N=230, 24.2m, for High Risk and Low Risk for ASD, respectively). CFs were analyzed for valid data retention (%Valid) and looking time at the CF (%CF) in 200ms bins up to 1s of total presentation time. Blank ISIs were examined for blinks and fixation counts as defined by a 1 degree 80ms distance dispersion algorithm. Linear mixed model analyses on over 2.5 million sifted rows of data with group x age x bin + Mullen nonverbal developmental quotient (NVDQ) fixed and intercept with bin slopes by subject nested in protocol random effects for CFs and group x age + NVDQ with subject intercept random effects nested within protocol for ISIs.

Results:

Toddlers with ASD looked longer at screens with CFs (%Valid) than DD (p<.05, d=.39), TDHR (p<.01, d=.31), and TDLR (p<.01, d=.20) toddlers, though they showed less looking with age compared to other groups (all p<.01). Similar results were found for %CF for age-related changes (p<.01), though only ASD-TDHR contrasts were significant (p<.01). For blank ISIs, toddlers with ASD also showed more Valid data and fewer blinks than TDHR (p<.001,p<.01) and TDLR (p<.001,p<.001) but not DD (p=.11,p=.37) groups, and more fixations than the TDHR group (p<.001). Higher NVDQ was associated with more %Valid, fewer blinks, and more fixations.

Conclusions:

Toddlers with ASD show increased looking towards scenes with salient non-social perceptual cues, as evident in CFs, but also during periods of visual inactivity. They also show greater exploratory activity during these blank trials as evident by more fixations, and may show decreased disengagement from the computer monitor in general, as evidenced by decreased blink rates and. These results contrast to opposing effects observed for social events (Shultz, Klin, & Jones, 2011; Chawarska, Macari, & Shic, 2012). Applications of explored approaches will be discussed.

Panel Session
176 - Recent Advances in Statistical Methods for Autism Research
10:30 AM - 12:30 PM - Room 308

Panel Chair: Elizabeth Stuart, *Johns Hopkins School of Public Health, Baltimore, MD*

Discussant: Elizabeth Stuart, *Johns Hopkins School of Public Health, Baltimore, MD*

Many complexities arise when studying individuals with Autism Spectrum Disorders (ASD), including challenges in measuring key constructs as well as in estimating the effects of exposures or interventions. This panel will highlight recent advances in statistical methods that are relevant for autism research. The first talk will discuss measurement challenges and specifically how to use Item Response Theory to equate ADOS modules 1 and 2, allowing longitudinal analysis across time. The other three talks will discuss various advances in estimating causal effects: innovative randomized designs for studying adaptive interventions (with three examples of using these designs to study interventions for children with ASD), clever use of non-experimental data to estimate the effects of non-randomized exposures (applied to examining the effects of antidepressant use during pregnancy), and the use of propensity scores to equate two groups (applied to examining the associations between prenatal nutritional supplementation and ASD). Attendees will come away with a better understanding of advanced statistical methods and how new methods can help them obtain better answers to more nuanced questions of relevance to autism research.

10:30 **176.001** Development and Validation of a Harmonized Scale of Autism Symptom Severity Across ADOS Modules 1 and 2: A Bsrc Study

A. Gross[1], *L. Kalb*[2], *G. S. Young*[3], *E. Stuart*[2], *R. Landa*[4], *T. Charman*[5], *K. Chawarska*[6], *T. Hutman*[7], *D. S. Messinger*[8], *S. Ozonoff*[9], *W. L. Stone*[10], *H. Tager-Flusberg*[11] *and L. Zwaigenbaum*[12], *(1)Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (2)Johns Hopkins School of Public Health, Baltimore, MD, (3)Psychiatry & Behavioral Sciences, UC Davis MIND Institute, Sacramento, CA, (4)The Kennedy Krieger Institute, Baltimore, MD, (5)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (6)Yale Child Study Center, Yale University School of Medicine, New Haven, CT, (7)University of California Los Angeles, Los Angeles, CA, (8)Psychology, University of Miami, Coral Gables, FL, (9)UC Davis MIND Institute, Sacramento, CA, (10)Department of Psychology, University of Washington, Seattle, WA, (11)Boston University, Boston, MA, (12)University of Alberta, Edmonton, AB, Canada*

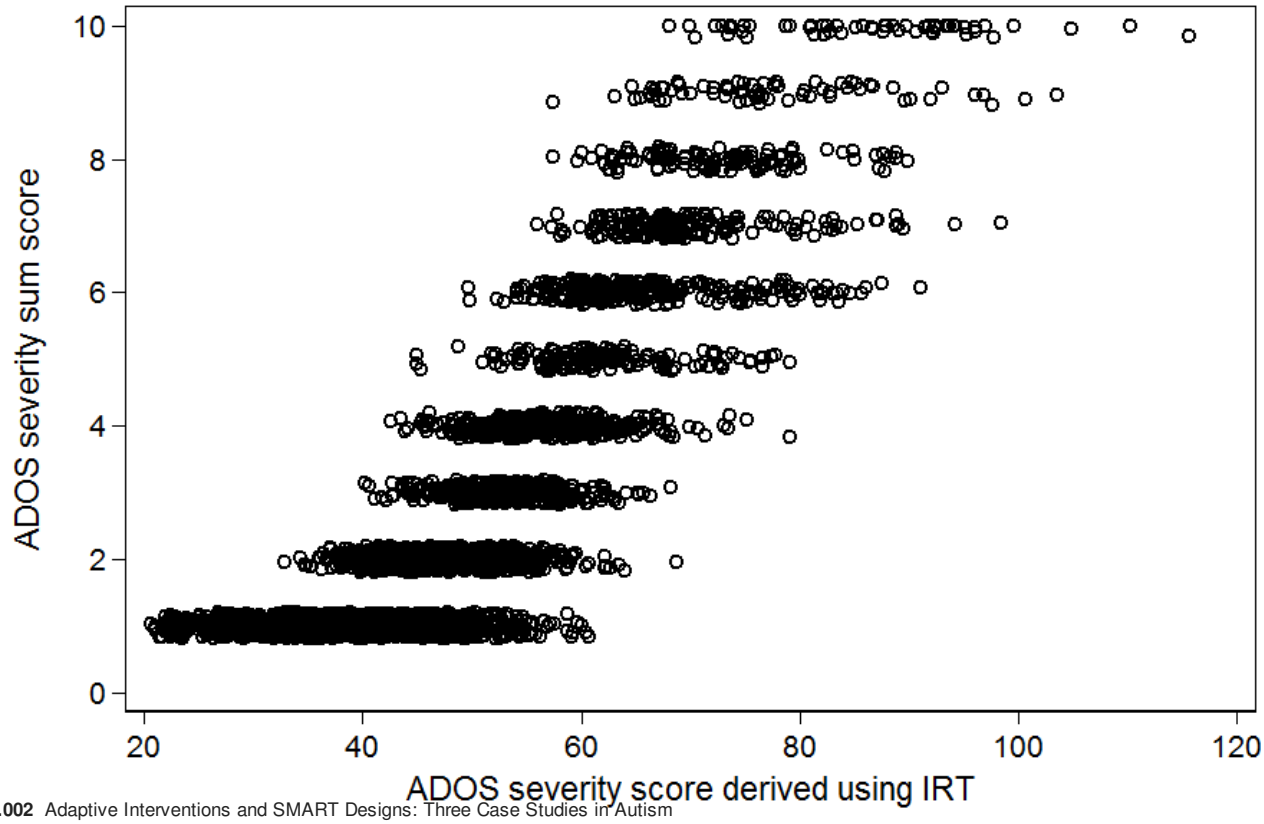
Background: The Autism Diagnostic Observation Schedule-Generic (ADOS-G) is a gold standard diagnostic assessment for autism spectrum disorders (ASD). The ADOS-G overall calibrated severity score (CSS), which provides a 10-point common metric across all ADOS modules, has several measurement limitations, including ceiling/floor effects, limited scoring range, collapsing of symptom domains, and questionable measurement invariance across modules. Failure of the overall CSS to capture heterogeneity in children with ASD led to research that culminated in defining separate CSS scores for social affect (SA-CSS) and restricted and repetitive behavior (RRB-CSS) domains. However, there is substantial overlap in distributions of domain calibrated scores of children with and without ASD. An alternate metric of ASD severity with expanded range may be more sensitive to differences in ASD behavioral phenotype and to changes in ASD severity over time.

Objectives: The goal of this study was to derive an alternative to the overall CSS that could be used across ADOS-G modules 1 and 2 for use in longitudinal research. Despite the introduction of the ADOS-2, many sites and consortia have substantial longitudinal ADOS-G data. We used item response theory (IRT) to provide a finer, more precise score on a metric common across modules 1 and 2.

Methods: Using data from the Autism Speaks Baby Sibs Research Consortium (N=2191 with 6237 observations, age range 24 - 48 months) with a broad range of autism severity (N=755 low-risk siblings, N=1436 high-risk), we applied graded response IRT models to equate the 21 items of the ADOS that were highly consistent in the nature of the behavior being scored and scoring criteria across ADOS modules 1 and 2. Data analyses were conducted on participants having 36-month diagnostic confirmation assessments. Measurement invariance by module, reliability, and convergent as well as criterion validity of the IRT-based autism severity score was assessed.

Results: A total of 21 items, representing items across each of the ADOS domains (Social, Communication, and Restricted/Repetitive Behavior), were used to develop the harmonized IRT ASD severity score (mean 50, SD 10, range 21.9 to115.6, 2716 distinct values). This IRT-derived severity score was highly correlated (r=0.86, p<.001) with the classic 10-point ADOS severity score, and was highly internally consistent (Cronbach's α=0.88). The IRT-derived score demonstrated strong criterion validity against clinical best estimates of ASD (sensitivity=0.84, specificity=0.82, AUC=0.93), which was marginally superior to the CSS (AUC=0.90). Whereas 46% (2023/4396) of CSS scores were at the ceiling or floor, 0.2% of IRT-derived scores (15/6237) fell at the ceiling or floor (see Figure). The IRT-derived score could be scored in 30% of records (1841/6237) that the CSS could not be scored due to item missingness.

Conclusions: The IRT-derived ASD severity measure demonstrated strong psychometric characteristics, compared to the classic 10-point severity score, in terms of reduced ceiling and floor effects, finer differentiation particularly in the non-ASD range of severity, and facilitates a linkage across ADOS modules. This measure may provide important advantages when characterizing trajectories and treatment responses during early, critical stages of development.



10:55 **176.002** Adaptive Interventions and SMART Designs: Three Case Studies in Autism

D. Almirall[1] *and C. Kasari*[2]*, (1)University of Michigan, Ann Arbor, MI, (2)University of California Los Angeles, Los Angeles, CA*

Background: Due to the great heterogeneity of children with autism spectrum disorders (ASDs), effective treatment often requires individualized, sequential decision-making. To do this, each child's treatment is dynamically tailored over time based on the child's changing state, including response to prior treatment. *Adaptive interventions* (also known as dynamic treatment regimens) operationalize such individualized decision making using a sequence of decision rules that specify which intervention option to offer, for whom, and when. Intervention options correspond to varying doses, types or delivery modes of pharmacological or behavioral treatments. The sequential, multiple-assignment, randomized trial (SMART) is a type of multi-stage randomized trial research design used to build high-quality adaptive interventions.
Objectives: The objectives of this talk are to (i) provide a brief introduction to adaptive interventions, and (ii) present case studies of three SMART designs in autism.
Methods: The first SMART study was designed to develop an adaptive intervention for children with ASD who are minimally verbal using a speech-generating device in the context of a naturalistic intervention involving joint attention, symbolic play, engagement and regulation (JASPER) plus enhanced milieu training (EMT). The second study, again among children with ASD who are minimally verbal, was designed to develop an adaptive intervention involving JASPER+EMT, discrete trials training (DTT), parent training, combined JASPER+EMT+DTT and a clinician-rated clinical global impressions measure to monitor child's progress. The third is a SMART pilot study, which aims to develop an adaptive intervention to improve social engagement outcomes in children with ASD in inclusive school settings. This novel study examines the feasibility and acceptability of adaptive interventions involving Remaking Recess (a school-level intervention), Classroom Supports (a classroom-level intervention), Parent- and Peer-mediated social skills interventions, and the use of paraprofessionals to monitor child progress on the playground and inform subsequent treatment decision-making. For each study, we present the SMART design, its rationale, and the scientific questions.
Results: Three SMART studies have been designed to develop adaptive interventions in children with autism. Each is designed to answer novel questions concerning how best to individualize treatment in children with ASD. The first study is completed; the second and third studies are in the field.
Conclusions: Adaptive interventions are intended to serve as a guide for sequential treatment decision-making in actual clinical practice. They hold the promise of improving outcomes for greater numbers of children with autism by providing the right treatment to children who need it, when they need it. Currently, there is great interest in the use of SMART designs to build high-quality adaptive interventions in autism.

11:20 **176.003** Prenatal Nutritional Supplementation and ASD: Causal Inference Analyses

E. A. DeVilbiss[1]*, C. Magnusson*[2]*, R. M. Gardner*[2]*, D. Rai*[3]*, C. J. Newschaffer*[4]*, K. Lyall*[4]*, C. Dalman*[2] *and B. Lee*[1]*, (1)Drexel University, Philadelphia, PA, (2)Karolinska Institutet, Stockholm, Sweden, (3)University of Bristol, Bristol, United Kingdom, (4)A.J. Drexel Autism Institute, Philadelphia, PA*

Background: Studies have suggested that early prenatal supplementation with folic acid, iron, or multivitamins may be protective against ASD, although other studies have not found evidence of this
Objectives: Using a large population-based study with high case ascertainment, we investigated relationships between early maternal nutritional supplementation (folic acid, iron, and/or multivitamins) and ASD, stratified by intellectual disability (ID).
Methods: The Stockholm Youth Cohort, a prospective cohort study, was examined using Swedish national and regional health registers. The exposure of interest was nutritional supplementation at the first antenatal visit, recorded in the Medical Birth Register. Children born between 1996 and 2005 were followed up for a diagnosis of ASD until December 31, 2011.
Results: Of 206,771 participants in this sample, 4317 cases (2.1%) of ASD were identified, consisting of 984 (0.5%) low-functioning autism cases (LFA; defined as the presence of comorbid ID) and 3333 (1.6%) high-functioning autism cases (HFA; defined as the absence of comorbid ID). Supplement users were different from non-users across multiple medical and social characteristics.
Our primary analysis indicated that overall, taking multivitamins or multiple vitamins (MV) by the first antenatal visit (median 10.1 weeks gestation) was associated with a lower likelihood of LFA relative to mothers who did not take nutritional supplements (adjusted odds ratio: 0.70 [95% confidence interval: 0.56-0.87]), whereas taking folic acid or iron alone was not associated with reduced risks of LFA (adjusted odds ratios: 1.24 [95% confidence interval: 0.91-1.70] and 1.04 [95% confidence interval: 0.89, 1.20], respectively). Supplement use was not associated with overall risk of HFA.
To inform interpretation of our LFA results, we will present results from causal inference analyses including a matched sibling analysis and propensity score (PS) matching. Since siblings share the same mother, a matched sibling analysis reduces the potential for residual confounding by maternal health status and behaviors. PS matching is a technique that matches supplement users and non-users based on the estimated probability of taking specific nutritional supplements prenatally. Matching on the PS can also reduce the potential for residual confounding since there is less reliance on model-based assumptions.
Conclusions: Early maternal vitamin supplementation, especially multivitamins or iron and folic acid used in combination, may be protective against low functioning autism. However, there was no evidence that either iron or folic acid supplements used individually was associated with either high or low functioning ASD. Results from sibling analyses and propensity score matching will aid in interpretation of potential causality.

11:45 **176.004** Clever Analysis of Nonheritable Risk Factors: Maternal Use of Antidepressants during Pregnancy and Risk of ASD

B. Lee[1] *and C. J. Newschaffer*[2]*, (1)Drexel University, Philadelphia, PA, (2)A.J. Drexel Autism Institute, Philadelphia, PA*

Background: Few nonheritable risk factors for ASD have been concretely established, in part due to methodological challenges of conducting observational epidemiology studies. Observational studies are subject to multiple biases and limitations that hinder causal inference. The alternative of randomized controlled trials is often not feasible for various reasons, such as ethical problems in studying randomized exposures in pregnant women. Thus, scientists attempting to identify nonheritable risk factors of ASD

must extract as much insight as possible from observational studies.
Objectives: The objective of this presentation is to discuss and critique three recent epidemiology studies in Denmark that performed clever analytic techniques to examine whether maternal use of antidepressants during pregnancy increases risk of child ASD, or if the increased risk is actually due to confounding by indication.
Methods: We examine three published studies by Sorensen et al. (2013), Hviid et al. (2014), and Gidaya et al. (2014) drawn from the same Danish register data. The different strategies used by the studies included: stratification on the indication; sibling analyses; negative controls; and simulation approaches for measurement error correction.
Results: Using traditional analytic approaches, all three studies found that maternal use of antidepressants during pregnancy increased risk of child ASD. However, after application of clever analytic approaches, only one study suggested an increased risk of ASD. All analytic approaches had their own difficulties, and such difficulties likely influenced to varying degrees the utility of these approaches. We offer insight as to what further studies on this topic can do to improve the state of science.
Conclusions: While clever analyses are often good ideas in theory, they are challenging to carry out in practice, and may yield flawed conclusions.

Panel Session
177 - Understanding Cultural Differences in Diagnostic and Treatment Services for Children with ASD
10:30 AM - 12:30 PM - Room 309

Panel Chair: Jennifer Singh, *School of History and Sociology, Georgia Institute of Technology, Atlanta, GA*

Discussant: Diana L. Robins, *Drexel University, Philadelphia, PA*

Despite the growing prevalence of ASD worldwide, there are disparities to diagnosis and treatment services especially for racial and ethnic minorities in the U.S. and low and middle-income countries (LMIC). The purpose of this panel is to share research on the utility of diagnostic and screening tools for culturally diverse communities and examine cultural differences in diagnosis and services in U.S. Latino populations and two LMIC countries, Bangladesh and South Africa. The panel will consist of four papers and Dr. Diana Robins will serve as the discussant. The first paper examines the processes of culturally adapting the ADOS-2 and ADI-R in rural Bangladesh and the use of the Social Communication Questionnaire. The second paper qualitatively analyzes contextual factors and acceptability of a caregiver-mediated early ASD intervention in South Africa. The third paper evaluates the utility of the Spanish ADI-R in distinguishing between ASD and DD in a U.S. based Latino population. The final paper surveys whether there are ethnic disparities between Latino and White children with ASD in specialty autism-related services, and whether condition severity moderate the relationship between ethnicity and receipt of autism services.

10:30 **177.001** Cultural Adaptations in ASD Diagnostic Assessments and Case Determination in a Rural Region of Bangladesh

L. C. Lee[1], *S. Risi*[2], *H. Rahman*[3], *A. Hasmot*[3], *A. A. M. Hanif*[3], *S. Shaikh*[3], *S. Mehra*[4], *M. Mitra*[5], *L. S. F. Wu*[6], *N. Z. Khan*[7], *K. West*[5] *and P. Christian*[6], *(1)Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (2)University of Michigan, Ann Arbor, MI, (3)Johns Hopkins University Bangladesh, Gaibandha, Bangladesh, (4)Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (5)International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (6)Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (7)Pediatric Neuroscience, Dhaka Shishu Children's Hospital, Dhaka, Bangladesh*

Background:
Cultural influence on the perception of autism-related behaviors has drawn much attention, yet data are scant on this subject. Because Autism Spectrum Disorder (ASD) diagnosis is solely based on observed behaviors, cultural norm and perception of these behaviors play a crucial role on modification of diagnostic assessment tools and threshold of diagnostic cut-offs. Taking advantage of a community-based ASD epidemiologic study recently conducted in rural Bangladesh, we aim to propose a way to modify criteria used in Western countries for the study population.
Objectives:
First, to describe the procedures of conducting the Autism Diagnostic Observation Schedule-2 (ADOS-2) and the Autism Diagnostic Interview – Revised (ADI-R) research training for local clinicians. Second, to discuss modifications on the diagnostic tools and case determination criteria. Third, to report screening process using Social Communication Questionnaire (SCQ). Fourth, to determine ASD case status based on ADOS-2 and ADI-R in children aged 8-10 years who were SCQ positive from this community-based epidemiologic study.
Methods:
Building on the infrastructure of JiVitA, a large maternal and child health project aims to evaluate interventions to improve reproductive and child health in Bangladesh, the present study adapted and culturally modified SCQ, ADOS-2, and ADI-R in order to estimate prevalence rate in the defined population. The A three-week long workshop was conducted in Bangladesh by an ADOS-2 and ADI-R expert from the US (Dr. Risi), followed with weekly conference calls to discuss practice administrations, standard practice videos and respond to questions, modification and cultural adaptations. SCQ was administered by research staff via an at-home interview. The ADOS-2 and the ADI-R were administered by a local developmental psychologist after achieving research-level reliability.
Results:
A total of 8211 mother's completed the SCQ screener on 4109 boys and 4102 girls aged 8-10 years. Children with SCQ>=15 and a selected group of SCQ<15 were invited for ADOS-2 and ADI-R evaluations. As a result, 107 ADOS-2 and 121 ADI-R were conducted.
Conclusions:
ADOS-2 and ADI-R research training in Bangladesh is a challenge for many reasons including language barriers and unknown cultural applicability of these instruments. Required research reliability can be reached; however, enormous effort and time are needed. Cultural adaptation may not be a one-time task occurring during translation, as the need for more adaption may be recognized and recommended after more experience is gained from ADOS-2 and ADI-R administration.
We substituted ADOS-2 standard materials with more culturally relevant materials when necessary (e.g., Description of a Picture materials on the ADOS). The ADI-R questions about more general behaviors such as toileting, aggression, family routine, as well as some items 'use of a body as a tool' were not as informative in this cultural context; however, specific social-communication items and RRB questions are more pertinent.
Because of reporting of specific behaviors related to ASD on the ADI-R was lower overall, standard cut-offs were reduced in an effort to capture children who may be exhibiting some ASD related behaviors and to assess these behaviors directly using the ADOS-2.

10:55 **177.002** Adapting Caregiver-Mediated Early Autism Interventions in South Africa: Contextual Factors and Acceptability of Caregiver Involvement

L. Franz[1], *J. Guler*[2], *N. Seris*[3], *N. Shabalala*[4] *and P. J. de Vries*[5], *(1)Duke Center for Autism and Brain Development, Duke University School of Medicine, Durham, NC, (2)Duke University, Durham, NC, (3)Psychology, University of Cape Town, Cape Town, South Africa, (4)University of Cape Town, Cape Town, South Africa, (5)Division of Child and Adolescent Psychiatry, University of Cape Town, Cape Town, South Africa*

Background:
A significant global challenge is to develop scalable, feasible, early interventions for ASD that can be implemented in diverse and low resource communities. Caregiver-mediated early ASD interventions could provide the necessary avenue to address the capacity barrier globally. However, important questions remain about contextual factors of importance in intervention adaptation and the acceptability of intervention techniques that utilize caregivers in a service delivery model.
Objectives:
This qualitative, South African study explored: (1) contextual factors relevant to the adaptation of a caregiver-mediated early ASD intervention, and (2) the acceptability of utilizing caregivers in the delivery of an early ASD intervention from the perspective of caregivers and providers.
Methods:
Focus groups and in-depth interviews were conducted in Cape Town, South Africa, with 28 caregivers of children with ASD and 12 local autism service providers. The caregivers included mothers (n=20), fathers (n=5), and grandmothers (n=3) of children with ASD who were under the age of 7 years. The local ASD service providers, who worked in the public health (n=7) or education (n=5) sector, included psychologists, educators, speech therapists, occupational therapists, and a parent advocate. This sample included participants from a number of African countries, representing the cultural diversity and typical migration patterns seen in South Africa. Participants spoke in English, isiZulu, isiXhosa, and Afrikaans in the interviews and focus groups. All data was translated, transcribed, and then coded for emerging themes using the NVivo qualitative data analysis software package.
Results:
Contextual factors reported by both caregivers and service providers included: (1) the importance of matching provider to family by spoken language, (2) cultural sensitivity to traditional parenting practices and family customs, (3) affordability of treatment, (4) the importance of immediate and extended family acceptance and support, and (5) the effects of community-based stigma. Specific caregiver contextual factors included: (1) the importance of religion and faith as a form of support and (2) feeling financially exploited by ASD service providers. Specific provider contextual factors that emerged included: (1) lack of parental psychoeducation, and (2) difficulty contacting or communicating with caregivers. Caregivers and service providers reported acceptability of the concept of training caregivers to deliver an early ASD intervention. Caregivers noted that they would experience this education and training as empowering and reported interaction styles with their children which suggest they may be able to be trained to implement early ASD interventions. Specifically, caregivers: (1) were aware of their child's affective state, (2) regularly engaged in child-directed play activities that

included both object-based play and sensory-social routines, and (3) utilized locally available, child-selected play materials.
Conclusions:
Common themes around important contextual factors and acceptability of utilizing caregivers in the service delivery model emerged from a culturally and geographically diverse group of participants. This study had the unintended positive consequence of providing a shared platform for parents and caregivers to seek support and gather information from one another, highlighting the paucity of available social support in this environment.

11:20 **177.003** Assessing Differences in Lifetime Item Scores of the Spanish ADI-R in Latino Children with ASD and Children with DD

S. B. Vanegas[1] *and S. Magana*[2]*, (1)Disability and Human Development, University of Illinois at Chicago, Chicago, IL, (2)University of Illinois at Chicago, Chicago, IL*

Background:
There is a growing body of research that has identified significant disparities in ASD diagnoses among racial/ethnic minority children (e.g., Daniels & Mandell, 2014). Thus, it is critical that research addresses possible issues in the diagnostic tools used with diverse populations. The Autism Diagnostic Interview-Revised (ADI-R; Lord et al. 1994) is a 'gold-standard' parent interview that provides a composite of past and current behaviors as it pertains to ASD. Select items from the extensive interview are then used to determine whether the individual demonstrates sufficient symptoms that would merit an ASD diagnosis. However, little is known whether the selected algorithm items from the ADI-R are adequate in identifying children with ASD in a Latino population.
Objectives:
The objective of this paper is to evaluate the utility of all lifetime items from the Spanish ADI-R in distinguishing between children with ASD and children with DD in a U.S. based Latino population.
Methods:
The current study included 50 Spanish-speaking Latino parents of children and adolescents who were between 4 and 16 years of age and received a clinical diagnosis of ASD (n = 29) or a Developmental Delay (DD; n= 21). Clinical diagnoses were confirmed by review of the medical records. The official Spanish version of the ADI-R was administered by trained interviewers. All lifetime item scores were converted based on the recommended guidelines (e.g., Rutter et al. 2003).
Results:
Analyses were first conducted on the lifetime algorithm items to determine which items distinguished children with ASD from children with DD. In the social reciprocity domain, the following items were significantly different between children with ASD and children with DD: social smiling, range of facial expressions, showing/directing attention, seeking to share enjoyment, use of other's body, offering comfort, and quality of social overtures. All restricted and repetitive behavior items, with the exception of unusual preoccupations and verbal rituals, distinguished the ASD and DD groups. The communication domain had the fewest items that were significantly different between children with ASD and children with DD. Additional analyses were then run on additional lifetime non-algorithm items. These analyses showed that children with ASD had higher levels of impairment on comprehension of simple language, social disinhibition, difficulties with changes to routines/environment, and self-injury (all p's < .05). These additional non-algorithm items demonstrated the largest differences observed between children with ASD and children with DD.
Conclusions:
The results of this study demonstrate that the communication domain had the lowest proportion of items that distinguished between ASD and DD, whereas the restricted and repetitive behavior items had the highest proportion of items. The results also find that additional items not included in the diagnostic algorithms of the ADI-R may enhance the validity of the parent interview among Latino families. This can be attributed distinct ways that ASD manifests or is perceived by Latino parents. With the publication of the DSM-5 and its updated diagnostic criteria for ASD, it is important to evaluate how existing diagnostic tools can be used to inform new diagnoses.

Table 1

Impairments on Lifetime Algorithm Items

	ASD ($n = 29$)		DD ($n = 21$)		F	Partial η^2
	M	*SD*	*M*	*SD*		
Social Reciprocity Domain						
Direct gaze	1.59	0.63	1.14	0.79	4.87*	.09
Social smiling	1.55	0.74	1.05	0.86	4.93*	.09
Range of facial expressions	1.48	0.78	0.81	0.87	8.16**	.15
Interest in children	1.59	0.78	1.14	0.91	3.42†	.07
Response to approaches	1.31	0.81	1.05	0.86	1.22	.02
Showing and directing attention	1.66	0.67	1.10	0.77	7.52**	.14
Offering to share	1.66	0.67	1.29	0.85	2.97†	.06
Seeking to share enjoyment	1.55	0.69	1.00	0.89	6.10*	.11
Use of other's body	1.10	0.82	0.62	0.74	4.63*	.09
Offers comfort	1.62	0.73	0.90	0.83	10.46**	.18
Quality of social overtures	1.38	0.82	0.76	0.89	6.43*	.12
Inappropriate facial expressions	1.03	0.68	0.67	0.66	3.66†	.07
Appropriateness of social overtures	1.55	0.78	1.19	0.93	2.22	.04
Friendships	1.03	0.94	0.81	0.98	0.67	.01
Imaginative play with peers	0.62	0.90	0.48	0.81	0.34	.01
Nonverbal Communication Domain						
Pointing to express interest	1.41	0.78	0.90	0.89	4.61*	.09
Conventional gestures	1.31	0.93	1.14	0.96	0.38	.01
Nodding head	1.10	0.98	0.43	0.81	6.68*	.12
Head shaking	1.03	0.98	0.38	0.74	6.59*	.12
Spontaneous imitation of actions	0.59	0.87	0.86	0.91	1.14	.02
Imaginative play	0.69	0.93	0.62	0.80	0.08	.00
Imitative social play	0.41	0.73	0.67	0.91	1.18	.02
Verbal Communication [a]						
Stereotyped utterances/echolalia	1.26	0.81	0.57	0.76	6.26*	.17
Social verbalization/chat	1.42	0.77	1.14	0.86	0.95	.03
Reciprocal conversation	1.37	0.76	1.14	0.86	0.63	.02
Inappropriate questions/statements	0.95	0.78	0.64	0.84	1.15	.04
Pronominal reversal	1.32	0.89	1.07	0.92	0.60	.02
Neologisms/idiosyncratic language	0.63	0.76	0.50	0.85	0.22	.01
Restricted, Repetitive, and Stereotyped Behaviors Domain						
Circumscribed interests	1.10	0.98	0.38	0.67	8.56**	.15
Unusual preoccupations	0.21	0.49	0.29	0.64	0.24	.01
Compulsions/rituals	0.86	0.95	0.29	0.64	5.76*	.11
Hand/finger mannerisms	1.00	0.93	0.48	0.81	4.31*	.08
Other complex mannerisms	0.93	0.92	0.38	0.74	5.08*	.10
Repetitive use of objects	1.38	0.82	0.48	0.75	15.86**	.25
Unusual sensory interests	1.10	0.77	0.24	0.44	21.36**	.31
Verbal rituals [a]	0.79	0.92	0.29	0.61	3.17†	.09

** $p < .01$; * $p < .05$; † $p < .10$

[a] Items are for verbal participants only, ASD $n = 14$, DD $n = 19$

11:45 **177.004** Severity and Latino Ethnicity in Specialty Services for Children with Autism Spectrum Disorder

S. Magana[1], *S. Parish*[2] *and E. Son*[3], *(1)University of Illinois at Chicago, Chicago, IL, (2)Brandies University, Waltham, MA, (3)Social Work, College of Staten Island, Staten Island, NY*

Background:
Children with autism spectrum disorder (ASD) experience a range of severity levels characterized as levels of support they need for everyday functioning. By this definition, greater levels of severity should warrant greater use of services and supports among children with ASD. In previous studies, Latino children with ASD in the USA have been shown to have lower access to diagnosis and treatment services than White children. However, none have examined service use in relation to severity.
Objectives:
In this study, our objective was to examine whether there are ethnic disparities between Latino and White children with ASD in specialty autism-related services, and whether condition severity moderate the relationship between ethnicity and receipt of autism services.
Methods:
We used data from the Survey of Pathways to Diagnosis and Services, a supplement to the National Survey of Children with Special Health Care Needs and analyzed current use of four specialty services commonly used by children with ASD: behavioral interventions, occupational therapy, social skills training, and sensory integration. The analytic sample included non-Latino White (n=1,063) and Latino (n=120) children with any ASD. When weighted, the sample represented 431,525 White children and 85,154 Latino children with any ASD. Logistic and Linear and logistic regressions were used to determine the relationships of ethnicity and severity to the outcome service variables, adjusting for demographic variables. An interaction term of ethnicity and severity was created to test for interaction effects.
Results:
We found that children whose conditions were more severe were twice as likely to receive each of the services as children who were less severe. Being Latino was significantly related to lower total service use. Furthermore, Latino children with ASD who had severe conditions received fewer specialty autism-related services than White children with similarly severe conditions. These disparities were evident despite the fact that the sample of Latino children in this data were more privileged than the general US Latino population given that it was an English speaking and relatively high income sample.
Conclusions:
Future research is needed to investigate factors that contribute to Latino children who have greater severity receiving fewer services than White children. Also, data sets are needed that are more representative of the US Latino population. Assertive policy initiatives are needed to address these disparities and ensure that these highly vulnerable children with severe conditions receive appropriate services and supports.

Panel Session

178 - Efforts Towards a More Cohesive Understanding of Anxiety in ASD: Correlates and Underlying Mechanisms

10:30 AM - 12:30 PM - Room 310

Panel Chair: Nicole Kreiser, *1750 East Fairmount Ave, Kennedy Krieger Institute, Baltimore, MD*

Discussant: Mikle South, *Brigham Young University, Provo, UT, Brigham Young University, Provo, UT*

Anxiety is a common co-occurring problem among individuals with ASD. However, the phenomenology, correlates and mechanisms of anxiety in this population remain poorly understood. The existing research has identified executive functioning (Lawson et al., 2015; Lopez, Lincoln, Ozonoff, & Lai, 2005), emotion regulation (White et al., 2014), and dispositional traits (i.e., Intolerance of Uncertainty; Boulter et al., 2014; Chamberlain et al., 2013) as potential correlates of anxiety in ASD. Physiological and fear conditioning processes (e.g., Chamberlain et al., 2013; South et al., 2011; Kleinhans et al., 2010) as well as brain circuitry related to anxiety in ASD have also been explored, though findings have been inconsistent. This panel attempts to explore several identified contributors to anxiety in ASD in an effort to move towards a more integrated understanding of neurobiological and psychological processes underlying anxiety in ASD. Panel presentations explore co-occurring anxiety in ASD in relationship to the following constructs: dimensions of emotion regulation impairment, profiles of executive functioning difficulties, brain circuitry (i.e., role of prefrontal cortex regions), dispositional traits (i.e., intolerance of uncertainty), and core ASD deficits. Integration of study findings, conceptual and methodological limitations and considerations, and future research directions will be discussed.

10:30 **178.001** The Underlying Structure of Emotion Regulation Impairment in ASD

C. A. Mazefsky[1], *L. Yu*[2], *S. W. White*[3] *and M. Siegel*[4], *(1)Department of Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA, (2)University of Pittsburgh School of Medicine, Pittsburgh, PA, (3)Virginia Polytechnic Institute and State University, Blacksburg, VA, (4)Maine Medical Center Research Institute - Tufts School of Medicine - Spring Harbor Hospital, Westbrook, ME*

Background:
Impaired emotion regulation (ER) is strongly associated with a range of psychopathology and poor functioning. Studies of verbal individuals with ASD indicate reliance on maladaptive ER strategies. Understanding of the phenomenology of ER in severely affected and less verbal individuals with ASD is limited given the dependence of most measures on verbal indicators or self-report. Further, despite substantial variability in emotional presentation in ASD, empirically-based dimensions of emotion dysregulation have not been identified.
Objectives:
To identify empirically-derived dimensions of emotion dysregulation in an ASD sample with a wide range of verbal and cognitive functioning, and explore how they are associated with psychiatric and cognitive factors.
Methods:
The *Emotion Dysregulation Inventory* (EDI) was developed to capture the full presentation of affective experiences and emotional control in individuals with ASD of any verbal ability. PROMIS® guidelines for item development and piloting were followed to create the 66-item EDI with a 5-point intensity scale ("not at all" to "very severe"). The EDI was completed by the parents/guardians of 190 children (mean age 13, range 4-20; 77% male) with ADOS-confirmed ASD who were admitted to one of six specialized psychiatric inpatient units for ASD. The mean non-verbal IQ based on the *Leiter-3* was 74 with a wide range (SD = 30, Range = 30-145) and 53% were non- or minimally-verbal. Parents completed a battery of questionnaires including the *Child and Adolescent Symptom Inventory*(CASI) as a measure of psychiatric symptoms. A maximum likelihood factor analysis with oblique rotation was conducted with EDI items and the association between the resultant factor scores and other participant characteristics was explored.
Results:
The EDI total score was normally distributed, not correlated with IQ or age, and did not differ based on verbal ability level, suggesting lack of IQ and verbal ability biases. Factor analysis of EDI items justified a 2-factor model, based on a higher eigenvalues for the first two factors (17.4; 4.8), scree plot inflexions, and factor loading patterns. The factors were moderately correlated (r = .34) but no items had a rotated factor loading above .4 on both factors. Factor one accounted for the most variance and included indicators of poor ER (e.g., rapidly escalating, intense, and labile reactions, difficulty calming down once upset) and negative mood (e.g., angry/irritable, agitated behavior, etc.). Factor 2 included symptoms characteristic of anxiety and depressive disorders (e.g., nervousness, decreased positive affect and vitality). Different patterns of correlations with CASI and Leiter subscale scores and administrator ratings also supported a distinction between the two factors.
Conclusions:
Two distinct dimensions of emotion dysregulation were identified. The results support theories arguing that the experience of negative emotion and its regulation are difficult to separate, as the primary factor included indicators of poor ER as well as heightened reactivity and more negative affect. However, specific manifestations of negative affect, namely anxiety and depression symptoms, loaded onto a separate factor. Identifying dimensions of emotion dysregulation in ASD will aid in the development of targeted intervention efforts and support the detection of underlying biological mechanisms.

10:55 **178.002** Differentiating Profiles of Anxiety and Executive Function in ASD without ID

C. E. Pugliese[1], *L. G. Anthony*[1], *X. You*[2], *A. C. Armour*[3], *Y. Granader*[1] *and L. Kenworthy*[4], *(1)Children's National Medical Center, Rockville, MD, (2)Children's National Health System, Washington, DC, (3)Children's National Medical Center, Arlington, VA, (4)Children's Research Institute, Children's National Medical Center, Rockville, MD*

Background: Youth with ASD experience high rates of co-morbid anxiety, which has been linked to rumination and inflexibility in typically developing (TD) youth and those with developmental disorders. Inflexibility is a near ubiquitous problem in ASD, which is also associated with a range of other EF problems. Given the fact that not all youth with ASD develop anxiety, it is important to explore whether anxiety in ASD is driven by inflexibility and/or other specific EF deficits. A further question is whether the heterogeneity of ASD anxiety symptomatology can be parsed with specific profiles of EF.
Objectives: To examine whether (1) specific domains of parent-reported EF, particularly flexibility, was predictive of greater parent-reported anxiety symptoms, and (2) specific profiles of EF and anxiety cluster together in subgroups of youth with ASD.
Methods: 220 youth (44 females) with a DSM diagnosis of ASD between the ages of 8 and 13 (M=10.46, SD=1.69) were evaluated on the Behavior Rating Scale of Executive Function (BRIEF) and Child Behavior Checklist (CBCL). Participants possessed average IQ (M=106.13, SD=19.17) and met CPEA criteria for 'broad ASD' on the ADI-R and/or ADOS. To determine whether specific EF domains were predictive of anxiety, we regressed CBCL Anxiety Problems DSM-oriented scale scores onto BRIEF subscales (predictors), age, and IQ (covariates). We also used a data driven, model free community-detection approach to parse heterogeneity in EF and anxiety profiles in ASD. This approach is an optimization clustering method, which identifies subgroups that share similar behavioral phenotypic features. It reveals profiles-based dimensions to detect how EF and anxiety cluster together in terms of relative strengths and weaknesses.
Results: When all predictors and covariates were entered into the regression model, the only significant predictor was the BRIEF shift scale (t=3.56, p<.001) with the overall model explaining 22.6% of the variance in Anxiety scores (F=8.43, p<.001). The community detection analyses revealed three subgroups: 1) a high anxiety group (n=88) clustered with high shifting and emotional control issues, 2) a low anxiety group (n=60) clustered with high disinhibition and working memory problems but fewer issues with flexibility and emotional control, and 3) a medium anxiety group (n=77) clustered with metacognitive impairments and fewer inhibition, shifting, and emotional control problems. See attached image for group profiles. Approximately 64%, 17%, and 53% of participants in each group, respectively, received Anxiety scores above the borderline cut-off on the CBCL.
Conclusions: Both regression and cluster analyses revealed positive associations between anxiety and inflexibility. In addition, the cluster analysis revealed that two other EF profiles were associated with anxiety: group 1 was characterized by relatively high anxiety, inflexibility, and emotion dysregulation; group 2 was associated by relatively high inhibition problems and relatively low anxiety. As such, clinical treatment may differ for each of these profiles; the highest anxiety group may need behavioral intervention for cognitive flexibility and emotion regulation along with effective, direct treatments for anxiety.

11:20 **178.003** The Relationship Between Intolerance of Uncertainty, Core ASD Deficits, and Anxiety

N. L. Kreiser[1], *A. Keefer*[1,2], *V. Singh*[1], *S. H. Mostofsky*[3] *and R. A. Vasa*[1], *(1)Kennedy Krieger Institute, Baltimore, MD, (2)School of Medicine, Johns Hopkins University, Baltimore, MD, (3)Johns Hopkins School of Medicine, Baltimore, MD*

Background: Intolerance of uncertainty (IU) is a dispositional trait involving maladaptive responding under conditions of uncertainty that has been linked to anxiety in typically developing (TD) individuals. Recently, there has been interest in examining how IU relates to ASD given high levels of anxiety and difficulty tolerating uncertain situations in this population. Several studies have examined the construct of IU in ASD. The findings indicate higher levels of IU and a positive relationship between anxiety and IU (Boulter et al., 2014; Chamberlain et al., 2013; Wigham et al., 2014). No studies to date have examined whether IU is exclusively a feature of anxiety in ASD or whether it is related to ASD characteristics irrespective of anxiety.
Objectives: The objectives of this study were to: 1) Replicate the finding of higher IU levels in youth with ASD compared to TD children (Aim 1), 2) Confirm the relationship between IU and anxiety (Aim 2), and 3) Examine whether IU was associated with core and related ASD characteristics (i.e., repetitive behaviors, executive dysfunction) when controlling for anxiety (Aim 3).
Methods: Fifty-seven children with ASD and 32 TD control participants (IQ > 80), ages 7- 16 years, participated in this study. Participants were a subset of a larger community sample of youth with ASD who were recruited for behavioral and neuroimaging research. ASD diagnosis was established by clinical evaluation and supported by the ADOS. Participants also completed measures of IU (Intolerance of Uncertainty Scale: IUSC), anxiety (SCARED), ASD behaviors (SRS), repetitive behaviors (RBS-R), and executive functioning (EF) (BRIEF). Due to a skewed distribution, non-parametric tests were utilized for all analyses. Aims 1 and 2 were pursued using Wilcoxon Mann-Whitney U tests and Spearman's Rho correlations. Aim 3 was examined using hierarchal linear regressions with bootstrapping.

Results: Children with ASD had significantly higher parent (z = -5.04, p < .001) and child (z = -3.69, p < .001) reports of IU compared to the TD group (Aim 1). For the ASD group, significant relationships between IU and anxiety were present based upon parent (r = .37, p = 01) and child (r = .50, p < .001) report (Aim 2). Regressions using both parent and child report showed that ASD diagnosis was associated with IU over and above the effects of anxiety (Table 1). Similarly, the relationship between IU and SRS, when controlling for anxiety, approached significance (p = .07). Neither repetitive behaviors nor EF difficulties were associated with IU when controlling for anxiety.
Conclusions: Findings from this study confirm that IU is elevated in youth with ASD and is associated with anxiety. The novel finding of this study is that core ASD deficits were related to IU in this study beyond the contributions of anxiety. This raises questions about whether IU might be an inherent or heritable feature of ASD or related to a unique presentation of anxiety in ASD. Heritability and longitudinal studies of IU as well as research with clinically anxious ASD samples are necessary to better understand these relationships.

Table 1: *Hierarchical Regressions Predicting the Effect of ASD Diagnosis (ASD versus TD) and ASD Deficits (SRS) on IU when Controlling for Anxiety*

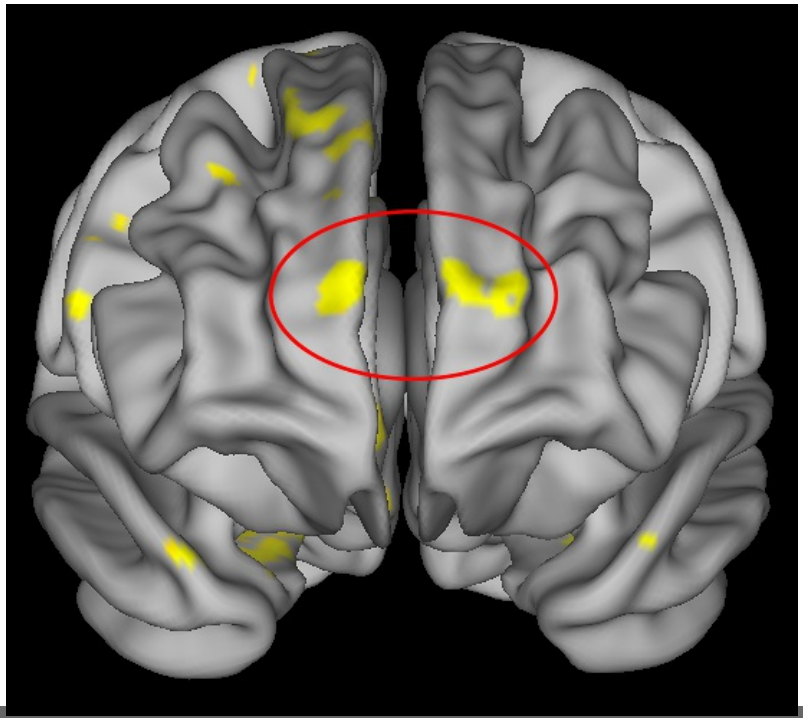
ASD Diagnosis Predicting Child-Reported IU									
	Model 1			Model 2			Model 3		
	B	SE B	B	B	SE B	β	B	SE B	β
Age	-.33	.92	-.04	.23	.82	.03	-.21	.82	-.03
Gender	6.69	4.02	.18	3.26	3.64	.09	2.98	3.52	.08
Verbal IQ	-.34	4.02	.18	**-.27***	.09	-.30	**-.19***	.09	-.30
SCARED-C				**.45****	.10	.45	**.43****	.10	.42
Diagnosis							**7.3***	2.97	.25
R^2	.15			.19			.25		
Change in R^2 (F)	**4.48****			**21.59****			**6.03***		
ASD Diagnosis Predicting Parent-Reported IU									
	Model 1			Model 2			Model 3		
	B	SE B	B	B	SE B	β	B	SE B	β
Age	1.21	.85	.16	.96	.72	.13	.54	.66	.07
Gender	2.86	3.52	.09	-.20	3.05	-.01	.20	3.05	-.01
Verbal IQ	-.05	.09	-.06	-.01	3.05	-.01	.12	.07	.16
SCARED-P				**.58****	.11	.53	**.44****	.10	.40
Diagnosis							**10.96****	2.60	.44
R^2	.04			.31			.41		
Change in R^2 (F)	.95			**28.93****			**17.81****		
SRS Predicting Parent-Reported IU									
	Model 1			Model 2			Model 3		
	B	SE B	B	B	SE B	β	B	SE B	β
Age	1.33	1.26	.15	.81	1.14	.09	1.40	1.17	.16
Gender	5.20	4.52	.16	2.19	4.15	.07	2.44	4.08	.08
Verbal IQ	-.04	.10	-.05	2.19	.09	-.03	-.02	.09	-.03
SCARED-P				**.47****	.13	.46	**.47****	.13	.46
SRS Total							.15	.09	.22
R^2	.05			.25			.04		
Change in R^2 (F)	0.83			**12.28****			2.82		

*p < .05, **p ≤ .001

11:45 **178.004** The Neurobiology of Emotion Regulation Problems and Co-Occurring Anxiety in ASD

J. Herrington[1], *A. McVey*[2], *J. C. Bush*[3], *K. Rump*[4], *J. Worley*[5], *L. R. Guy*[6], *J. Pandey*[7], *J. Miller*[8] *and R. T. Schultz*[9], *(1)The Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (2)Marquette University, Milwaukee, WI, (3)Indiana University, Bloomington, IN, (4)The Center for Autism Research, Philadelphia, PA, (5)CHOP, Blue Bell, PA, (6)TEACCH Autism Program, University of North Carolina at Chapel Hill, Greensboro, NC, (7)Children's Hospital of Philadelphia, Philadelphia, PA, (8)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (9)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA*

Background:
There is a growing recognition that emotion regulation difficulties are common in ASD, resulting in increased symptoms of anxiety. However, the neurobiology of emotion regulation problems in ASD has yet to be fully examined. Data from non-ASD samples suggest that this examination will point to brain systems that we already know function differently in ASD, but are seldom interpreted in terms of emotion regulation. This is particularly true of prefrontal cortex (PFC), where decades of affective neuroscience research have implicated cognitive control structures in the regulation of emotion. This presentation examines data from two functional MRI studies that associate anxiety deficits with abnormal PFC function in ASD.
Objectives: To examine the role of cognitive control (PFC) regions in youth diagnosed with co-occurring anxiety and ASD.
Methods: Both fMRI studies used face-processing tasks that are known to elicit activity in emotion and emotion regulation structures. The first study (N = 81 ASD, 67 control, mean age = 12.5 years) follows a dimensional approach, examining the relationship between anxiety symptoms (measured via the Screen for Child Anxiety Related Emotional Disorders) and PFC function in ASD. The second study follows a categorical approach, including ASD samples with formal anxiety disorder diagnoses (established via the Anxiety Disorder Interview Schedule; n = 15), and without (n = 13). ASD diagnoses were made following a developmental interview with parents and administration of the Autism Diagnostic Observation Schedule.
Results: Both dimensional and categorical approaches strongly associated increased anxiety in ASD with increased activation in multiple portions of PFC, including both dorsal and ventral medial PFC, superior frontal gyrus, and the frontal poles (see Fig. 1 for an illustration of the frontal pole activation). Although ASD studies often interpret activation in many of these regions in terms of mentalizing abilities, they also have known relationships with cognitive control. Given the direction of the results (i.e., increased PFC activity in ASD with anxiety), interpretations of findings in terms of anxiety and emotion regulation seem more parsimonious than those related to mentalizing. Post hoc analyses indicated that the findings from these studies cannot be attributed to differences in core ASD symptoms or intellectual level.
Conclusions:
Findings of altered PFC function in ASD may be best accounted for by models of emotion regulation that integrate cognitive control processes. The direction of effects (increased PFC activation) suggests that individuals with ASD and increased anxiety symptoms are over-engaging brain systems involved in cognitive control and emotion regulation. Future research should explore whether this increase is a compensatory response for increased levels of negative affect, or possibly inefficient communication between PFC and other emotion structures (i.e., amygdala).



Poster Session
179 - Brain Structure (MRI, neuropathology)
11:30 AM - 1:30 PM - Hall A

1 **179.001** A Longitudinal MRI Study of Subcortical Brain Development in Infants Who Develop Autism and Infants with Fragile X Syndrome

M. D. Shen[1], *M. Styner*[1], *M. R. Swanson*[1], *J. J. Wolff*[2], *J. T. Elison*[2], *R. G. Smith*[1], *M. M. Graves*[1], *K. Botteron*[3], *S. Dager*[4], *R. T. Schultz*[5], *L. Zwaigenbaum*[6], *A. M. Estes*[7], *J. Piven*[1], *H. C. Hazlett*[8] *and .. The IBIS Network*[1], *(1)University of North Carolina at Chapel Hill, Chapel Hill, NC, (2)University of Minnesota, Minneapolis, MN, (3)Psychiatry and Radiology, Washington University School of Medicine, St. Louis, MO, (4)University of Washington School of Medicine, Seattle, WA, (5)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (6)University of Alberta, Edmonton, AB, Canada, (7)University of Washington Autism Center, Seattle, WA, (8)Carolina Institute for Developmental Disabilities, University of North Carolina at Chapel Hill, Chapel Hill, NC*

Background: Previous research has shown that the caudate is enlarged in preschool-aged children with fragile X syndrome (FXS) (Hazlett, 2009; 2012). The amygdala is enlarged in young children with ASD (Hazlett, 2009; Mosconi, 2009; Nordahl, 2012; Schumann, 2009; Sparks, 2002) and exhibits neuronal abnormalities (Amaral, 2008; Schumann, 2006). However, it is unknown whether altered growth trajectories of the caudate and amygdala can be detected prior to age 2.
Objectives: We conducted a longitudinal MRI study and hypothesized that infants with FXS would show caudate enlargement, while infants who develop ASD would show amygdala enlargement, compared to age-matched control infants.
Methods: Longitudinal MRIs were collected at 6, 12, and 24 months in N=21 infants with FXS, N=50 high-risk infants who were later diagnosed with idiopathic ASD, N=227 high-risk infants who were not diagnosed with ASD (HR-neg), and N=134 low-risk control infants (LR-neg). Between 6-24 months, 50 scans were acquired in the FXS group, 153 in the ASD group, 611 in the HR-neg group, and 330 in the LR-neg group. Multi-atlas subcortical segmentation generated volumes for left and right caudate, amygdala, globus pallidus, putamen, thalamus, and hippocampus. A repeated-measures mixed-effects model tested main effects and interactions with group, while controlling for age, sex, and total cerebral volume (TCV).
Results: For the caudate, there was a significant main effect of group ($F_{3,456}$=16.33, p<.0001), as well as TCV, age and sex, but no group interactions. Pairwise comparisons revealed that the FXS group had larger caudate volume at 6, 12, and 24 months, compared to all other groups (p<.0001). The FXS group had 16% larger caudate volume at 6 months (vs. all other groups), 20% larger at 12 months, and 17% larger at 24 months (Fig. 1). For the amygdala, there was a significant group x age interaction ($F_{3,494}$=6.35, p<.05) with the ASD group having a steeper trajectory, such that by 12 months the ASD group had significantly larger amygdala volume (5% larger vs. HR-neg and LR-neg) and the FXS group had significantly smaller amygdala (5% smaller vs. HR-neg and LR-neg), after controlling for TCV, age and sex (Fig. 2). The globus pallidus showed a significant main effect of group ($F_{3,494}$=4.45, p<.05) with the FXS group having larger volume at 6-24 months. There were no significant group differences in the thalamus, putamen, or hippocampus. No group x laterality interactions were observed in any structure. Behavioral analyses revealed that caudate enlargement in the FXS group was significantly associated with greater motor stereotypies (r=.55, p<.05).
Conclusions: Infants with FXS have a striking enlargement of the caudate present by 6 months of age, whereas infants who develop ASD have amygdala enlargement that emerges between 6 and 24 months. While FXS shares some behavioral characteristics with idiopathic ASD, it appears that longitudinal brain imaging can delineate distinct brain trajectories early in life. Caudate enlargement has a pathological effect on motor behavior, consistent with findings in preschoolers (Wolff, 2013). We will examine the association between amygdala size and behaviors regulated by this brain region, including sensory function and social ability.

Figure 1

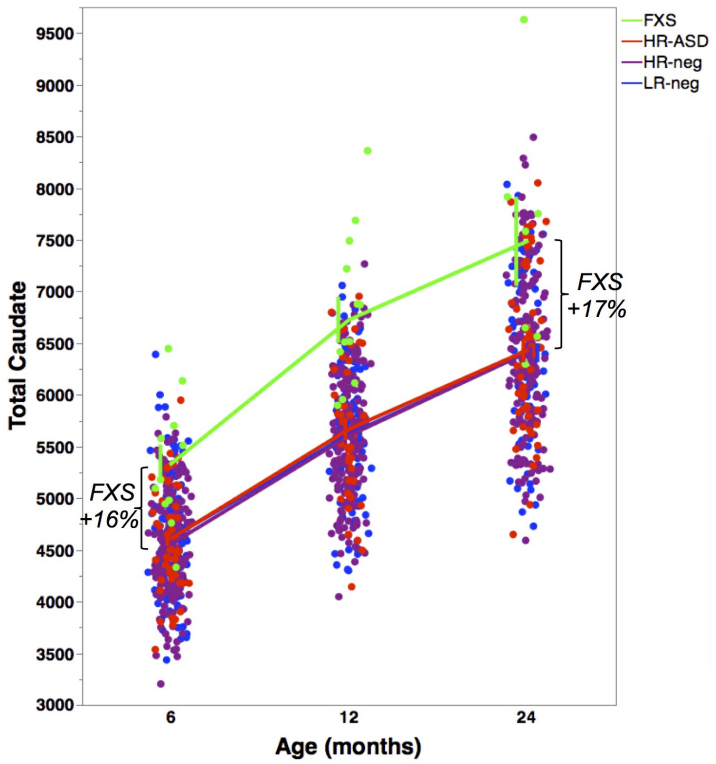
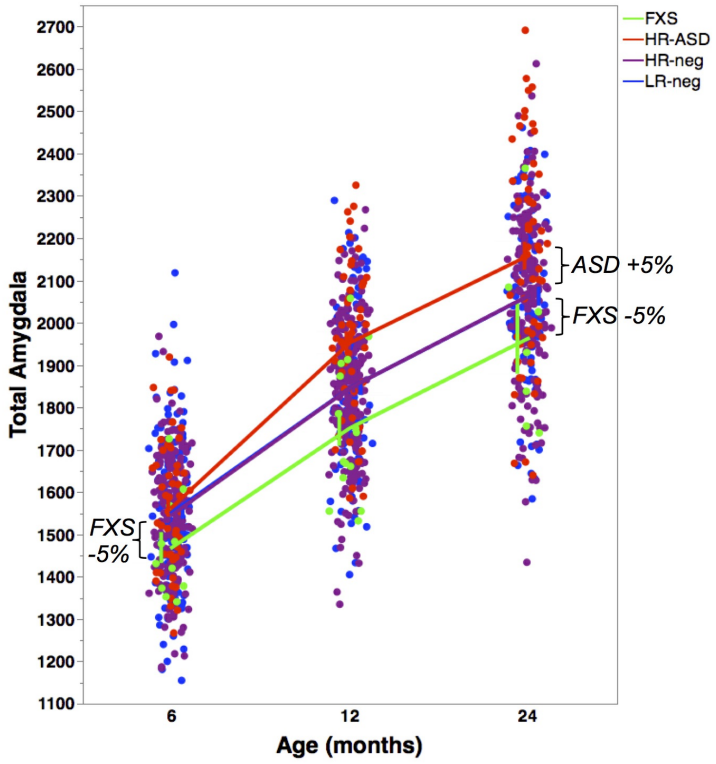


Figure 2



2 **179.002** Age, Verbal IQ and Autism Severity Information Improves ASD Classification Based on Brain Morphometry

*G. J. Katuwal[1,2], N. D. Cahill[3], S. A. Baum[4] and **A. M. Michael**[1], (1)Autism and Developmental Medicine Institute, Geisinger Health System, Lewisburg, PA, (2)Center for Imaging Science, Rochester Institute of Technology, Rochester, NY, (3)School of Mathematical Sciences, Rochester Institute of Technology, Rochester, NY, (4)Faculty of Science, University of Manitoba, Winnipeg, MB, Canada*

Background:
Previous findings of brain morphometry abnormalities in autism spectrum disorder (ASD) have been inconsistent (Chen 2011). In addition, previous large multi-site studies that use brain morphometry to classify ASD from typically developing controls (TDC) report low classification accuracies (<60 %) (Haar 2014; Katuwal 2015; Sabuncu & Konukoglu 2014). The variability of the reported findings and the low accuracies can be mainly attributed to the heterogeneity of ASD.
Objectives:
In this study we investigate if the challenges posed by the heterogeneity of ASD brain morphometry for ASD classification can be improved by utilizing autism severity (AS), verbal IQ (VIQ) and age information.
Methods:
Structural MRIs of 373 ASD and 361 TDC male subjects (age range: 6-40years) from the ABIDE were preprocessed using FreeSurfer. For each image, 538 brain morphometric features were derived. ASD vs. TDC classification was performed using the Random Forest classifier on morphometric features. Classification success was measured using the area under the curve (AUC) metric estimated by 10-fold cross validation. AS, VIQ and age information were utilized in two ways. First, VIQ and age information were used in conjunction with morphometric features. Second, subjects were divided into 3 sub-groups each for AS, VIQ and age (Figure 1). In this scheme,

subject numbers of ASDs and TDCs were matched either by 'up-sampling' the smaller class in each training fold or by 'down-sampling' the larger class to match demographics of the smaller class.

Results:

A moderate AUC of 0.61, similar to the best of previous work, was achieved when only brain morphometric features were used for classification. Adding age and VIQ to brain morphometry features improved the AUC to 0.68. When subjects were divided into sub-groups, classification performance improved significantly and AUC patterns of both the up-sampling and down-sampling schemes matched (Figure 1). The highest AUC of 0.92 was achieved in the down-sampling scheme for the low AS group (Figure 1B). The most important features for classification varied across sub-groups (Figure 2), however, they were predominantly from the left amygdala, right hippocampal, ventricular, insular, frontal and temporal regions. Further, the mean of Cohen's d metric of the important features followed the AUC patterns. In both schemes, AUC was high for low AS (4 to 5) but decreased for moderate AS (6 to 7) and high AS (8 to 10). AUC decreased with VIQ. AUC was moderate for age groups of 6-13years and 18-40years but low for 13-18years age group. See Figure 1 for AUC values.

Conclusions:

The variability of the important features for classification across the sub-groups indicates that brain anatomical abnormalities in ASD are dependent on factors such as AS, VIQ and age. The increase in classification performance with the utilization of the above information demonstrates that the challenges posed by ASD heterogeneity can be mitigated by sub-grouping ASD. This study shows that the search for brain markers for sub-groups of ASD may be more fruitful than searching for markers across the whole spectrum of autism.

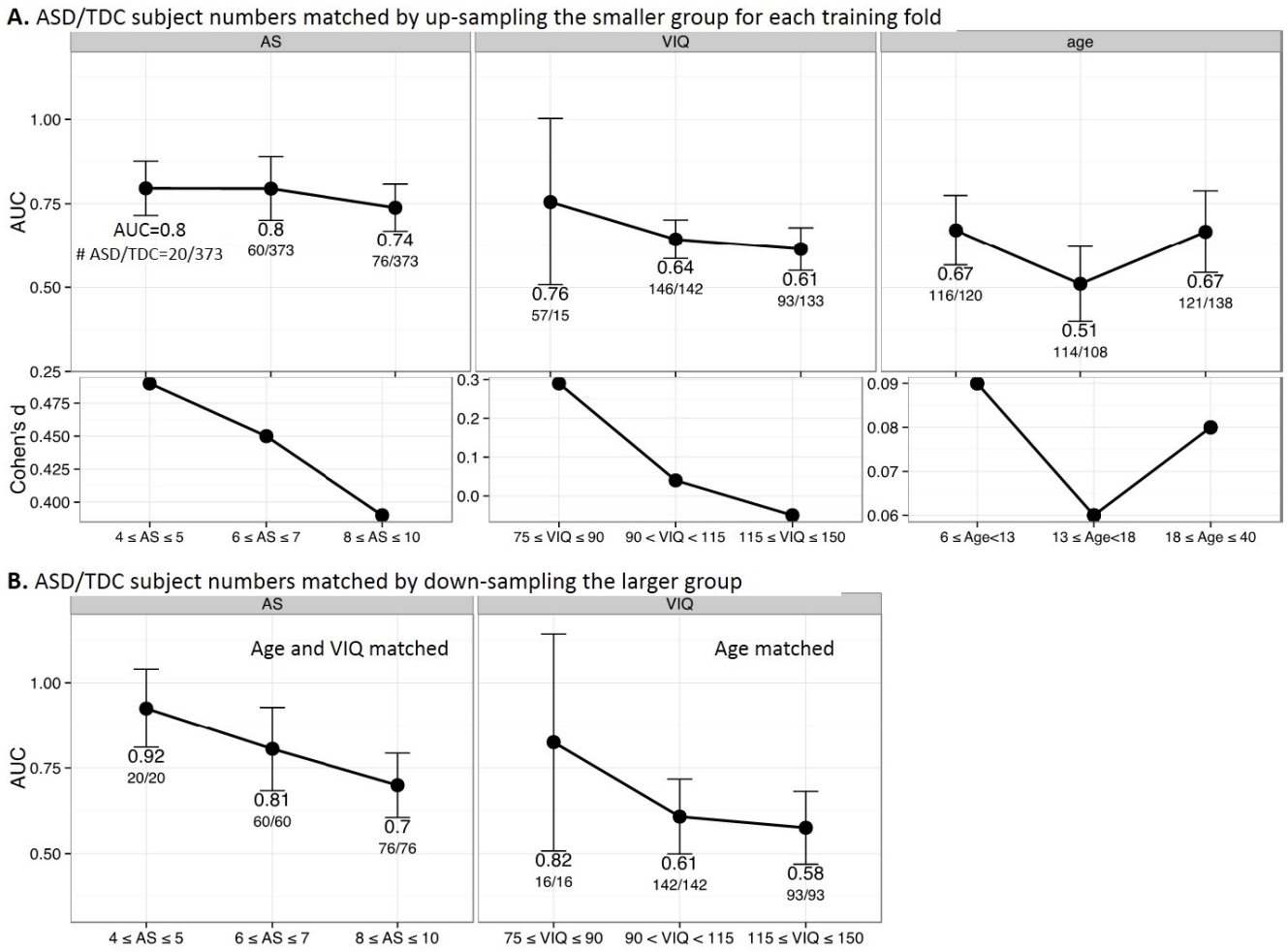


Figure 1: Improvement in classification when subjects are sub-grouped by autism severity (AS), verbal IQ (VIQ) and age. Mean and standard deviation of area under the curve (AUC) across 10 test folds are presented. The Cohen's d which is proportional to the separation of features follows the AUC.

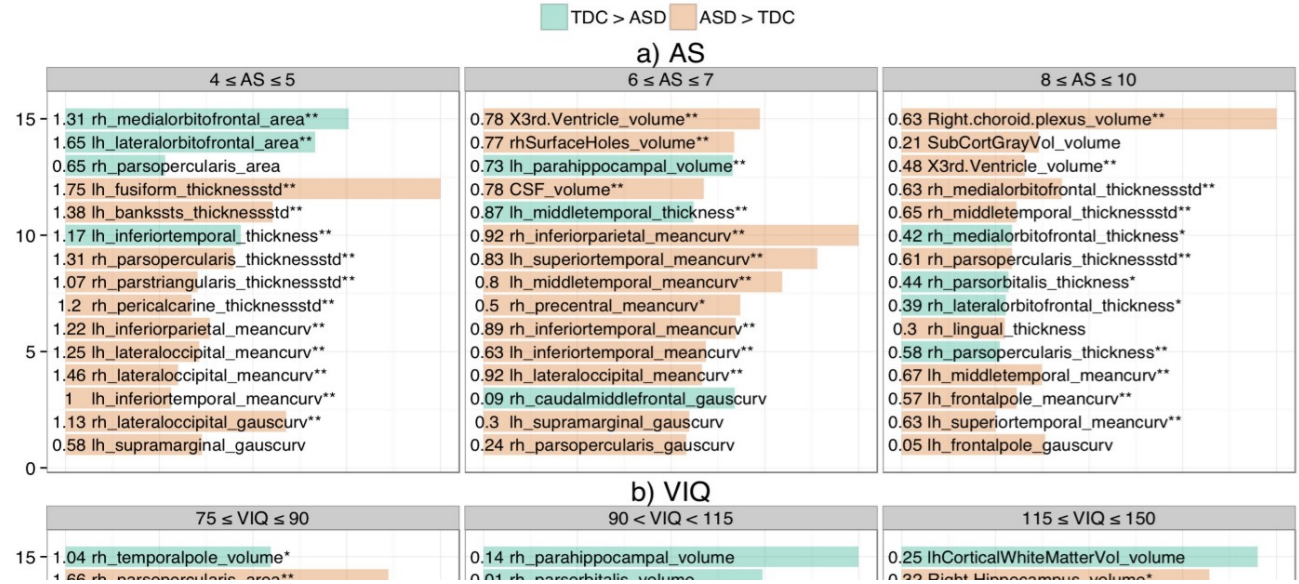


Figure 2: Most Important Features for Classification. Top 15 important features for ASD vs. TDC classification in each sub-group are presented. Each feature is represented by a bar. The length of the bar represents the relative % importance for classification (with respect to the top feature). The color of the bar represents the directionality of ASD vs. TDC group difference. The features have been grouped by volume, area, thickness, thickness standard deviation, folding index, mean curvature and Gaussian curvature. Before and after each feature we present the Cohen's d value and two sample t-test significance (P<0.005** and P<0.05*).

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3 **179.003** Altered Organization of the Connectome in Pre-School Aged Children with Autism Spectrum Disorder

D. Grayson[1], *D. D. Li*[2], *S. J. Rogers*[2], *D. Fair*[3], *C. W. Nordahl*[2] *and D. G. Amaral*[4], *(1)UC Davis Mind Institute, Davis, CA, (2)University of California at Davis, Sacramento, CA, (3)Oregon Health & Science University, Portland, OR, (4)UC Davis The M.I.N.D. Institute, Sacramento, CA*

Background: It is now largely recognized that Autism Spectrum Disorder (ASD) is a syndrome that involves alterations in brain connectivity. Previous diffusion-weighted imaging (DWI) research in late childhood has emphasized microstructural alterations of white matter pathways in Autism by using voxel-wise statistics. However, thorough analyses of whole-brain network properties of the structural connectome in early childhood are, thus far, limited.
Objectives: In the current study, we expand on the literature by using probabilistic tractography along with a graph theoretical measurement, termed communicability, to determine what aspects of brain communication might be altered in children with Autism.
Methods: T1-weighted structural images and DWI were acquired in a sample of 55 children with ASD (age range: 3-5 years) and 13 typically developing (TD) children matched on age and gender. Scanning was performed while children were sleeping and images were visually inspected to exclude subjects with motion or other noticeable

artifact. Voxelwise diffusion was modeled using constrained spherical deconvolution (Tournier et al., 2008) and probabilistic tractography was performed throughout all voxels of white matter. The Freesurfer cortical gray matter parcellation of 83 regions was then used to generate a whole-brain structural connectivity matrix (the connectome) for each subject. In order to understand how alterations in the structural connectome might relate to altered functional brain communication, we applied a measure termed communicability. Communicability measures the ease with which information can travel between two nodes (Crofts and Higham, 2009) by calculating a weighted sum of all paths between them. Comparisons of communicability across all node pairs was conducted between ASD and TD subjects using the Network-Based Statistic (Zalesky et al., 2010). In addition, multi-dimensional scaling was applied to child matrices to examine the variability of brain-wide communicability profiles within the TD and ASD populations.
Results: Structural networks of children with ASD showed remarkable agreement with their TD counterparts across much of the region set when comparing node strength (i.e. the sum of a node's connection strengths) and node communicability (the sum of a node's communicabilities). However, results indicated reduced communicability in ASD between a subset of nodes including regions of the frontal cortex and the caudate (T-statistics>3, FWE-corrected P<.04). Results implicate the lateral orbitofronal cortex most heavily, although the frontal operculum and superior frontal cortex also had reduced communicabilities. Our multi-dimensional scaling analysis identified a small number of subjects with ASD (n=6) whose pattern of brain-wide communicability differed markedly from the central tendency of the TD group and the remainder of the ASD sample.
Conclusions: Consistent with previous work, our findings suggest that from an early age ASD may be linked with alterations in brain communicability. In particular, connections throughout the integrative systems of the frontal cortex appear most atypical. Importantly, while our findings were robust across the group, not all children shared the same brain phenotype - highlighting sample heterogeneity. Future work will focus on characterizing this heterogeneity, and identifying the behavioral, genetic, and immunological correlates of these connectome phenomena.

4 **179.004** Association Between Microstructural Properties of the Uncinate Fasiculus and Emotion Recognition in Women with and without Autism Spectrum Conditions

A. N. Ruigrok[1], *M. C. Lai*[2,3,4], *M. V. Lombardo*[3,5], *F. dell'Acqua*[6], *M. Catani*[6], *J. Suckling*[7,8,9], *B. Chakrabarti*[1,10], *D. G. Murphy*[11], *C. MRC AIMS*[12] *and S. Baron-Cohen*[3,7], *(1)Department of Psychiatry, Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (2)Department of Psychiatry, National Taiwan University Hospital and College of Medicine, Taipei, Taiwan, (3)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (4)Centre for Addiction and Mental Health, The Hospital for Sick Children, and Department of Psychiatry, University of Toronto, Toronto, ON, Canada, (5)Department of Psychology and Center for Applied Neuroscience, University of Cyprus, Nikosia, Cyprus, (6)Department of Psychological Medicine and Psychiatry, Section of Brain Maturation, Kings College London, London, United Kingdom, (7)Cambridgeshire and Peterborough NHS Foundation Trust, Cambridge, United Kingdom, (8)Behavioural and Clinical Neuroscience Institute, University of Cambridge, Cambridge, United Kingdom, (9)Department of Psychiatry, Brain Mapping Unit, University of Cambridge, Cambridge, United Kingdom, (10)School of Psychology & Clinical Language Sciences, University of Reading, Reading, United Kingdom, (11)Sackler Institute for Translational Neurodevelopment, Department of Forensic and Neurodevelopmental Sciences,, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (12)Autism Research Centre, University of Cambridge; the Institute of Psychiatry (IoP) at King's College, London; Autism Research Group, University of Oxford, Cambridge, United Kingdom*

Background: Autism spectrum conditions (ASC) are a heterogeneous set of neurodevelopmental conditions. Difficulties with communication and social interactions are some of the main characteristics of ASC. Previous studies have noted potential sex/gender differences in the behavior and brain structural characteristics in individuals ASC, based on studies in which females are frequently outnumbered.
Objectives: This study aims to investigate interactions between neuropsychological tasks measuring emotion recognition and mentalizing and microstructural properties of the uncinate fasciculus (UF; which connects the frontal and temporal lobes) in women with and without ASC.
Methods: 42 age- and IQ-matched women with (n=21) and without ASC were scanned (3T GE) using a cardiac-gated 32-direction diffusion-weighted sequence. ExploreDTI was used for preprocessing (Leemans, et al., 2009) and UF deterministic tractography was performed according to guidelines given by Catani & Thiebaut de Schotten (2008) using TrackVis software (http://trackvis.org). Participants completed the "Reading the Mind in the Eyes" (RMET) and the Karolinska Directed Emotional Faces (KDEF) tasks. Number of correct responses was used to test for group differences in performance on the RMET, and log-transformed accuracy-adjusted reaction times (aaRT; mean reaction time divided by accuracy) were used for each individual emotion on the KDEF. A multivariate repeated-measures analysis of covariance (MANCOVA) was performed on fractional anisotropy (FA), mean diffusivity (MD), radial diffusivity (RD), axial diffusivity (AD) and tract volume respectively, with 'hemisphere' as within-subjects factor, 'diagnosis' as between-subject factor, and 'IQ' as a covariate. Any significant interaction effects were followed up by post-hoc ANCOVAs.
Results: On average, typically developing (TD) females performed better on the RMET (TD, 28.5; ASC, 23.0; $F(1,38) = 10.1$, $p = 0.003$) and identified "happy" KDEF expressions faster (TD, 1561ms; ASC, 1925ms; $F(1,38) = 9.82$, $p = 0.003$). No group differences were found for other emotional KDEF expressions. There were no group differences in FA, MD, number of streamlines or volume of the UF. Significant hemispheric asymmetries were found across groups for FA and MD, with higher FA ($F(1,40) = 31.6$, $p < 0.001$) and lower MD ($F(1,40) = 14.9$, $p < 0.001$) in the right UF. In women with ASC, higher FA in the right UF was related to better identification of the "happy" facial expression (TD: $r = -0.36$, $p = 0.12$, ASC: $r = -0.44$, $p = 0.05$) and higher MD of the right UF was associated with better performance on the RMET (TD: $r = -.03$, $p = 0.89$, ASC: $r = 0.45$, $p = 0.04$). Fisher's Z-test was used to compare the correlation coefficients and showed that there were no significant group differences.
Conclusions: This is the first study that investigates if and how microstructural properties of WM in TD and ASC females relate to socio-emotional task performance. Two significant correlations were found between microstructural properties of the right UF and performance on mentalizing tasks. However, post-hoc Fisher's Z-test determined that the effect sizes were not significantly different between groups. Future research should investigate if socio-emotional task performance in autism can be predicted by any other WM tracts.

5 **179.005** Associations Between Cortical Thickness and Social Cognition in Autism Spectrum Disorders

K. A. R. Doyle-Thomas[1], *N. E. Foster*[2], *A. Kushki*[3], *C. Horlin*[4], *A. Tryfon*[5], *K. L. Hyde*[6], *A. C. Evans*[6], *J. D. Lewis*[6], *L. Zwaigenbaum*[7] *and E. Anagnostou*[8], *(1)Bloorview Research Institute, Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada, (2)University of Montreal, Montreal, QC, Canada, (3)Bloorview Research Institute, Toronto, ON, Canada, (4)Holland Bloorview, Toronto, ON, Canada, (5)McGill University, Montreal, QC, Canada, (6)Montreal Neurological Institute, Montreal, QC, Canada, (7)University of Alberta, Edmonton, AB, Canada, (8)University of Toronto, Toronto, ON, Canada*

Background: Cortical thickness atypicalities in individuals with autism spectrum disorders (ASD) have been reported in several brain regions. Normative studies have shown that cortical thickness is associated with socio-emotional capacities such as theory of mind. Recent studies with individuals with ASD have explored the relationship between cortical thickness and socio-communicative abilities using scores from diagnostic measures such as the Autism Diagnostic Interview–Revised. The use of these assessments however precludes a comparison with typically developing (TD) peers.
Objectives: The present study examined emotion recognition in individuals with and without ASD using the Reading the Mind in the Eyes task (RMET), and explored whether overall performance, specific valances, and the level of difficulty were associated with differences in cortical thickness.
Methods: 51 youth with ASD and 15 TD controls (7-17 years of age) were included in these analyses. Participants were part of a multi-site imaging study (NeuroDevNet) at two Canadian sites, the Hospital for Sick Children, and the Montreal Neurological Institute. Participants were imaged using a Siemens Allegra 3T MRI system. A T1-weighted high-resolution automatic scan was obtained at the following parameters: TR=2300 ms, TE=2.96 ms, flip angle=90, FoV=256 x 192 x 240, slice thickness=1mm. Total imaging time was approximately 5 minutes. The CIVET automated analysis pipeline was using for preprocessing analysis. SurfStat and SAS were used for statistical analysis. We explored (1) baseline differences in age and IQ, (2) performance differences in RMET total scores, valence scores (positive, negative and neutral) and difficulty scores (easy and difficult), (3) the relation between RMET total, valence and difficulty scores, and cortical thickness between groups and (4) the effect of site.
Results: Groups were similar on age (ASD = 13.03±2.78, TD = 12.91±2.60, p=0.58), but significantly different on IQ (ASD = 95.55±18.88, TD = 116.06±7.97, p<0.001). RMET total scores were significantly poorer in individuals with ASD compared to TD youth (ASD = 16.41±0.61, TD = 20.29±1.16, p=0.004). After controlling for IQ, scores were no longer significantly different (ASD = 16.96±0.54, TD = 18.29±1.09, p=0.29). IQ was not controlled for in subsequent analyses. A significant interaction was observed between accuracy and cortical thickness between groups in the inferior frontal gyrus (Brodmann area; BA 45, p=0.05) and the cingulate gyrus (BA 32, p=0.003) for overall performance; the superior frontal gyrus (BA 11, p<0.001) and the medial prefrontal gyrus (BA 10, p<0.001) for negative emotions; and the middle frontal gyrus (BA 11, P=0.003), the inferior frontal gyrus (BA 44, p=0.008), and the cingulate gyrus (BA 24, p=0.016) for difficult emotions, after controlling for age and correcting for multiple comparisons. The results did not change significantly when controlling for site. In all cases, TD individuals showed increased cortical thickness related to improved accuracy, whereas no such relation was observed in individuals with ASD. No significant interactions were found between performance and cortical thickness for positive or neutral emotions, and easy items (all p>0.05).
Conclusions: These findings suggest that cortical thickness across the brain may relate to social perception in different ways in individuals with and without ASD.

6 **179.006** Asymmetry of Fusiform Structure in ASD and Its Association with Symptom Severity

C. C. Dougherty[1], *D. W. Evans*[2], *G. J. Katuwal*[1,3] *and A. M. Michael*[1], *(1)Autism and Developmental Medicine Institute, Geisinger Health System, Lewisburg, PA, (2)Department of Psychology, Bucknell University, Lewisburg, PA, (3)Center for Imaging Science, Rochester Institute of Technology, Rochester, NY*

Background:
Deviations from typical brain asymmetry have been implicated in neurodevelopmental disorders (Renteria 2012). Of the brain regions implicated in autism spectrum disorder (ASD), the fusiform gyrus, is associated with abnormalities in face processing (Schultz 2003). Although the fusiform may underlie ASD symptoms, only a few studies have examined its structural asymmetry (Herbert 2002; 2005). The asymmetry of the fusiform in terms of volume, surface area (SA), cortical thickness (CT), or developmental

trajectory are not well characterized. Furthermore, the relationship between fusiform asymmetry and ASD symptom severity is unclear.

Objectives:

We examine the following: 1) Left-Right (L-R) asymmetry of volume, SA, and CT of the fusiform gyrus in ASD compared to typically developing controls (TDC); 2) developmental differences in fusiform asymmetry between ASD and TDC; 3) correlation between fusiform asymmetry and symptom severity as measured by Gotham Autism Severity Scores (Gotham 2009).

Methods:

Structural MRIs and demographics of 128 ASDs (average age ± std: 15.5 ± 4.1 years) and 127 TDCs (15.6 ± 3.8 years) from the ABIDE dataset were used in this study. All subjects were right handed males between the ages of 6 to 25 years. We processed the MRIs with FreeSurfer and derived the volumes, SAs and CTs of the fusiform gyri. Symmetry index (SI) (Galaburda 1987) of the above measures was calculated as the difference between the left and right hemispheric measures as a percentage of the average of the left and right measures.

A generalized linear model was fitted for SI with the following regressors: age, ASD/TDC status, verbal IQ (VIQ), performance IQ (PIQ), and age status interaction. For correlations between SI and symptom severity, SIs from 69 ASDs were fitted with the following regressors: age, VIQ, PIQ, and ADOS. The aforementioned model was repeated with autism symptom severity scores from 28 ASDs. ADOS and severity score analyses were limited to a subset of subjects for whom these data were available.

Results:

Significant group differences in volume (*p = 0.031)* and SA (*p = 0.031)* asymmetries emerged between ASD and TDC. ASD subjects exhibited greater leftward asymmetry for both measures (Figure 1A). Although significant overall group differences are evident, asymmetries for ASDs were spread both leftward and rightward (see distribution in Figure 1A). A significant interaction with age (*p = 0.049)* emerged in SA for ASD and TDC with decreasing leftward asymmetry in ASD with increasing age (Figure 1B). ADOS scores and fusiform volume asymmetry were negatively correlated (*p = 0.047)*. A stronger correlation (*p = 0.0097)* was observed between autism symptom severity and fusiform volume asymmetry. See Figure 2A, B.

Conclusions:

We provide evidence for abnormal patterns of asymmetry in fusiform gyrus volume and SA in ASD compared to TDC. The wide distribution of asymmetry in ASD may indicate the presence of ASD subtypes, and closer evaluation is needed. Furthermore, the development of asymmetry in fusiform SA may differ in ASD. Finally, we provide evidence that asymmetry in fusiform volume may be related to autism symptom expression using both ADOS and autism severity scores.

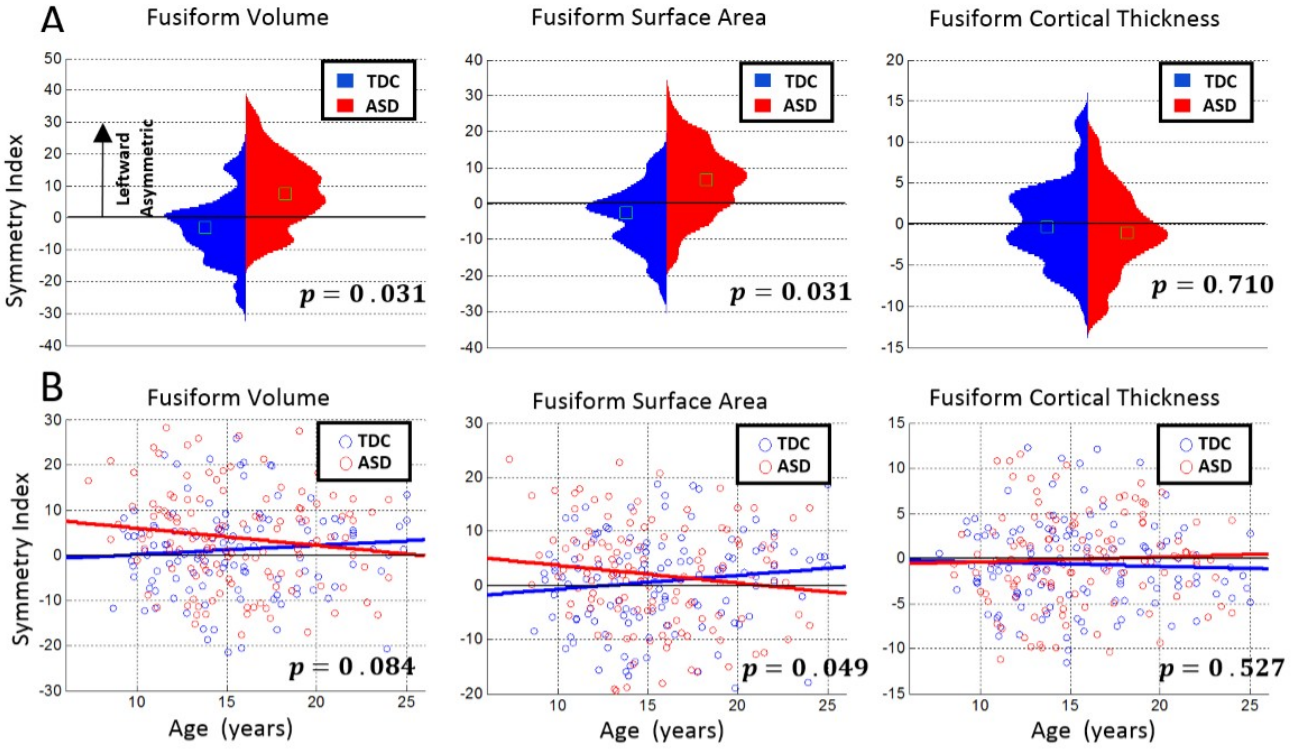
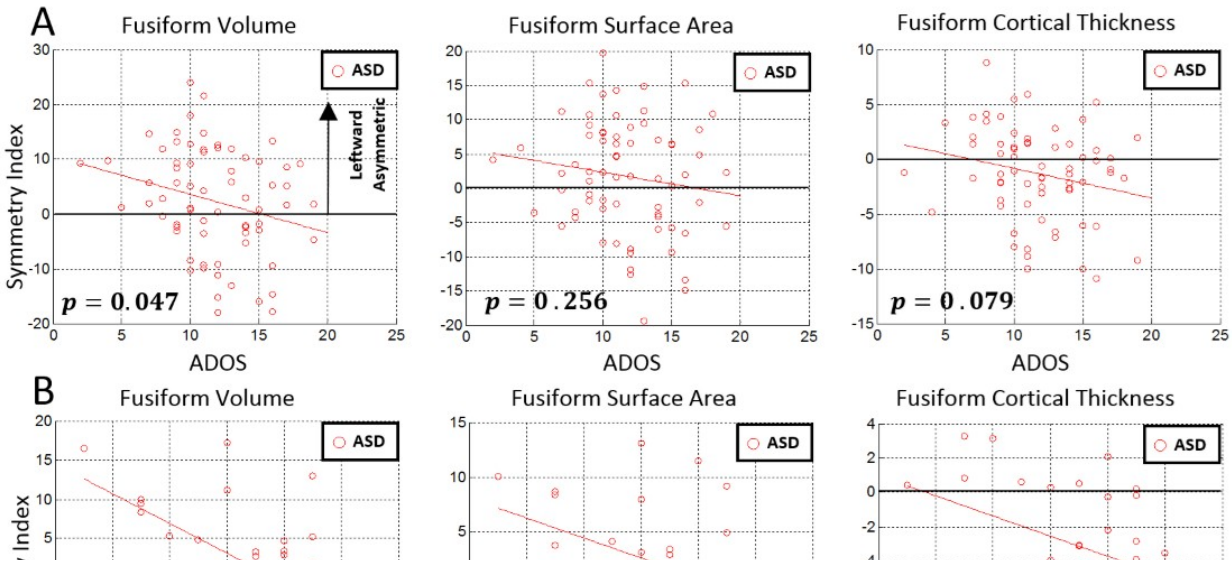


Figure 1: Distribution of Symmetry Index and Age x Diagnosis Interaction Plots: A depicts distribution of symmetry index (adjusted for age and IQs) for ASD (red) and TDC (blue) for fusiform volume, surface area, and cortical thickness. Group means are presented in the green box. Group mean differences were significant for volume ($p = 0.031$) and surface area ($p = 0.031$). **B** depicts symmetry Index across age range for cross-sectional data (adjusted for IQs). Age x diagnosis interaction was significant for surface area ($p = 0.049$). Linear fit indicates a trend of decreasing leftward asymmetry with age for ASD and decreasing rightward asymmetry for TDC.



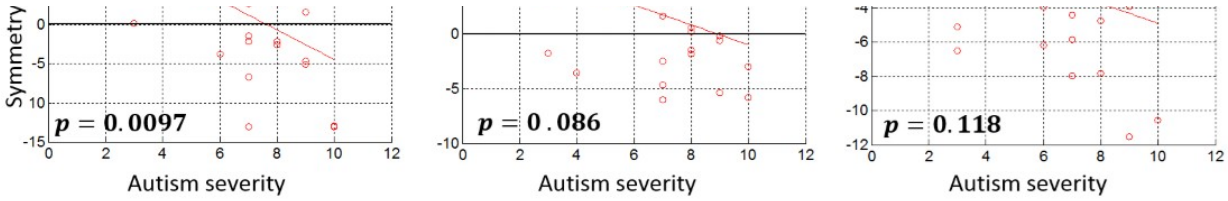


Figure 2: Symmetry index vs. ADOS and Autism Severity plots: A depicts relationships between symmetry index and ADOS for fusiform volume, surface area, and cortical thickness in ASD. Results indicate a significant negative relationship between volume symmetry index and ADOS score ($p = 0.047$). **B** depicts relationships between symmetry index and autism severity scores as measured by Gotham autism severity scores. A significant relationship between volume symmetry index and autism severity emerged ($p = 0.0097$). Data were adjusted for age and IQs.

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7 **179.007** Atypical Language-Related Asymmetry Stratifies Male Individuals with Autism with and without Language Delay

D. L. Floris[1,2], *M. C. Lai*[3,4,5], *T. Auer*[6], *M. V. Lombardo*[3,7], *C. Ecker*[8], *B. Chakrabarti*[1,9], *S. J. Wheelwright*[1], *E. Bullmore*[10,11,12,13], *C. MRC AIMS*[14], *D. G. Murphy*[8], *S. Baron-Cohen*[3,10,13] *and J. Suckling*[10,11,12,13], *(1)Department of Psychiatry, Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (2)Department of Child and Adolescent Psychiatry, The Child Study Center at New York University Langone Medical Center, New York City, NY, (3)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (4)Centre for Addiction and Mental Health, The Hospital for Sick Children, and Department of Psychiatry, University of Toronto, Toronto, ON, Canada, (5)Department of Psychiatry, National Taiwan University Hospital and College of Medicine, Taipei, Taiwan, (6)MRC Cognition and Brain Sciences Unit, University of Cambridge, Cambridge, United Kingdom, (7)Department of Psychology and Center for Applied Neuroscience, University of Cyprus, Nikosia, Cyprus, (8)Sackler Institute for Translational Neurodevelopment, Department of Forensic and Neurodevelopmental Sciences,, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (9)School of Psychology & Clinical Language Sciences, University of Reading, Reading, United Kingdom, (10)Cambridgeshire and Peterborough NHS Foundation Trust, Cambridge, United Kingdom, (11)Department of Psychiatry, Brain Mapping Unit, University of Cambridge, Cambridge, United Kingdom, (12)National Institute of Health Research, Cambridge Biomedical Research Centre, Cambridge, United Kingdom, (13)Behavioural and Clinical Neuroscience Institute, University of Cambridge, Cambridge, United Kingdom, (14)Autism Research Centre, University of Cambridge; the Institute of Psychiatry (IoP) at King's College, London; Autism Research Group, University of Oxford, Cambridge, United Kingdom*

Background:
Handedness and language are the most lateralized functions in the brain. Individuals with autism exhibit core deficits in language and auditory functions and show increased rates of non-right-handedness and atypical language specialization. Based on these observations, the prediction is that language-related measures of asymmetry should be sensitive to different developmental language profiles in individuals with autism.
Objectives:
No previous studies have examined lateralized differences in cortical language-related structures between language-delayed and non-language-delayed individuals with autism. Only one has looked at differences in handedness between these subgroups. Thus, we aimed to compare individuals with autism with and without language delay (LD) on language-related asymmetry measures including handedness and auditory and language cortical asymmetry.
Methods:
Sample 1: Participants were recruited online from the Cambridge Autism Research Database. The sample comprised 445 males with autism (LD=52, no LD=393) and 2,372 control male adults without autism (18-60 years). Handedness was categorically classified as 'right-handed' or 'non-right-handed'. A Chi-square-test compared the handedness categories across groups.
Sample 2: Participants comprised 67 right-handed, high-functioning adult males with autism (LD: 26; no LD: 41) and 69 male adults aged 18-43 years. Autistic symptoms were assessed by the ADI-R and ADOS. Language was assessed by a phonological memory and a word-generativity task.
T1-weighted images were segmented, rigid-body registered and reflected across the midline using SPM8. All images were mapped onto a symmetrical study-specific DARTEL template. Laterality indices (LI) were defined as: 2*(right–left)/(right+left). Spatially-restricted voxel-wise analysis of LIs was conducted using two co-activation maps for the terms 'language' and 'auditory' from the online database NeuroSynth. To test the effect of LD, univariate ANCOVAs were conducted for the interaction between diagnosis and any significant cluster and language and symptom measures as dependent variables.
Results:
Sample1: A significant between-group difference in handedness was observed across the three groups of autism with LD, without LD, and controls (p<0.001). Individuals with autism with LD were more strongly non-right-handed than controls (Cohen's d=0.404) and individuals with autism without LD showed an intermediate position (Cohen's d=0.198).
Sample2: Voxel-wise analysis of LIs within the auditory ROI revealed significant reductions from typical leftward asymmetry in adults with autism with LD (cluster-level FDR-corrected q=0.015), but not in individuals with autism without LD who had a significant intermediate position based on a polynomial trend analysis (p<0.001). There were no significant differences for the language ROI. There was a trending interaction between diagnosis and the significant auditory cluster for social reciprocity symptoms (ADI-A) (p=0.066). Follow-up correlational analyses showed significance within individuals with autism with LD (r=0.373, p=0.036), but not in individuals with autism without LD (r=-

0.092, p=0.289).
Conclusions:
Increased non-right-handedness and reductions in leftward asymmetry of perisylvian regions were found in male adults with autism. These potentially constitute behavioural markers and biological underpinnings of LD associated with autism, and represent a putative cardinal neurophenotype of LD in autism. It still has to be established whether handedness also differentiates between different developmental language profiles in females with autism and whether atypical cortical asymmetries are more pronounced in language-delayed females with autism.

8 **179.008** Atypical Patterns of Gyrification in Preschool-Aged Boys with Autism Spectrum Disorder

L. Libero[1], *M. Schaer*[2], *H. Ohta*[3], *S. J. Rogers*[4], *D. G. Amaral*[5] *and C. W. Nordahl*[4], *(1)UC Davis MIND Institute, Sacramento, CA, (2)Stanford University, Palo Alto, CA, (3)Showa University, Tokyo, Japan, (4)University of California at Davis, Sacramento, CA, (5)UC Davis The M.I.N.D. Institute, Sacramento, CA*

Background: Gyrification is a measure that describes the convolution or cortical folding of the brain. It is a feature of human cortex that develops prenatally and very early in life. Early adverse events affecting cerebral development are known to result in cortical folding alterations that can be quantified later on in the brains of children. Given that gyrification develops early in life, investigating this neural feature in a young population of children with autism spectrum disorder (ASD), close in time to the age of diagnosis, may provide insight into the earliest neuropathological manifestations of ASD.
Objectives: To examine local gyrification index in a large sample of young children with ASD and age-matched typically developing (TD) children.
Methods: Participants included 105 male children with ASD and 48 typically developing boys between 2 and 3.5 years of age enrolled in the Autism Phenome Project. T1-weighted structural MRIs were collected for each child and local gyrification index (LGI) was quantified based on these images. Retrospective measures including birth head circumference, birth length, birth weight, and gestational age at birth were acquired retrospectively from medical records. A subgroup of boys with ASD (n = 19) were classified as having disproportionate megalencephaly (ASD-DM; based on having a standardized ratio of total cerebral volume to height that was 1.5 SD above the mean for the TD group), while the remaining 86 boys with ASD had brain volume to height ratios within the normal range. Group comparisons included all children with ASD relative to TD, followed by comparisons of each ASD subgroup relative to TD.
Results: There were no significant differences between groups for age, gestational age, birth weight, birth length, or birth head circumference. However, the children with ASD had significantly reduced LGI in left and right fusiform gyrus, compared to TD boys. Additional comparisons of ASD subgroups revealed a different pattern of gyrification alterations in the ASD-DM group. Compared to TD boys and controlling for differences in brain volume, the ASD-DM group had significantly increased LGI in right superior frontal, left isthmus cingulate, and left posterior cingulate, suggesting that the ASD-DM group has a different neural phenotype from boys with ASD without megalencephaly. An examination of the relationships between global gyrification and measures from birth records revealed the children with ASD had a significant positive correlation between head circumference at birth and global gyrification, while the TD group had no such relationship.
Conclusions: Significant alterations in LGI in right and left fusiform in boys with ASD holds strong implications for social and emotional processing. But importantly, not all children with ASD exhibited this pattern of alterations; our results suggest that boys with ASD and disproportionate megalencephaly may have a different neural phenotype. Associations between global gyrification at 2-3.5 years of age with birth head circumference in the ASD group suggest that alterations in gyrification patterns may be determined prenatally and already present at birth.

9 **179.009** Autism Spectrum Disorder Is Characterized By Structural Under-Connectivity in Reward Circuitry

B. Tunc[1], *D. Parker*[1], *R. T. Schultz*[2,3] *and R. Verma*[1], *(1)Center for Biomedical Image Computing and Analytics, University of Pennsylvania, Philadelphia, PA, (2)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (3)Departments of Pediatrics and Psychiatry, University of Pennsylvania, Philadelphia, PA*

Background: The idea that the reward system dysfunctions play a central role in etiology of autism spectrum disorder (ASD) has gained increased interest over the last decade due to the potential of unifying currently disjoint characteristics of ASD such as social deficits and repetitive behaviors under a single theory. The brain regions associated with the reward circuitry have been repeatedly reported as being affected in ASD. However, the literature still lacks a systematic connectivity analysis of the reward circuitry in ASD, as well as changes in its integration with other circuitries corresponding to distinct neuropsychological mechanisms.
Objectives: The aim of this work is to provide a systematic connectivity analysis of the reward system in ASD, by studying diffusion imaging based structural connectivity changes within the reward circuitry, as well as between the reward circuitry and several other circuitries.
Methods: A dataset of 97 male participants with ADOS/expert clinician confirmed ASD (age: 12.6 2.9 years) and age-matched 75 male TDCs with diffusion tensor imaging (DTI) data were studied. Data processing entailed generating connectivity maps (connectomes) of the entire brain, using a parcellation scheme of 82 cortical and subcortical gray matter regions (*i.e.* nodes of connectome). Network measures encoding connectivity changes at multiple levels including individual regions, clusters of regions, and specific functional subnetworks were calculated and compared between the groups using univariate parametric statistical tests.
Results: Our results suggested significant structural connectivity differences related to subcortical and several cortical regions traditionally associated with the reward system. Almost all regions of the reward circuitry including caudate, putamen, pallidum, hippocampus, accumbens area, amygdala, and orbitofrontal cortex showed local connectivity differences. Connectivity was significantly weaker in the ASD group in the reward circuitry as a whole, and in its integration with circuitries associated with other neuropsychological systems, including those composing the *social brain*.
Conclusions: Regions of reward circuitry were, both individually and as a whole, affected by ASD induced changes. Overall, our findings were in line with the social motivation theory of ASD, which suggests that ASD phenomenology is significantly associated with deficiencies in social reward mechanisms. These results strengthen speculation that developmental trajectories in ASD may be altered in those who develop ASD by early appearing reward deficiencies, such that social interactions are not reinforced typically. This may impact cognitive and social development. If Social motivation deficits precede fully syndrome ontogeny, interventions that boost social motivation, rather than aiming at the improvement of specific social skills, might be the most effective strategy.

10 **179.010** Autism Spectrum Disorder Liability Is Modulated Along a Gender Continuum from the Female to Male Neuroanatomical Brain Phenotype

D. Andrews[1], *M. Gudbrandsen*[1], *A. Marquand*[2,3], *E. Daly*[1], *C. M. Murphy*[1], *S. Baron-Cohen*[4], *M. C. Lai*[4,5,6], *M. V. Lombardo*[4,7], *A. N. Ruigrok*[4], *E. Bullmore*[4,8], *J. Suckling*[4], *S. C. Williams*[2], *M. Craig*[1], *D. G. Murphy*[1] *and C. Ecker*[1], *(1)Sackler Institute for Translational Neurodevelopment, Department of Forensic and Neurodevelopmental Sciences,, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (2)Centre for Neuroimaging Sciences, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (3)Donders Institute for Brain, Cognition and Behaviour, Radboud University, Nijmegen, Netherlands, (4)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (5)Department of Psychiatry, National Taiwan University Hospital and College of Medicine, Taipei, Taiwan, (6)Centre for Addiction and Mental Health, The Hospital for Sick Children, and Department of Psychiatry, University of Toronto, Toronto, ON, Canada, (7)Department of Psychology and Center for Applied Neuroscience, University of Cyprus, Nikosia, Cyprus, (8)Department of Psychiatry, Brain Mapping Unit, University of Cambridge, Cambridge, United Kingdom*

Background: Autism spectrum disorder (ASD) is a neurodevelopmental condition more commonly observed among males, with an estimated male:female prevalence ratio around 2-5:1 (Fombonne 2005, Lai 2015). Findings of a greater familial etiological load of ASD in females relative to males suggest the existence of male-specific risk, and female-specific protective factors for ASD (Robinson, 2013). However, while the existence of gender-related risk and protective factors for ASD are supported by genetic and demographic studies, little research has been conducted to establish whether having a female or male brain phenotype mediates ASD liability.
Objectives: Here, we aimed to (1) identify neuroanatomical patterns that are characteristic of the male and female brain phenotype, and (2) test the hypothesis that having a male or female brain phenotype represents a risk or protective factor for ASD, respectively.
Methods: 98 right-handed adults with ASD (49 males, 49 females) and 98 matched neurotypical controls (51 males, 47 females) aged 18-42 years were recruited and assessed at the IoPPN, London, and the ARC, Cambridge. A Gaussian Process classifier (GPC) (Rassmussen 2006, Marquand 2010) was initially trained to make probabilistic predictions for each control participant based on binary classes of biological sex using eight surfaced based measures of cortical neuroanatomy (cortical thickness, grey & white matter surface areas, cortical volume, grey:white matter signal intensity ratio, curvature, sulcal depth, and metric distortion). This approach allowed us to derive a probabilistic prediction for each individual based on the binary categories dictated by biological sex, and to represent each brain along a gender continuum with individuals being most confidently classified representing the prototypical male or female brain phenotype. The performance accuracy of each model was estimated using leave-one-out cross validation and tested for significance via permutation of class labels (n=1000). Subsequently, we applied each predictive model to the males and females with ASD in order to estimate probabilistic predictions for individuals with ASD along a gender continuum. ASD liability for each model as a function of neuroanatomical gender phenotype was estimated as the ratio of males (females) with ASD to the total number of males (females) in eight bins along the axis of predictive probabilities of gender.
Results: Across all eight vertex based cortical features, GPC was able to separate male from female controls at accuracies ranging from 68% for metric distortion to 84% for G:W intensity ratio (p<=.001). When predicting individuals with ASD we found that female ASD cases were allocated more frequently to the male category across all eight models (as opposed to the female category), significantly above chance level (p-values ranging from <.001-<.002). When examining the proportion of ASD cases as a function of predictive probability for the male phenotype, we found that increased probabilities for the male brain phenotype were associated with an increased prevalence ratio for ASD within our sample.
Conclusions: Our results support the hypothesis that having a male brain phenotype constitutes greater risk for the development of ASD regardless of biological sex, hence implying that a female brain phenotype may provide a protective effect for ASD.

11 **179.011** Autism and Early Exposure to the Extrauterine Enviroment

ABSTRACT WITHDRAWN

Background: Children born extremely preterm (EPT) have an elevated risk for autism spectrum disorder (ASD). In this condition, MRI studies have suggested volumetric brain abnormalities. We hypothesized that such volumetric changes are present already in the neonatal brain
Objectives: To explore regional grey matter (GM) and white matter (WM) volume differences in EPT infants at termequivalent age (TEA) with a positive screen of ASD and/or a clinical diagnosis of ASD compared to a group of unaffected EPT infants.
Methods: We included 87 children born in Stockholm between January 2004 and March 2007 with a gestational age (GA) of <27 weeks + 0 days. Infants underwent MRI at TEA. 23 children had scores above cut-off on the Social Responsiveness Scale (SRS) and/or a clinical diagnosis of ASD at 6,5 years, and out of them 11 infants had high-quality 3D MRI and no focal lesion. Comparisons were made with 22 EPT infants with a negative ASD screening. Global (atlas-based segmentation) and regional (voxel-based morphometry (VBM)) analyses were applied. Significant clusters at the corrected ($p<0.05$) and uncorrected ($p<0.001$) level are reported for VBM.
Results: Out of 87children, 26% of EPT children either screened positive for ASD and/or had a clinical diagnosis of ASD. The ASD positive group showed significantly smaller total volumes of temporal, occipital, insular and limbic cortices in the global analysis. They also had grey matter reductions, predominantly involving the left parietal and lateral occipital cortices according to the regional analysis. After including birth weight as a covariate only the regional differences remained.
Conclusions: EPT birth resulted in high positive screens for ASD at 6,5 years. Altered brain volumes and different maturational trajectories in regions involving social communication and behavior domains were detectable already in the neonatal period.

12 **179.012** Brain Morphometry of Dimensional Autism: A Twin Study

E. Cauvet[1]*, A. Van't Westeinde*[1]*, K. Mevel*[1,2]*, R. Toro*[3] *and S. Bolte*[4]*, (1)Karolinska Institutet, Stockholm, Sweden, (2)LaPsyDÉ UMR CNRS 8240, Universités Paris Descartes et Caen Normandie - Sorbonne Paris Cité -GIP Cyceron, Paris, France, (3)Institut Pasteur, Paris, France, (4)Department of Women's and Children's Health, Pediatric Neuropsychiatry Unit, Karolinska Institutet, Stockholm, Sweden*

Background:
Structural morphology related to Autism Spectrum Disorder (ASD) might give valuable insights into its etiology and contribute to the identification of biomarkers for diagnostic and treatment purposes. However, though many studies do report abnormal brain morphology, the structural imaging literature on ASD has shown inconsistent results. The latter is probably due in part to the small sample sizes but also to the complex interaction between brain structure and age, gender, IQ and phenotypic heterogeneity in ASD (Haar et al., 2014; Lefebvre et al., 2015). Moreover, most previous research used a volume-based approach, which only partly characterizes brain morphology, and being less sensitive to subtle alterations in anatomy (Raznahan et al., 2013). Twin design is one way to overcome some of these issues, but to date there have been few twin-based imaging studies, of which most have used limited sample sizes (Mevel et al., 2014).
Objectives:
Our aim was to investigate the relation between both volume- and surface-based brain morphology and a continuous estimate of autistic traits in a population-based sample enriched of broader phenotypic autism and clinical ASD.
Methods:
T1 weighted anatomical images of 116 subjects aged 8-23 years, both mono- and dizygotic twins, were acquired within the Roots of Autism and ADHD Twin Study Sweden (RATSS) (Bölte et al., 2014). Within twin-pair differences in estimates of lobar volume (FSL, N=116) and gyral volume, surface area and cortical thickness (Freesurfer, N=48) of regions previously implicated in ASD were correlated to within twin-pair differences in total scores on the parent-report Social Responsiveness Scale (SRS). The results from the within twin-pair conditional regression model were compared to a regular linear regression model across all subjects, which is more sensitive to differences in age and gender.
Results:
Higher SRS scores were associated with an increase in white matter volume in the Right Occipital lobe ($z=2.1$, $p=0.04$), and Bilateral Parietal lobes (left: $z=-2.3$, $p=0.02$ and right: $z=-3.4$, $p=<0,001$), using within twin pair differences on volume-based morphometry. Surface-based analysis confirmed these findings: higher SRS scores were related to 1) an increase in gray matter volume and surface areas in the right Lateral Occipital gyrus (respectively $z=2.3$, $p=0.02$ and $z=1.8$, $p=0.066$), and 2) a decrease of gray matter volume and surface areas in the left Inferior Parietal gyrus (respectively $z=-2.4$, $p=0.02$ and $z=-3.8$, $p<0.001$). No differences in cortical thickness were related to SRS score in these regions. Only the associations with the Right Occipital lobe white matter volume were repeated using the linear regression model.
Conclusions:
A higher score on the SRS, indicating increasing autism traits, seems to be related to altered volume and surface area in sensory regions namely Occipital and Parietal, when using a within twin-pair design, but not when using a conventional linear regression model. Crucially, twin models allowed us to detect brain structure alterations related to ASD that are sensitive to differences in age, gender and IQ. Our results further add evidence that alterations in cortical thickness and surface area may independently contribute to changes in brain volume and ASD pathology.

13 **179.013** Cortical Correlates of Gustatory and Olfactory Avoidance in Autism

G. Wallace[1]*, H. S. Popal*[2]*, E. I. White*[2]*, K. Simmons*[3]*, L. Kenworthy*[4] *and A. Martin*[2]*, (1)The George Washington University, Washington, DC, (2)NIMH, Bethesda, MD, (3)Laureate Institute for Brain Research, Tulsa, OK, (4)Children's Research Institute, Children's National Medical Center, Rockville, MD*

Background: Autism spectrum disorder (ASD) has been linked with sensory related atypicalities dating back to seminal descriptions by Leo Kanner and Hans Asperger. This sensory dysfunction is thought to contribute to, if not drive feeding-related problems in ASD. These problems, including food selectivity and food refusal, are considerable mealtime stressors for families and interfere with daily functioning during adolescence and adulthood. Nevertheless, to date, investigations into sensory-related phenomena in ASD have concentrated on vision and audition to the relative exclusion of gustation and olfaction. Moreover, the neural underpinnings of taste and smell remain largely unexplored in ASD. Therefore, in the present study we investigated structural neural correlates of gustatory and olfactory sensory atypicalities in ASD.
Objectives: Examine structural brain correlates of gustatory and olfactory avoidance in ASD.
Methods: 40 adolescent and young adult males with ASD (M age=16.60, SD=2.78; M IQ=113.28, SD=15.08), diagnosed using the Autism Diagnostic Interview, Autism Diagnostic Observation Schedule, and DSM criteria, completed self-ratings of items from the olfactory portion of the Sensory Avoidance quadrant of the Adolescent/Adult Sensory Profile. Each participant also provided a high-resolution 3 Tesla anatomic magnetic resonance imaging scan. The FreeSurfer image analysis suite (version 5.1) was used to derive vertex-level cortical thickness and to complete data analysis.
Results: In the ASD group, increasing gustatory/olfactory avoidance was associated with increasing cortical thickness (cluster corrected *p*s<.05) in several regions, including the primary (insula and frontal operculum) and secondary (portions of the orbitofrontal cortex) gustatory cortex of the right hemisphere and both inferior and medial temporal cortices bilaterally. See Figure 1.
Conclusions: This is the first study to examine neural correlates of gustatory and olfactory avoidance in ASD. Strikingly, self-ratings of these behaviors in ASD were correlated with thickness in distinct cortical regions (e.g., insula/frontal operculum and orbitofrontal cortex) that are crucial to gustatory and olfactory function more broadly. These findings complement existing literature linking these sensory-related behaviors with these brain regions using structural brain imaging in non-ASD populations. For example, one prior study found increased cortical thickness in the orbitofrontal cortices and increased gray matter volume in medial temporal cortices in congenital anosmia (i.e., the loss of smell) (Frasnelli et al., 2013; NeuroImage). Another study found that individual differences in laboratory tests of olfactory function were positively associated with cortical thickness in the insula and orbitofrontal cortices of the right hemisphere in neurotypical adults (Frasnelli et al., 2010; Exp Brain Res). The present study extends this work to ASD, which is characterized by both gustatory and olfactory sensory avoidance. However, it remains unclear whether these brain correlates are the result of a history of these sensory-related avoidant behaviors or their cause. Future work in earlier developmental periods and longitudinal studies are needed to answer this question.

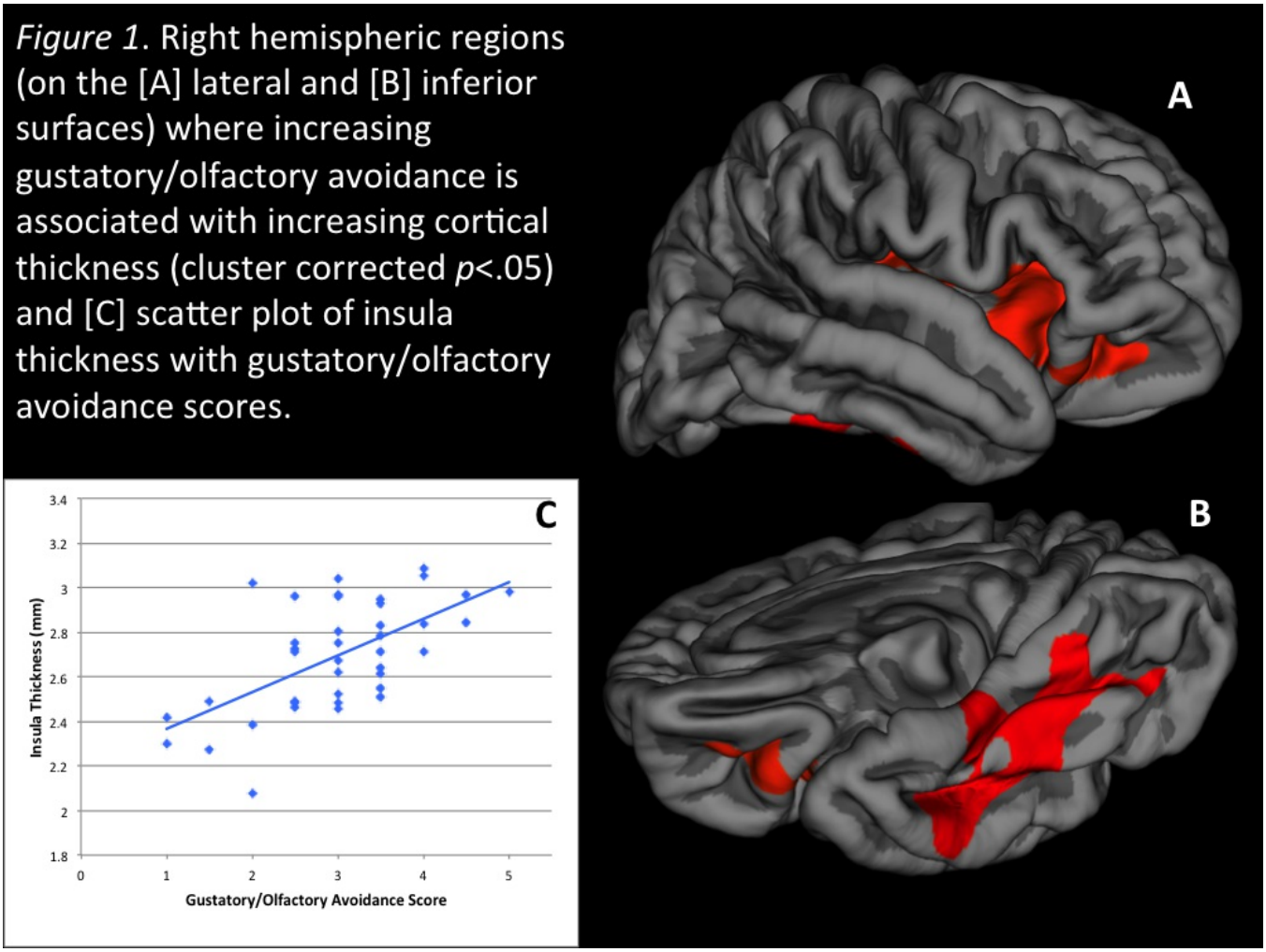


Figure 1. Right hemispheric regions (on the [A] lateral and [B] inferior surfaces) where increasing gustatory/olfactory avoidance is associated with increasing cortical thickness (cluster corrected $p<.05$) and [C] scatter plot of insula thickness with gustatory/olfactory avoidance scores.

14 **179.014** Coupling Between Global and Regional Brain Structural Variation in Autism Is Modulated By Symptom Severity

N. E. Foster[1,2], *M. Sharda*[1], *K. A. R. Doyle-Thomas*[3], *A. Tryfon*[1,2], *E. Anagnostou*[3,4], *A. C. Evans*[2], *L. Zwaigenbaum*[5], *J. D. Lewis*[2], *J. P. Lerch*[6], *K. L. Hyde*[1,2] *and .. NeuroDevNet ASD Imaging Group*[7], *(1)International Laboratory of Brain, Music and Sound Research, University of Montreal, Montreal, QC, Canada, (2)Montreal Neurological Institute, Montreal, QC, Canada, (3)Bloorview Research Institute, Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada, (4)University of Toronto, Toronto, ON, Canada, (5)University of Alberta, Edmonton, AB, Canada, (6)Mouse Imaging Centre, Hospital for Sick Children, Toronto, ON, Canada, (7)NeuroDevNet, Vancouver, BC, Canada*

Background: Brain imaging has revealed differences between individuals with Autism Spectrum Disorders (ASD) and Typical Development (TD), both in global (e.g., mean cortical thickness; CT) and regional structure. Global differences may reflect genetic or environmental influences acting across the brain in neurodevelopment, whereas local differences presumably reflect region-specific influences. However, global and regional factors in ASD have so far been studied separately, even though they act in concert to affect brain structure.
Objectives: 1) Examine how global CT drives regional CT differently in ASD, and 2) Test whether local uncoupling of CT in ASD is explained by symptom severity.
Methods: Participants were 48 ASD and 50 TD males from the NeuroDevNet project. Groups were age-matched (mean=12.8 years, SD=3.0) and had IQ>70. ASD participants were diagnosed using ADI-R and ADOS. CT was calculated from T1 MR images using CIVET software. Effects of age, IQ, site and brain volume were removed. Coupling between global mean CT and regional CT was assessed at two regional spatial levels: in 58 AAL regions (mean value), and by vertex (20mm smoothing). In both cases, the correlation of each region's CT with global CT was calculated across subjects, separately by group. Group differences in correlation were assessed via Fisher transformation. For the AAL analysis, P values were corrected via false discovery rate. For vertex analysis, clusters were calculated using permutation testing to control familywise error (FWE) rate to P<0.05. Developmental effects were examined by splitting the sample at median age and repeating the analysis in both age cohorts. After identifying regions where global-regional correlation differed between groups, the contribution of each ASD subject to the correlation difference was quantified by factoring out the baseline TD relationship. The resulting residuals represented CT variation in ASD unaccounted for by the baseline global influence. Linear interaction analyses then tested modulation by symptom severity (SRS, ADI-R, ADOS) of the correlation between residual CT and global mean CT.
Results: A strong influence of global CT upon regional structure was evident in the global-regional CT correlations in both groups. Regional correlations were generally diminished in ASD vs TD. After FWE correction, a correlation decrease was found in right inferior frontal gyrus (IFG) in both AAL and vertex analyses. Younger and older participants showed similar effects. Interaction analyses showed that global-regional coupling in ASD was modulated by symptom severity (SRS) in the right IFG.
Conclusions: Variability in regional cortical structure is strongly driven by a global component in both TD and ASD, but there is a greater degree of variance unexplained by global CT in ASD. The more localized nature of structural variability in ASD is consistent with the idea that brain differences in ASD result from a complex interaction of genetic factors. These results are important from a functional perspective because of IFG's role in social cognition and theory of mind, core features of ASD. This work offers a new approach to examine brain structural variability in special populations, and highlights the importance of accounting for global and local factors in brain structure.

15 **179.015** Diffusivity Measures Detect Changes in Cellular Organisation in the Cortex Associated with Elevated Glutamate in ASD: A 7T MRS and Ex Vivo DTI Study

S. A. Chance[1], *M. Torso*[1], *R. McKavanagh*[1], *K. Miller*[1] *and M. Jenkinson*[2], *(1)University of Oxford, Oxford, United Kingdom, (2)NDCN (FMRIB), University of Oxford, Oxford, United Kingdom*

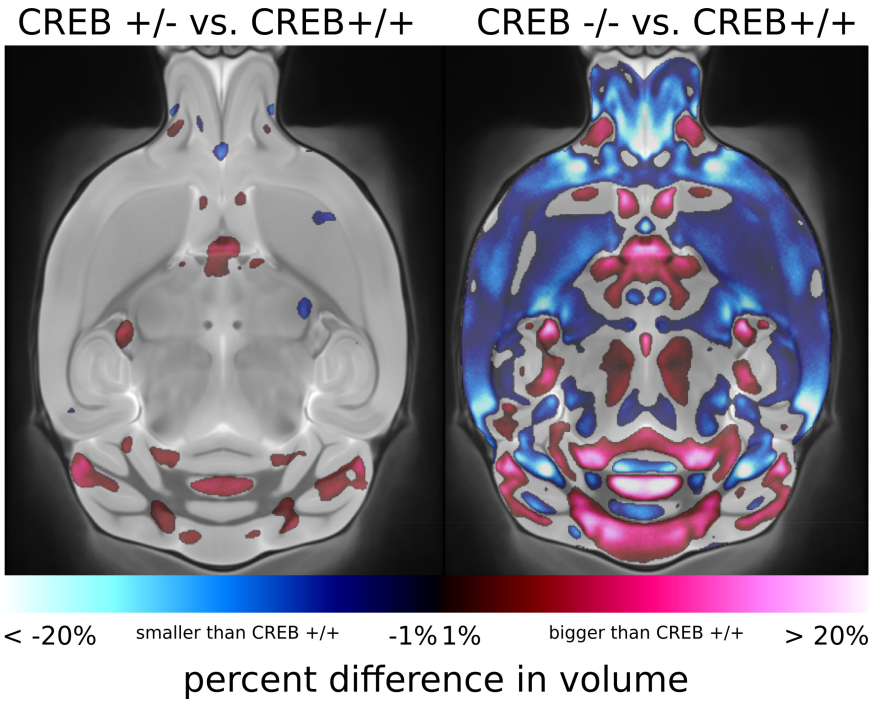
Background:
Minicolumns of cells are altered in cortical regions in ASD. Minicolumns have been found to be wider in primary and associative cortex. New MR imaging measurements derived from analysis of high resolution DTI of cerebral cortex show promise as an index of minicolumn alterations.
Objectives:
The present study sought to confirm these DTI measures as potential biomarkers for ASD by investigating: (i) the correspondence between histology and DTI in selected cortical regions and in the arcuate fasciculus that connects them; (ii) their diagnostic sensitivity for detection of ASD in vivo.
Methods:
2 experiments were conducted to confirm the utility of these biomarkers. The newly developed 'CHIPS' (Cortical High-Intensity Profile Segmentation) software was used to calculate several unique measures by comparing diffusivity data with the predicted minicolumn vertical axis derived from structural MRI of cortical grey matter.
i) **Post-mortem** MRI was conducted to validate the DTI signal as an index of minicolumn alteration by comparison of histological measurements from the identical brain regions. The 3T MRI acquisition protocol on formalin-fixed tissue included: Modified spin-echo sequence with 3D segmented-EPI, and Structural 3D balanced steady state free precession (BSSFP) sequence. Data processing used the FMRIB software library (FSL). ROIs were Brodmann areas 9, 40, 41, 42 . Fiber tracts were estimated via

Bayesian Estimation of Diffusion Parameters (Bedpostx). The arcuate fasciculus was obtained and thresholded. The mean FA, MD, Drad and Dax were extracted from the tracts.
ii) **In vivo** 7T DTI and magnetic resonance spectroscopy (MRS) were conducted to investigate the relationship of the DTI signal to neurochemical markers of elevated excitation in ASD. A sample of 11 ASD and 10 TD individuals were MRI scanned and MRS was used to measure brain metabolites in primary visual and medial prefrontal cortex. Data were collected with the semi-LASER sequence and the LCModel. A VBM analysis was also performed on these structural scans.
Results:
i) The post-mortem DTI confirmed the model's predictions indicating a clear correlation between the mean diffusivity and minicolumn width and significant differences in the components of the principal diffusion direction between TD and ASD in brain regions with wider minicolumns.
ii) The high resolution in vivo DTI and MRS found significantly elevated glutamate in ASD and correlations between increased prefrontal glutamate and a diffusion marker of wider minicolumns.
The inferior frontal gyrus also had significantly reduced grey matter density in ASD compared to TD individuals. The relationship between glutamate and the diffusion signal in this region was different from other brain regions and contrasted with TD controls.
Conclusions:
Diffusivity parameters in the cerebral cortex correspond to variation in the minicolumnar organisation of neurons. Minicolumns are more widely spaced in several cortical regions in ASD and this can be detected using novel diffusivity measures.
There is a link between elevated excitation (glutamate level) and these microstructural changes in ASD, consistent with the excitation/inhibition imbalance hypothesis. Greater excitation appears to be associated with wider minicolumns in ASD which may have a toxic effect causing reduced grey matter in some regions.

16 **179.016** Disruption of Creb-Dependent Transcription Alters Brain Anatomy

***D. A. Vousden**, M. C. van Eede, L. Spencer Noakes, B. J. Nieman and J. P. Lerch, Mouse Imaging Centre, Hospital for Sick Children, Toronto, ON, Canada*

Background: In the nervous system, many signaling cascades converge upon and activate the CREB family of transcription factors. Subsequent CREB-dependent gene expression has been implicated in many complex processes, including cell growth/survival, synaptic plasticity, and memory formation. Mutations of genes in the CREB signaling pathway are associated with neurodevelopmental disorders, including Rubinstein-Taybi syndrome, Coffin-Lowry syndrome, and other "Rasopathies".
Objectives: To use whole-brain MRI to characterize whether loss of CREB affects mouse brain anatomy, and whether these effects depend on CREB gene dosage.
Methods: We used male and female mice with targeted deletions of two CREB isoforms (CREBαδ mutants). All 3 genotypes (CREB+/+, CREB+/-, and CREB-/-, n=12-16/genotype/sex, total N=82) were used. At 2-4 months of age, mice were perfusion-fixed for high-resolution (40 µm isotropic) ex-vivo MRI. Automated algorithms were used to align the images and compute the volumes of 62 segmented structures for each brain. The Jacobian determinant of the deformation field was used to measure expansion/contraction at each voxel. For each structure or voxel, ANOVAs were performed to determine whether that structure/voxel volume differed by genotype. Gene dosage effects were modeled by treating genotype as an ordered factor and testing for linear versus quadratic genotype effects. Multiple comparisons were controlled using a False Discovery Rate of 5%.
Results: Total brain volume was reduced by 2.5% in CREB-/- mice versus CREB+/+ mice ($p<0.001$) but did not differ significantly between CREB+/- and CREB+/+ mice. The loss of brain volume in CREB-/- mice was driven by a significant decrease in volume throughout the cerebral cortex, olfactory bulbs, basal ganglia, amygdala, hippocampus, and major white matter tracts, including the corpus callosum and anterior commissure. These areas remained significantly smaller in CREB-/- mice versus CREB+/+ mice even after normalizing for brain volume. In general, the absolute volume of these areas did not differ between CREB+/+ and CREB+/- mice. Notable exceptions include some white matter tracts including the lateral olfactory tract and internal capsule. As in CREB-/- mice, these were significantly smaller in CREB+/- versus CREB+/+ animals. Intriguingly, the arbor vita and cerebellum were significantly larger in CREB+/- versus CREB+/+ mice, and were larger still in CREB-/- animals, indicating a gene-dose effect.
Conclusions: Loss of CREB produces a substantial volume loss throughout the brain, including cortical and subcortical areas, and white matter tracts. Even after accounting for differences in total brain volume, most of these regions were smaller in CREB-/- versus CREB+/+ mice. This suggests these areas either fail to develop fully or undergo degeneration. CREB+/- mice were overall phenotypically similar to CREB+/+ mice. The exceptions included white matter tracts, suggesting they may be more sensitive to disruption of CREB-dependent transcription. Overall, disrupting CREB has widespread effects on brain anatomy which may underlie the intellectual impairments observed in related neurodevelopmental disorders.



Effect of CREB genotype on brain anatomy as assessed by MRI. The percent difference in volume between CREB +/- (*left*) or CREB -/- (*right*) and wildtype CREB +/+ mice was computed at each voxel. Then ANOVAs and t-tests were performed to assess the effect of genotype on the volume of each voxel. Multiple comparisons were accounted for using the false discovery rate (FDR). Transverse brain slices depict areas where there was a significant (5% FDR) main effect of genotype and a significant difference in volume between that genotype and the CREB +/+ mice. Increases in volume compared to CREB +/+ mice are displayed in red, and decreases are displayed in blue.

17 **179.017** Dysgenesis of the Corpus Callosum As Evidence of Developmental Defects of Long Distance Connectivity in Autism

***J. Wegiel**[1], W. Kaczmarski[2], T. Wisniewski[3], W. T. Brown[4], K. K. Chadman[5], E. London[6], K. Nowicki[3], I. Kuchna[6], S. Y. Ma[3] and J. Wegiel[5], (1)Developmental Neurobiology, New York State IBR, Staten Island, NY, (2)Developmental Neurobiology, New York State Institute for Basic Research in Developmental Disabilities, Staten Island, NY, (3)New York State Institute for Basic Research in Developmental Disabilities, Staten Island, NY, (4)Human Genetics, Institute for Basic Research in DD, Staten Island, NY, (5)Developmental Neurobiology, NYS Institute for Basic Research in Developmental Disabilities, Staten Island, NY, (6)NYS Institute for Basic Research in Developmental Disabilities, Staten Island, NY*

Background: The corpus callosum (CC) is the largest white matter tract containing 138 to 195 million axons (Riise 2006, Tomasch 1954) that connect homologous brain cortical areas. Neuroimaging studies reveal a reduced size of the CC in individuals diagnosed with autism (Minshew 2007, Frazier 2009) whereas postmortem studies of control subjects reveal a correlation between the area of CC and the number of axons (Riise and Pakkenberg 2006). Despite strong neuroimaging evidence of CC pathology, the microscopic characteristics of axonal CC abnormalities in autism are lacking.
Objectives: The aim of this postmortem study of the brain of autistic subjects is (a) to characterize the type and topography of structural CC defects and (b) expand the concept of CC pathology by detection of markers of focal CC midline axonal misguidance.
Methods: The brain hemispheres used in this study were preserved for several parallel studies designated to detect the global pattern of developmental abnormalities in autism. Brain hemispheres of 10 autistic individuals from 4 to 56 years old and 10 age matched control subjects were fixed with formalin, dehydrated, embedded in celloidin, and cut into serial 200-µm thick sections that were stained with cresyl violet. Every 6th section was used to establish the midsaggital area of the corpus callosum. Postmortem MRI and serial coronal sections were used to characterize CC developmental abnormalities. Segmentation of the CC applied in this study was based on diffusion tensor

imaging and fiber tractography distinguishing five CC regions reflecting the position of cortical neurons contributing to CC connectivity (Hofer 2006).
Results: This postmortem study revealed (a) more CC shape differences, (b) significant reductions of the midline CC area ($p<0.05$) associated with significant area deficits in regions II, IV and V ($p<0.05$), and (c) partial agenesis of the corpus callosum in autistic subjects. A consistent feature in three cases was the lack of axonal connections in region IV (primary sensory cortical connections), lack in one case and a severe (50% and 66%) deficit in the other two cases of axonal connections in region III (primary motor cortex connections). In addition in an 11 year old female, a 60% deficit was detected in region I (prefrontal cortex projections) and a 42% deficit in region V (connections of parietal, temporal and occipital cortex). CC dysplasia detected in autistic subjects, a several millimeter-wide gap between truncated arms of the left and right corpus callosum, appears to be a marker of axonal misguidance in the CC midline. Studies of animal models and human fetal brain suggest that the axonal misguidance detected in examined autistic subjects reflects a developmental failure of guidepost cells including glial wedge, indusium griseum, midline zipper glia, and subcallosal sling cells (Richards 2004, Sanchez-Camacho 2011).
Conclusions: Regional reduction of CC area and midline CC dysgenesis reflect deficits of axonal interhemispheric connections and defects of long distance connectivity in autism. Our study demonstrates the presence of cortical neurons interhemispheric connectivity deficit in the majority of postmortem examined autistic subjects and focal CC midline axonal misguidance in 30% of cases.

18 **179.018** Electron Microscopic Analysis of Myelin Thickness and Oligodendrocytes in Autism

T. A. Avino[1] *and C. M. Schumann*[2]*, (1)University of California at Davis MIND Institute, Sacramento, CA, (2)UC Davis MIND Institute, Sacramento, CA*

Background: Structural and functional brain imaging studies support the prevailing hypothesis that autism involves disruptions to cortical network connectivity. Specifically, diffusion tensor imaging (DTI) studies of white matter in autism have reported reductions to the integrity of fiber tracts throughout the cerebrum and combined functional imaging studies demonstrate reduced cortical synchrony among brain areas. One potential explanation for this deficient communication in autism is alterations to the myelin sheathing these axons, which has been reported in the frontal lobe (Zikopoulos & Barbas, 2010). In the present study, we further examine these ultrastructural changes to the myelination of axons within the temporal lobe white matter in autism and explore the characteristics of oligodendrocytes from the same subjects as a potential mediator of these abnormal myelin findings. Our results have implications for the observed physiological disruptions in the disorder as well as informing how these ultrastructural changes may occur.
Objectives: The goal of the present study was to assess the degree of myelination of axons occupying the temporal lobe white matter in individuals with autism relative to their age-matched typically developing counterparts. Furthermore, we examine these myelin thickness findings with regard to oligodendrocyte characteristics, such as their overall number, in the same subjects.
Methods: Data regarding the overall number of oligodendrocytes were acquired stereologically using an optical fractionator method from the amygdala in frozen 50µm sections of the temporal lobe (Morgan et al., 2015). From adjacent 50µm sections, white matter dissections were made from the superior temporal gyrus and fusiform gyrus within 4mm of the gray-white matter boundary and prepared for electron microscopic processing. Myelinated axons of varying sizes were randomly selected for myelin thickness measures (g-ratio) and imaged at 8,400x magnification.
Results: For all subjects, data from the g-ratio measures indicates proportionally thinner myelin with increasing axon diameter, which is consistent with previous reports. However, individuals with autism demonstrate thinner myelin in both cortical regions and across all axon sizes compared to their age-matched typically developing counterparts. Furthermore, these results show an age x diagnosis interaction wherein ASD subjects regress towards thinner myelin with increasing age whereas the typically developing subjects show a slow and gradual thickening of myelin with age. Lastly, correlation analysis reveals a strong positive relationship between the number of oligodendrocytes and myelin thickness in both ASD and typically developing subjects ($r = .85$, $p < .01$).
Conclusions: Our data demonstrate a reduction of myelin thickness in autism affecting at least 2 cortical locations across all axon size classes potentially providing a substrate for which altered cortical communication and/or increased diffusivity is occurring in the disorder. These data are consistent with similar reports of alterations to myelinated axons in areas of the frontal lobe in autism (Zikopolous & Barbas, 2010) and also demonstrate abnormal myelination patterns with increasing age in autism. Our data also show a strong relationship between the number of oligodendrocytes and myelin thickness in both subject groups, potentially providing a mechanism for which hypomyelination and/or altered myelinated axon density is occurring in autism.

19 **179.019** Finding Individual Developmental Brain Circuitry and Brain-Behavior Associations in Autism By a New Multivariate Crossmatch Method

N. Lange[1]*, D. C. Dean*[2]*, B. G. Travers*[3]*, B. A. Zielinski*[4]*, A. L. Alexander*[2] *and J. E. Lainhart*[2]*, (1)Psychiatry, Harvard Medical School, Boston, MA, (2)Waisman Center, University of Wisconsin-Madison, Madison, WI, (3)Occupational Therapy Program in Kinesiology, University of Wisconsin Madison, Madison, WI, (4)Pediatrics and Neurology, University of Utah, Salt Lake City, UT*

Background:
There is an ongoing worldwide search for clinically meaningful associations between an individual's cognitive-behavioral functioning and brain structure and function in autism. For this pursuit, we developed a new case-by-case method, being a longitudinal extension of an existing crossmatch method, to compare one individual's longitudinal Mahalanobis distances from another's based on any type and number of individual brain and/or other measurements.
Objectives: To employ the new method to identify individual associations between circuitry network distances and scores on ADOS, SRS, and VABSII Receptive and Expressive Language assessments, if any.
Methods: Our sample consisted of repeated and co-temporal brain image measurements and cognitive-behavioral assessments contributed by 92 male participants with autism ages 3-35 years followed for 12 years, and 56 age-matched typically developing male participants also followed for 12 years. Study design and scanner settings have been described elsewhere. Based on current literature on the corpus callosum (CC) and arcuate fasciculus (AF) in autism, we examined means and growth rates of fractional anisotropy (FA) in the CC genu, CC body, CC splenium, right AF, left AF, right AF longitudinal segment, and left AF longitudinal segment in order to find the best DTI brain measurements that separate the participants with autism from typically developing participants, if any.
Results: The new multivariate method found that the best subset of the regional FA measures in the corpus callosum and arcuate fasciculus included the body, splenium, left AF, right AF, right AF longitudinal segment, left AF longitudinal segment, and the growth rate of the genu (distribution separation p-value < 0.000000005). Two other measurement subsets performed equally well, having identical distribution separation p-value. These included, separately and in addition, the genu, splenium, left AF longitudinal segment, and the growth rates of the body, splenium, left AF, and the left AF longitudinal segment. The single measurement included in all three measurement subsets was the growth rate of the genu. These aggregated FA means and growth rates showed significant associations with the selected cognitive-behavioral measures.
Conclusions: Developmental circuitry differences in autism, as measured in the corpus callosum and arcuate fasciculus, are complex. Our findings suggest that the growth rates of the brain circuitry structures examined may play a more salient role than the mean sizes of regional DTI coefficients in distinguishing differences in the brains and cognitive-behaviors of individuals with autism.

20 **179.020** Gray Matter Volume Deficit and Neuropsychological Performance in First Degree Relatives of Children with Autism Spectrum Disorder

S. Srinath*, J. V. Kommu, G. Venkatasubramanian, K. Kumar, S. C. Girimaji, S. P. Seshadri, C. Prasad, S. M. Kaku and T. Kandavel, National Institute of Mental Health and Neurosciences, Bangalore, India*

Background:
Neurobiological studies evaluating for potential endophenotypic markers in First Degree Relatives (FDRs) of children with Autism Spectrum Disorder (ASD) are sparse in India because a) very few centers in the country are involved in research of this kind, b) challenges of obtaining consent from participating parents. Search for endophenotypic markers in ASD, a known to be a heritable disorder, is a logical way forward. Among several neurocognitive parameters, facial emotion recognition deficit is one such marker. However, concurrent assessment involving both neuropsychological tests and gray matter volumes in FDRs of ASD has received little attention.
Objectives:
To study the gray matter volume and the neuropsychological profile of FDRs of children with ASD
Methods:
36 parent/s of 19 children with ASD and 11 matched controls were recruited for the study in a university teaching hospital in southern India. The index children aged 30 months to 14 years were diagnosed by experienced child psychiatrists as per DSM IV guidelines. The index children were rated on Childhood Autism Rating Scale (CARS). Parents were assessed using a) MINI-Plus, b) neuropsychological assessment that comprised tests from the NIMHANS Neuropsychological battery, subtests of Wechsler's memory scale III and the Embedded figure test, c) Magnetic Resonance Imaging (3-Tesla):T1-weighted images were processed using SPM (http://www.fil.ion.ucl.ac.uk/spm), implemented through the Voxel Based Morphometry (VBM) Toolbox 8. Statistical parametric maps were examined for group differences as well as correlation between Gray Matter Volumes (GMV) of FDRs and CARS scores of the index child / neuropsychological test scores of FDRs.
Results:
There was a significant negative correlation between the CARS score of the index child and left superior parietal lobule [T=5.76] and right insula [T=5.58] GMV of the FDRs (N=36). The FDRs had significantly deficient volume of right fusiform gyrus in comparison with healthy controls [T=3.45]. FDRs (N=31) demonstrated a significant negative correlation between a) the embedded figure test score and bilateral superior temporal gyri [Left: T=5.71; Right: T=5.31], b) finger-tapping test score and left inferior frontal gyrus [T=5.89] c) Controlled Word Association Task score and the left middle frontal gyrus [N=29; T=4.22]. All these findings were significant at p (uncorrected) ≤ 0.001 and small volume correction ($p<0.05$).
Conclusions:

Certain brain regions implicated in the study findings are relevant for neurocognitive aberrations seen in ASD, namely, fusiform gyrus in face processing and fronto-temporal network in working memory. Significant negative correlation between neuropsychological test performance and frontal/temporal brain regions in this study adds support to what is already stated in literature. The findings of the Superior Parietal Lobule (which has been implicated in mediating motor learning and repetitive behavior) and the Insula (implicated in emotion processing) having a negative correlation with the CARS score needs further confirmation. Larger sample of FDRs, improved methods and addition of oculomotor tests of sensorimotor responses and diffusion tensor imaging studies may give us more robust support for these findings and potentially reveal additional endophenotypic markers for ASD.

21 **179.021** Increased Sensorimotor U-Fiber Connections in Autism: Localization and Association with Symptom Severity

C. Buckless[1], *E. Bordbar*[1,2], *S. H. Mostofsky*[2] *and D. Crocetti*[1], *(1)Kennedy Krieger Institute, Baltimore, MD, (2)Johns Hopkins School of Medicine, Baltimore, MD*

Background: Autism spectrum disorder (ASD) is commonly associated with deficits with motor skills and tactile sensory processing. Multiple DTI studies have revealed abnormalities in the white matter connectivity in individuals with ASD, including in fronto-parietal regions crucial for motor and sensory control; however, U-fibers connecting primary somatosensory cortex and the primary motor cortex ("sensorimotor U-fibers") have not been examined in detail. Mapping sensorimotor U-fibers to clusters associated with three functionally distinct regions: foot, hand, face and mouth, could help characterizing microstructure in underlying white matter tracts in children with ASD.
Objectives: To examine the sensorimotor U-fibers in order to reveal differences between children with ASD and typically developing (TD) white matter fiber integrity and symptom severity.
Methods: Diffusion weighted imaging was acquired on 20 boys with ASD and 20 typically developing (TD) boys aged 8-12 years. Groups were balanced for age and IQ. All children were right handed. MRIStudio was used to perform deterministic fiber tracking in the left sensorimotor cortex. The fibers were further segmented into face/mouth, foot, and hand regions using spherical fMRI-based seeds. Total number of streamlines (white matter connections), Fractional Anisotropy (FA) and mean diffusivity (MD), FA were calculated for the whole sensorimotor fiber map and for each region separately. ANOVA was used to examine the effect of diagnosis on number of streamlines, FA, and MD. Pearson's correlations were used to examine associations between the number of streamlines, FA, and MD and symptom severity. Symptom severity was assessed using the Autism Diagnostic Observation Schedule (ADOS).
Results: Preliminary analysis suggests boys with ASD showed increased total number of sensorimotor U-fiber streamlines (p=0.031); this appeared to be particularly localized to the foot (p=0.032). Pearson's correlation further revealed a positive correlation between the increased number of streamlines and increased symptom severity (ADOS total score; r=0.50, p=0.025). Interestingly, while we observed an association between increasing age and total number of streamlines for face/mouth (r=0.554, p=0.011), foot (r=0.457, p=0.043), and for all regions collapsed (r=0.443, p=0.051) in TD boys, this was not observed in boys with ASD. MD was significantly higher in ASD boys for foot (p=0.013) and hand region (p=0.042) sensorimotor U-fibers, but not for face/mouth. FA was not significantly different in any of the three regions or the overall fiber map.
Conclusions: Consistent with prior findings suggesting disorganized overgrowth of early developing white matter connections, we found children with ASD show increased volume (number of streamlines) and decreased organization of sensorimotor U-fiber connections. The findings were localized to foot and hand regions, and there was a positive association with symptom severity, such that increase volume was associated with increased symptom severity. In addition, children with ASD showed an anomalous association of sensorimotor U-fiber volume with age: whereas the number of streamlines increased with age in the TD children, this relationship was not seen in children with ASD.

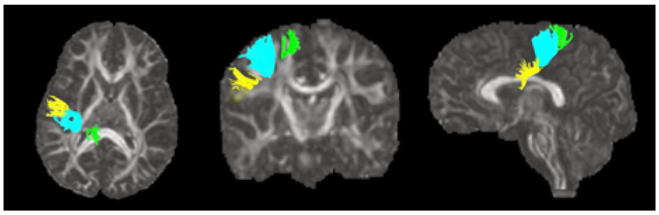


Figure 1: 3D rendering of sensorimotor U-fibers corresponding to foot (green), hand (blue) and face/mouth (yellow) regions.

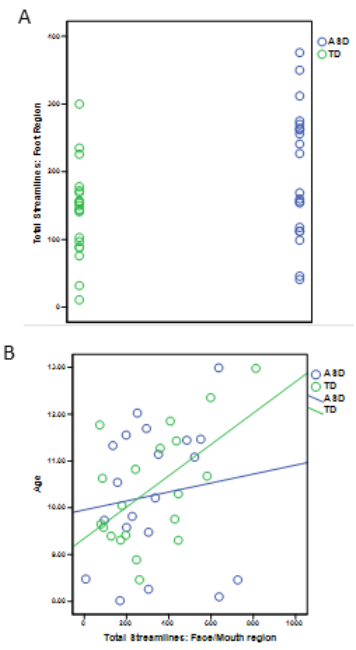


Figure 2: (A) effect of diagnosis in which total number of streamlines in foot region is significantly increased in ASD (p=0.032). (B) the positive association between age and total streamlines in face/mouth region (r=-.554, p=0.011). (C) the positive association between symptom severity demonstrated with ADOS total score and total streamlines collapsed across regions (r=0.50, p=0.025)

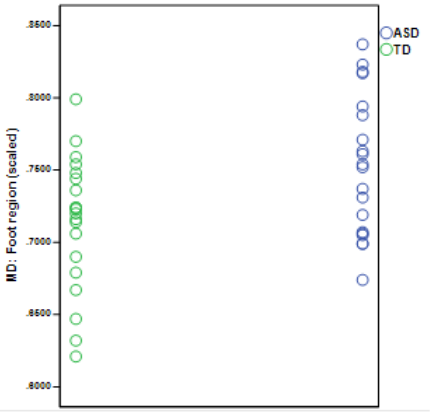


Figure 3: Effect of diagnosis is shown in which MD in foot region is significantly increased in ASD (p=0.013).

22 **179.022** Longitudinal Microstructure of the Thalamus and Anterior Limb of the Internal Capsule in Individuals with Autism Spectrum Disorder

K. McLaughlin[1], *B. G. Travers*[2], *D. C. Dean*[1], *D. Tromp*[1], *N. Adluru*[1], *D. Destiche*[1], *D. P. Samsin*[1], *M. D. Prigge*[3], *A. Froehlich*[4], *E. D. Bigler*[5], *N. Lange*[6], *A. L. Alexander*[1] *and J. E. Lainhart*[1], *(1)Waisman Center, University of Wisconsin-Madison, Madison, WI, (2)Occupational Therapy Program in Kinesiology, University of Wisconsin Madison, Madison, WI, (3)Pediatrics, University of Utah, Salt Lake City, UT, (4)University of Utah, Salt Lake City, UT, (5)Psychology/Neuroscience Center, Brigham Young University, Provo, UT, (6)McLean Hospital, Cambridge, MA*

Background: The thalamus is a highly connected brain area, and white matter connections related to the thalamus have been shown to be atypical in adolescents with autism spectrum disorder (ASD) and related to motor impairments in this population (Nair et al., 2013). What is not known is how thalamic white and gray matter microstructure develops and changes from childhood through adulthood in ASD. In other populations, gray matter microstructure has been shown to be a sensitive marker of age-related changes (Manna et al., 2015). Given that the thalamus is a key sensorimotor relay area, it is essential to examine microstructural changes in thalamic gray and white matter and surrounding white matter tracts as a function of age and motor ability in ASD.
Objectives: (1) To compare the longitudinal development of white and gray matter microstructure of the bilateral thalamus and the anterior limb of the internal capsule (ALIC)

between the ASD and typically developing groups. (2) To examine if microstructure in these areas are related to finger tapping speed.
Methods: Fifty-six males with typical development and 100 males with ASD (ages 3.3 to 41 years old) underwent longitudinal DTI scanning on Siemens 3T scanner at four points across a 10-year period of time (DW, single-shot, spin-echo EPI, b=1000, 12 non-collinear directions, 4 averages). At the time of each scan, participants completed a neuropsychological battery of tasks, including finger tapping speed. Groups were matched on age (p= .46). Anatomical regions of interest were defined, including the left and right thalamus and left and right ALIC, a white matter tract connecting thalamus to frontal cortices. Linear mixed-effects analyses examined age-related changes in thalamic microstructure as a function of group, accounting for repeated measures over time. For aim 2, linear mixed-effects analyses examined finger tapping speed changes as a function of thalamic microstructure and age.
Results: In the ALIC, the group with ASD had significantly lower fractional anisotropy (FA) and higher radial diffusivity (RD) (p < .05). However, developmental trajectories in the ASD and typically developing groups did not differ. In the thalamus, the group with ASD had significantly different developmental trajectories from the group with typical development in FA, RD, and mean diffusivity (MD) (all p's < .02) but not axial diffusivity. After accounting for age, the thalamus predicted finger tapping speed (p = .009), but the anterior limb of the internal capsule did not (p > .28).
Conclusions: DTI studies in ASD have traditionally focused on white matter tracts. However, DTI in gray matter has been used to examine aging and learning-related brain changes (Sagi et al., 2012) in non-ASD populations. In applying DTI to the thalamus and ALIC, we found that the microstructure of the thalamus demonstrated a different pattern of results than the microstructure of the ALIC. Specifically, the thalamic metrics had distinct developmental trajectories in ASD compared to the ALIC metrics. Further, the thalamic microstructure related to finger tapping speed, whereas the ALIC microstructure did not.

23 **179.023** Longitudinal Trajectories of Large-Scale Brain Network Architecture in Autism

B. A. Zielinski[1], *M. D. Prigge*[2], *M. White*[2], *D. C. Dean*[3], *B. G. Travers*[4], *A. L. Alexander*[3], *N. Lange*[5], *E. D. Bigler*[6] *and J. E. Lainhart*[3], *(1)Pediatrics and Neurology, University of Utah, Salt Lake City, UT, (2)Pediatrics, University of Utah, Salt Lake City, UT, (3)Waisman Center, University of Wisconsin-Madison, Madison, WI, (4)Occupational Therapy Program in Kinesiology, University of Wisconsin Madison, Madison, WI, (5)McLean Hospital, Cambridge, MA, (6)Psychology/Neuroscience Center, Brigham Young University, Provo, UT*

Background:
Background: Autism spectrum disorders (ASD) comprise complex neurological conditions characterized by childhood onset of dysfunction in multiple cognitive domains. Accumulating evidence suggests that autism is a network-based disease, and that abnormalities in brain network structure underlie the abnormal brain function at the core of the disorder[1]. However, developmental timing and topology of brain network development in autism remains unclear. Here we utilize longitudinal structural MRI data to evaluate developmental trajectories of large-scale brain networks in autism.
Objectives: Using an emerging technique known as structural covariance MRI (scMRI)[2], in tandem with correlated cortical thickness change, this study sought to characterize autism-related longitudinal growth trajectories of network-level brain architecture. Specifically, we sought to determine whether specific developmental abnormalities in large-scale brain network organization are associated with autism, and whether network trajectories and correlated inter-regional change are associated with behavioral measures.
Methods: We used scMRI and cortical thickness correlation (MACACC)[3] to determine longitudinal trajectories of large-scale brain networks in autism. Using scMRI, we first identified canonical large-scale 'structural covariance networks' (SCNs) strongly implicated in autism, namely the socioemotional salience network (SN), the speech network, and the default mode network (DMN). Three hundred and forty-five MRI scans were examined from 97 males with autism (mean age = 16.8 years; range 3–36 years) and 60 age-matched males with typical development (mean age = 18 years; range 4–39 years), with an average of 2.2 scans and interscan interval of 2.6 years. FreeSurfer was used to parcellate the cortex into 34 regions of interest per hemisphere and to calculate mean cortical thickness for each region using methods reported previously[4]. Partial correlation (controlling for age at date of scan) was used to characterize region-wise relationships in cortical thickness change across time using scMRI-derived network hubs as reference regions. We then determined patterns of regional change that correlated with a broad array of behavioral scores.
Results: Region-based cortical thickness correlation revealed specific perturbations in longitudinal brain network architecture within distinct SCNs, consistent with phenotypic manifestations of autism. Thickness correlation maps in controls were consistent with canonical SCN topologies[2]. Extent and topology of the salience network (SN), involved in social- emotional regulation of environmental stimuli, demonstrated weaker average correlation in autism, corroborating earlier findings[1]. The speech network in ASD lacked right temporal regions that were highly correlated with left pars opercularis in the TDC group. The DMN in ASD showed stronger correlations posteriorly and weaker frontal correlations, which were stable across time. Behavioral data also demonstrated distinct differences between ASD and TDC. For example, thickness of the left pars opercularis was negatively correlated with social responsiveness scale (SRS) score in TDC, whereas right pars opercularis was positively correlated with (SRS) in ASD.
Conclusions: Abnormal longitudinal trajectories of large-scale brain network structure characterize autism, and these abnormalities are consistent with phenotype. Moreover, specific patterns of structural coherence in ASD are correlated with behavioral measures. Our findings are consistent with a network vulnerability model of autism, and provide a plausible approach to MRI-based subphenotyping.

24 **179.024** Longitudinal, Voxel-Based Analysis of White Matter Contributions to Processing Speed in Individuals with Autism Spectrum Disorder

B. G. Travers[1], *D. C. Dean*[2], *D. Tromp*[2], *N. Adluru*[2], *D. Destiche*[2], *B. A. Zielinski*[3], *M. D. Prigge*[4], *A. Froehlich*[5], *J. S. Anderson*[5], *P. T. Fletcher*[5], *E. D. Bigler*[6], *N. Lange*[7], *A. L. Alexander*[2] *and J. E. Lainhart*[2], *(1)Occupational Therapy Program in Kinesiology, University of Wisconsin Madison, Madison, WI, (2)Waisman Center, University of Wisconsin-Madison, Madison, WI, (3)Pediatrics and Neurology, University of Utah, Salt Lake City, UT, (4)Pediatrics, University of Utah, Salt Lake City, UT, (5)University of Utah, Salt Lake City, UT, (6)Psychology/Neuroscience Center, Brigham Young University, Provo, UT, (7)McLean Hospital, Cambridge, MA*

Background: Slowed processing speed has been commonly reported in autism spectrum disorder (ASD) and has major implications for social and cognitive functioning. A recent longitudinal investigation found that processing speed was substantially slower across the life span in individuals with ASD compared to individuals with typical development, and processing speed was correlated with whole-brain fractional anisotropy (a diffusion tensor imaging measure of circuit integrity) (Travers et al., 2014). However, until recently, it has not been possible to examine which white matter tracts within the whole brain are longitudinally related to processing speed in ASD and in typical development. Given that processing speed is a difficulty for many people with ASD, understanding the specific white matter tracts that underlie processing speed difficulties is essential.
Objectives: The objective of this study is to use a voxel-based, longitudinal approach to examine the white matter tracts in the brain that are related to processing speed in individuals with autism and individuals with typical development.
Methods: Fifty-one males with typical development and 70 males with ASD (ages 6.4 to 40.6 years old) underwent longitudinal processing speed assessments and longitudinal DTI scanning on Siemens 3T scanner at four points across a 10-year period of time (DW, single-shot, spin-echo EPI, b=1000, 12 non-collinear directions, 4 averages). Groups were matched on age (p = .48). Voxel-based, linear mixed-effects analyses examined fractional anisotropy as a function of group and processing speed, controlling for age, head motion, and a head coil replacement (between Times 1 and 2).
Results: In both the ASD and typically developing groups, the results suggested that processing speed was significantly related with a number of white matter areas, including the bilateral posterior medial parietal cortex, the tip of the anterior genu/cingulate, left temporal parietal junction, and the right prefrontal white matter (p< .05, FDR corrected). However, a group x processing speed interaction demonstrated that the group with ASD had weaker correlations between these areas and processing speed than the group with typical development (See Figure 1, p< .05, FDR corrected).
Conclusions: We found that processing speed in both groups was related to the white matter microstructure of areas previously reported to be implicated in processing speed (i.e., the bilateral posterior medial parietal cortices, the tip of the genu of the corpus callosum/anterior cingulate, the temporal white matter, and prefrontal white matter) (Turken et al., 2008). However, there were significantly weaker correlations in the ASD group between these white matter areas and processing speed, suggesting that these areas may not contribute as much to processing speed in the ASD group as in the typically developing group. At the group level, these data imply that white matter contributions to processing speed are similar in both groups, albeit these relations were weaker in ASD, suggesting compensatory mechanisms more inter-individual variability in ASD.

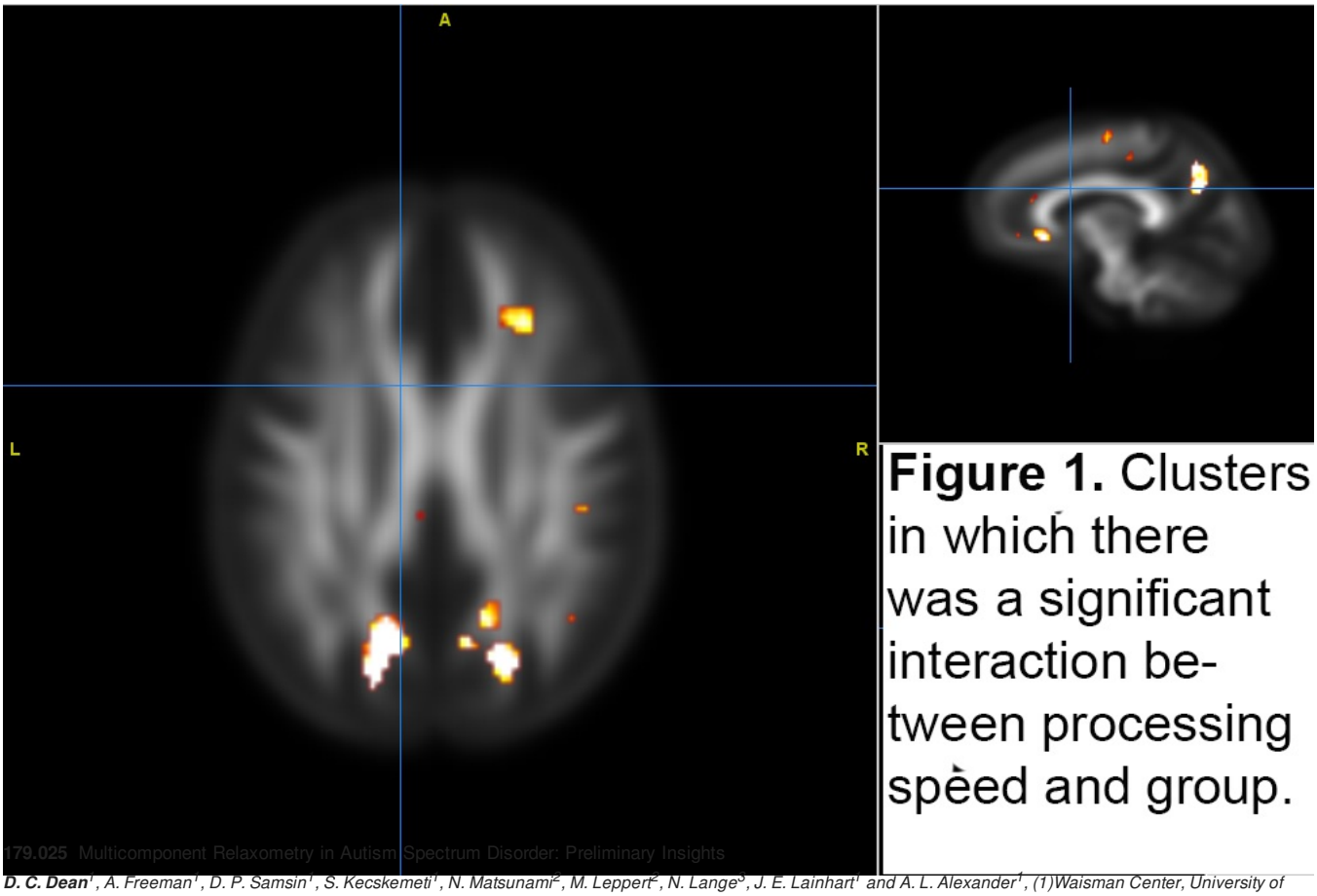
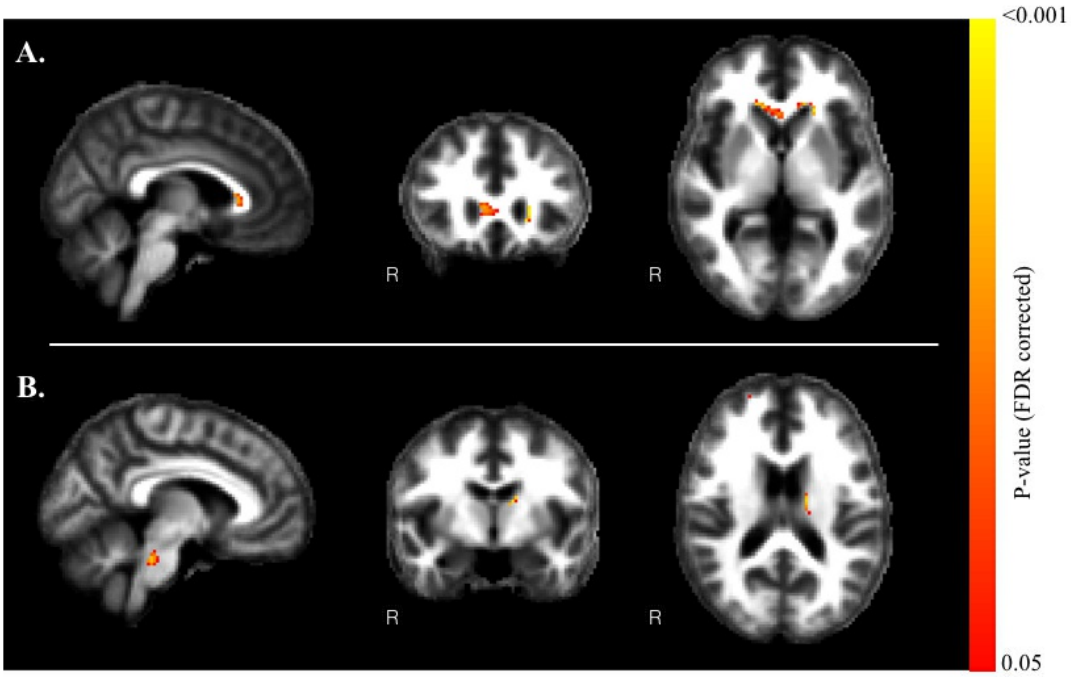


Figure 1. Clusters in which there was a significant interaction between processing speed and group.

25 **179.025** Multicomponent Relaxometry in Autism Spectrum Disorder: Preliminary Insights

D. C. Dean[1], *A. Freeman*[1], *D. P. Samsin*[1], *S. Kecskemeti*[1], *N. Matsunami*[2], *M. Leppert*[2], *N. Lange*[3], *J. E. Lainhart*[1] *and A. L. Alexander*[1], *(1)Waisman Center, University of Wisconsin-Madison, Madison, WI, (2)University of Utah, Salt Lake City, UT, (3)McLean Hospital, Cambridge, MA*

Background: Important to white matter and the establishment of brain connectivity is myelin. It is accepted that normal brain function relies on rapid and coordinated brain messaging afforded by myelinated axons, while recent studies have suggested that autism spectrum disorder (ASD) is associated with alterations to white matter (for review, see Travers et al., 2012). While several neuroimaging techniques that are sensitive to changes in myelin have been used to study white matter in ASD, these neuroimaging techniques are inherently non-specific to changes in myelin content. Multi-component analysis of relaxation time data, also termed multi-component relaxometry, may provide a more sensitive measure of myelin content through measurement of myelin water fraction (MWF; Alexander et al. 2011). The study of brain's myleoarchitecture using MCR may thus provide important new insights into the neurological substrates of ASD and illuminate key brain regions involved in the development and onset of ASD.
Objectives: We examined the extent to which the underlying white matter microstructure, as measured by relaxometry and multicomponent relaxometry measures, compared in a small sample of ASD and typically developing (TD) individuals. Specifically, we compared quantitative R_1 relaxation rates, R_2 relaxation rates, and MWF in these individuals.
Methods: *MRI Acquisition*: Participants for this study consisted of 22 individuals between 10 and 42 years of age, 14 of which were diagnosed with ASD. Magnetic resonance imaging (MRI) data were acquired from each participant using a 32 channel head RF coil on a 3.0 Tesla GE MR750 scanner. Multiple flip-angle spoiled gradient echo (SPGR) and balanced steady-state free precession (bSSFP) images were acquired and mcDESPOT post-processing (Deoni et al. 2013) was used to calculate R_1 ($1/T_1$), R_2 ($1/T_2$), and MWF parameter maps. Images were subsequently non-linearly registered to the MNI template using the Advanced Normalization Tools (ANTS) software.
Voxelwise linear regressions, corrected for multiple comparisons using the FDR, examined differences between ASD and TD groups, while co-varying for age.
Results: No significant age differences were observed between the two groups ($p=0.67$). MWF was found to be significantly ($p<0.05$, FDR corrected) reduced in the genu of the corpus callosum in the ASD group compared to the TD group (**Fig. 1A**). R_2 was also observed to be reduced in smaller clusters near the thalamus and pontine crossing tract of the brain stem (**Fig. 1B**). R_1 was not observed to significantly differ between the groups.
Conclusions: Our preliminary findings suggest that, within this small sample, the ASD group has reduced MWF in genu of the corpus callosum, compared to the TD group, while also having reduced R_2 near the thalamus and brain stem. These findings agree well with the current literature that describes alterations of white matter microstructure associated with ASD while also suggesting the possibility of that these white matter alterations may result from atypical myelin content. While these findings are promising, it is important to note that the small sample size of the current study limits our ability to interpret these findings. Future analyses will extend these characteristics in a larger sample of individuals.



26 **179.026** Orbitofrontal Cortex Sulcogyral Anatomy and Value Signals: An Interaction of Structure and Function

M. A. Patti[1], *C. Hyde*[1], *K. M. Adamson*[1], *H. Zhang*[2], *S. Deitrick*[1] *and V. Troiani*[1], *(1)Geisinger Autism & Developmental Medicine Institute, Lewisburg, PA, (2)Temple University, Philadelphia, PA*

Background:
The orbitofrontal cortex (OFC) has an important function in codifying individual social and motivational behaviors. Atypical organization of the OFC architecture has been linked to psychiatric disorders including schizophrenia and Autism Spectrum Disorder (ASD) (Watanabe et al, 2014). Little is known about the influence of atypical cortical organization on functional organization of the OFC. Here we characterized two types of motivational brain responses, food and social, as well as their underlying sulcogyral anatomy.
Objectives:
This study localizes face-selective and food-selective value signals in OFC for each individual by contrasting faces or food with all other objects. We also characterize subject's OFC sulcogyral pattern type bilaterally, in order to determine if a pattern exists between variation in OFC sulci and OFC peak signal location for faces and food. We predict that value signals for faces are located in medial OFC and value signals for food are located in lateral OFC. We anticipate individuals with more consistent sulcogyral anatomy will have greater spatial consistency in the location of their face- and food-selective value signals.
Methods:
In this experiment, 28 healthy adults (mean age: 21; 14 females) were scanned using a 3T Siemens MRI and completed the Broader Autism Phenotype Questionnaire (BAP-Q). Value signals were determined for each individual by contrasting faces or food with all other objects using a variant of a standard fMRI face localizer task that included faces, food, scenes, and objects. OFC structure was determined by classifying each hemisphere as Type I, II, or III, based on the continuity of the medial and lateral orbital sulcus.
Results:
Consistent with our hypothesis, we found that medial value signals were more often associated with faces (27/28 subjects), while only 14 subjects had medial food value signals. While lateral value signals were consistently present for both faces and food (27/28 for food; 26/28 for faces, these were found in distinct sulcogyral locations within lateral OFC. Frequency of OFC sulcogyral patterns was consistent with previously published work, with Type I the most prevalent, followed by Type II and Type III. We found that subjects with a Type II pattern (known to increase risk for schizophrenia; Lavoie et al. 2014) were more likely to have atypical value signal locations. We also found that individuals with a Type II pattern present in at least one hemisphere scored significantly higher on the Aloof subscale of the BAP-Q ($p<0.05$). Ongoing analysis and additional data collection to increase sample size will validate these findings and combine the functional and structural characterizations to test for an anatomo-functional relationship.
Conclusions:
Future studies will attempt to identify the developmental trajectory and stability of object-selective patches in OFC. Understanding predictable developmental patterns of sulcogyral anatomy in typically developing healthy controls will allow us to better characterize and assess deviations that may occur in an ASD population. Observable structural and functional differences in sulcogyral pattern and value signal location may assist as predictive biomarkers of cross-diagnostic social or motivational behavior.

27 **179.027** Post-Mortem Analysis of Amygdala Neuron Morphology in ASD

R. K. Weir, *M. D. Bauman and C. M. Schumann, UC Davis MIND Institute, Sacramento, CA*

Background:
The amygdala is a medial temporal lobe structure posited to function as a danger, salience and value detector. It evaluates the emotional significance of environmental stimuli and coordinates appropriate responses. This has highly significant implications for the development of social interactions and thus makes it an ideal target for study in terms of autism spectrum disorders (ASD). Previous MRI and post-mortem studies from our lab have determined that the amygdala is larger in children diagnosed with ASD compared to typically developing (TD) controls, a difference that resolves by adulthood (Schumann et al., 2004; Schumann & Amaral, 2006).
Objectives:
The neurobiological underpinnings responsible for the differences in amygdala volume remain unknown. Our laboratory has been exploring two conceivable hypotheses: 1) Are there a greater number of neurons or 2) are the neurons physically larger in the amygdala of young children with ASD? This latter hypothesis is addressed here in a study of lateral nucleus neuron morphology across a range of ages from 4-46 years.
Methods:
Tissue from 17 TD and 16 ASD cases was assembled from a combination of samples from the NIH NeuroBioBank (previously NICHD brain and tissue bank) and the brain repository at UC Davis MIND Institute. Blocks of amygdala tissue approximately 1.5x1.5x0.5cm were excised from the temporal lobe and neurons were visualized using a modified Golgi-Kopsch staining technique. After dehydration and embedding in parlodion, 150µm sections were cut on a sliding microtome. 10 lateral nucleus neurons per

case were selected (fully impregnated, central within the slice and free from obscurities) to be traced using Neurolucida software (MBF Biosciences). Measures of dendrite morphology such as total dendritic length, segment count and spine density were analyzed using Neurolucida Explorer (MBF Biosciences) and statistical analyses conducted in SPSS v22 (IBM).
Results:
In an early analysis of a small subset (6 TD and 5 ASD cases) of the full case list, we have found a trend for a linear decrease in spine density across age ($F_{(1,9)}$=2.98, P=0.11), however this did not differ between the ASD and the TD group. Similarly with this small subset, no significant group differences were found in total dendritic length or spine density.
Conclusions:
This is the largest post-mortem analysis comparing neuron morphology in ASD vs. typically developing controls and the first study of its kind in the amygdala. The findings help to resolve our understanding of why the amygdala grows larger in children with autism spectrum disorders.

28 **179.028** Premature Aging in Autism: The Double Jeopardy Hypothesis of White Matter Integrity

H. M. Geurts[1], *P. C. M. Koolschijn*[2], *M. W. Caan*[3], *S. D. Olabarriaga*[3] *and J. Teeuw*[3], *(1)University of Amsterdam, Amsterdam, NH, Netherlands, (2)University of Amsterdam, Amsterdam, Netherlands, (3)Academic Medical Center, Amsterdam, Netherlands*

Background: Typical development of brain white matter (WM) microstructure across the lifespan shows a curvilinear pattern with a plateau around mid-adulthood and a rapid decrease in old age. Autism spectrum disorder (ASD) is typified as a brain connectivity disorder in which WM abnormalities are already present early on in life. However, it is unknown whether older adults with ASD show similar age-related WM deterioration as observed in typical aging.
Objectives: The aim of this first cross-sectional study in mid and late adulthood in ASD was to characterize WM integrity and its relationship with age.
Methods: We utilized diffusion tensor imaging with head motion control in 48 adults with ASD and 48 age-matched controls (30-75 years, IQ>80), who completed a Flanker task. We focused on fractional anisotropy, and mean, axial, and radial diffusivity of 18 major fiber tracts. Intra-individual variability (IIV) measures based on performance on the Flanker interference task were used to assess IIV-WM integrity associations between groups.
Results: We observed widespread reductions in white matter integrity in ASD, which persisted after taking head motion into account. These alterations were generally found in long-range association and projection tracts. Importantly, group-by-age interactions revealed increased age-related white matter deterioration in ASD, again for major association and projection fibers in the brain. We also observed different IIV-white matter integrity relations between groups. For example, reduced fiber coherence in callosal fibers was associated with higher IIV (when controlling for differences in MRT) in ASD, but not in controls.
Conclusions: The observed white matter integrity reductions lend support to the structural under connectivity hypothesis in ASD. These reductions seem to have behavioral repercussions given an atypical relationship with IIV. Taken together, the current results may suggest a premature aging pattern in adults with ASD.

29 **179.029** Reduced Age-Related Trajectories of Fractional Anisotropy and Volume for the Left Arcuate Fasciculus in Autism

K. A. Kellett[1], *P. T. Fletcher*[2], *M. D. Prigge*[3], *N. Lange*[4], *E. D. Bigler*[5], *A. L. Alexander*[6] *and J. E. Lainhart*[6], *(1)Department of Psychology, University of Wisconsin-Madison, Madison, WI, (2)University of Utah, Salt Lake City, UT, (3)Pediatrics, University of Utah, Salt Lake City, UT, (4)McLean Hospital, Cambridge, MA, (5)Psychology/Neuroscience Center, Brigham Young University, Provo, UT, (6)Waisman Center, University of Wisconsin-Madison, Madison, WI*

Background: The arcuate fasciculus is a white matter fiber bundle connecting canonical language regions in the brain. Previous diffusion tensor imaging studies comparing metrics of white matter microstructure integrity of the arcuate fasciculus between individuals with autism and typical development have been cross-sectional with regard to age and have produced inconsistent results.
Objectives: To compare age-related trajectories of arcuate fasciculus development between individuals with autism spectrum disorder (ASD) and typically developing controls (TDC) by examining longitudinal changes in mean fractional anisotropy (FA) and total volume for both left and right arcuate fasciculi.
Methods: Three-hundred and seventy-six diffusion-weighted imaging scans were collected from 94 males with autism (mean age of 15.1 years at first scan with age range of 3.0 – 45.4; nonverbal IQ > 60) and 43 males with typical development (mean age of 16.0 years at first scan with age range of 4.0 – 29.5). One to four scans were acquired per participant, at an average interscan interval of 2.5 years. Diffusion tensor image processing involved implementing a previously used volumetric segmentation approach to extract arcuate fasciculus white matter tracts, from which mean FA and total volume of tracts were measured. Using age mean-centered at time of first scan (15.4 years), longitudinal mixed effects models were used to identify group differences in longitudinal age-related trajectories for left arcuate mean FA, left arcuate total volume, right arcuate mean FA, and right arcuate total volume.
Results: For the left arcuate fasciculus, the ASD group showed a reduced age-related increase in mean FA compared to the TDC (group by age interaction: $t(232) = 2.84$, $p = 0.02$, Bonferroni corrected); the ASD group had significantly lower FA than the TDC (group effect: $t(135) = 3.5$, $p = 0.002$, Bonferroni corrected). Additionally, the ASD group showed a smaller age-related increase in left arcuate volume compared to the TDC (group by age interaction: $t(237) = 2.68$, $p = .03$, Bonferroni corrected), but ASD and TDC groups did not significantly differ in left arcuate volume. For the right arcuate fasciculus, no significant group or age-related group differences were found for mean FA or total volume.
Conclusions: Our results suggest that development of the left arcuate fasciculus occurs more slowly in individuals with autism. The ASD group compared to TDC group showed a reduced age-related increase in FA, indicative of a slower increase in axonal organization and density, as well as a reduced age-related increase in volume for the left arcuate fasciculus tract. Given that language functioning is typically left lateralized, future study will examine relationships between development of language ability and white matter microstructure in the arcuate fasciculus in autism.
Funding Source: This study was supported by NIH RO1 MH080826, NIH RO1 MH097464, and Eunice Kennedy Shriver National Institute of Child Health and Human Development T32 HD07489. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Mental Health, NICHD, or the National Institutes of Health.

30 **179.030** Rescue of Neuroanatomical Impairments Following Mecp2 Reactivation in Adult Mice

R. A. Allemang-Grand[1], *J. P. Lerch*[2], *L. Spencer-Noakes*[2] *and B. J. Nieman*[2], *(1)Hospital for Sick Children, Toronto, ON, Canada, (2)Mouse Imaging Centre, Hospital for Sick Children, Toronto, ON, Canada*

Background: Rett syndrome is a neurodevelopment disorder caused by sporadic mutations in the X-linked gene, Mecp2[1]. Interestingly, reactivation of Mecp2 leads to a rescue of the neuronal and behaviour impairments in adult mice[2,3]. Although these findings are exciting, these studies quantified rescue in a limited number of brain regions and restricted their analyses to a few time points. However, to fully understand the dynamics, a non-invasive, high-throughput method is required that can quantify where the remodelling of the cellular structure occurs across the entire brain and the time course of these changes. Magnetic Resonance Imaging (MRI) is an imaging modality that has the ability to longitudinally acquire high-resolution neuroanatomical information from the mouse brain.
Objectives: We scanned mice longitudinally with MRI to determine: a) the brain regions affected by Mecp2 silencing and b) the spatial and temporal changes that occur in the brain following Mecp2 reactivation.
Methods: At P50, male Mecp2-STOP/Cre and Cre littermates were scanned in vivo with a Manganese-enhanced MRI protocol (MEMRI), followed by 4 weeks of treatment with oil or tamoxifen to reactivate Mecp2. At P80, a follow up MEMRI scan was conducted. The acquired images were aligned using a series of iterative linear and nonlinear registrations steps[4]. This process generates a consensus average representing each individual brain and the deformations of each image from this average. The Jacobian-determinants, which represents local volume changes, were then extracted from the deformations fields and used as the dependent variable in the statistical analyses to assess volumetric changes.
Results: At P50, Mecp2/Cre mice began to show reduced mobility and breathing impairments. At this age, total brain volume of Mecp2/Cre (n=9) mice was 14% smaller than Cre (n=5) controls (t-statistic=4.07, $p < 0.001$). Following normalization for brain volume, volumetric decreases were found across the cortex, striatum, hippocampus, while volumetric increases were found in the cerebellum and medulla. Following the baseline scan, Mecp2/Cre mice treated with oil showed a steady increase in body weight (beta=0.33, $p < 0.05$) and phenotypes reaching a score of 5 around 80 days of age. Conversely, tamoxifen treatment reduced the increase in body weight of Mecp2/Cre mice (beta=0.07, p=0.42) and reversed the increase in phenotype score from 2 at 60 days, to 0 by 80 days. At P80, the brain of Mecp2/Cre mice treated with tamoxifen (n=4) was 30% larger than Mecp2/Cre treated with oil (n=2) (t-statistic=8.71, $p < 0.001$). Interestingly, the tamoxifen treated Mecp2/Cre brain grew at a rate of 1.73mm^3 per day (beta=1.73, $p < 0.05$), eventually reaching Cre control volumes at 80 days (t-statistic=0.32, p=0.76). A regional-based analysis demonstrated a lack of regional specificity, with all brain regions increasing in volume following Mecp2 reactivation.
Conclusions: Our results demonstrate that Mecp2 mice have volumetric differences across many brains networks early in adult life. However, following Mecp2 reactivation, a substantial neuroanatomical rescue occurs across the brain eventually normalizing with controls.

31 **179.031** Selective Impairments in White Matter Integrity of Right Inferior Longitudinal Fasciculus in ASD

B. Boets[1,2,3], *L. Van Eylen*[4], *K. Sitek*[3], *I. Noens*[4], *J. Steyaert*[1], *S. Sunaert*[5] *and J. Wagemans*[6], *(1)Child and Adolescent Psychiatry, KU Leuven, Leuven, Belgium, (2)Leuven Autism Research consortium (LAuRes), KU Leuven, Leuven, Belgium, (3)McGovern Institute for Brain Research, Massachusetts Institute of Technology, Cambridge, MA, (4)Parenting and Special Education Research Unit, KU Leuven, Leuven, Belgium, (5)Translational MRI, KU Leuven, Leuven, Belgium, (6)Laboratory of Experimental Psychology, KU Leuven, Leuven, Belgium*

Background: One of the most widely established features of the neural phenotype of ASD is the reduced integrity of long-range white matter fiber tracts as assessed by diffusion-weighted imaging, leading to the conceptualization of ASD as a "disconnection" syndrome. Recent methodological studies, however, have shown that this same pattern of aberrant connectivity may artifactually result from excessive head motion and poorer data quality. A recent study comparing white matter integrity in children with ASD and TD controls while carefully controlling for head motion and data quality, revealed that the classical effect of reduced fractional anisotropy (FA) in multiple and widespread white matter tracts in ASD disappears (Koldewyn et al., 2014, PNAS). Instead, reduced white matter integrity was present in only one tract, the right inferior longitudinal fasciculus (ILF). This same tract has also been identified as particularly affected based on a recent quantitative meta-analysis of diffusion-weighted imaging studies in ASD (Hoppenbrouwers et al., 2014, RASD).
Objectives: We aimed to replicate these findings in an independent sample of adolescents with ASD and TD, using an identical methodological approach. Moreover, given the evidence of atypical visual processing in ASD and given the involvement of the ILF in ventral visual stream processing, we also assessed the association between ILF integrity and a series of visual processing measures.
Methods: Diffusion MRI data were obtained in 19 12-to-18-year-old boys with ASD and 19 age-matched TD boys. Anatomically constrained probabilistic diffusion tractography was carried out using TRACULA to extract integrity measures of 18 major white-matter pathways. Application of a strict head motion criterion resulted in a sample of 18 ASD and 17 TD participants, well-matched in terms of data quality. In addition to the structural connectivity data, a series of questionnaires and experiments were administered to assess ASD characteristics, attention to detail, perceptual grouping, visual processing style, motion coherence sensitivity and visual search.
Results: Comparing ASD vs. TD on each of the 18 tracts revealed similar FA values for both groups on every tract (all p>.10), with the exception of significantly reduced integrity of the right ILF in ASD (p=.022). FA values of left ILF (p=.057) and right SLFt (p=.058) were marginally significantly reduced in ASD . Apart from both questionnaires, no group differences were observed on any of the visual processing tasks. Concerning associations of white matter integrity with visual processing measures and ASD characteristics, we observed that poorer integrity of right ILF showed a (statistically insignificant) association with a more fragmented processing style (r_s=-.31, =.07), slower perceptual grouping and detection of Gabor patterns (r_s=-.29, p=.10),slower visual search (r_s=-.32, p=.06), more attention to detail (r_s=-.33, p=.06) and more ASD characteristics (r_s=-.31, p=.06). As expected no association was observed between ILF integrity and coherent motion sensitivity (p>.28), a traditional measure of dorsal visual stream functioning.
Conclusions: Our findings support the growing evidence for a specific and selective impairment of the right ILF in ASD. Suggestive evidence for a modest association between white matter integrity of this ventral visual pathway and behavioral visual processing performance was found.

32 **179.032** Structural Connectivity of the Accumbofrontal Tract in Youth with and without Autism: Associations with Behavioral Phenotypes

L. M. Hernandez[1], *J. Liu*[1], *C. Ponting*[2], *K. E. Lawrence*[1], *S. Y. Bookheimer*[1] *and M. Dapretto*[1], *(1)University of California, Los Angeles, Los Angeles, CA, (2)Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA*

Background: Human neuroimaging work suggests that reward processing is affected in individuals with autism spectrum disorder (ASD); compared to neurotypical controls, individuals with ASD show altered brain activity to rewarding stimuli in nodes of reward circuitry including the ventral striatum, anterior cingulate, and prefrontal cortex (e.g., Scott-Van Zeeland 2010; Dichter 2012; Kohls 2013). The inferior portion of the VS encompasses the nucleus accumbens (NAcc), a region that animal studies indicate is critical for the formation of positive associations with social rewards (Dolen 2013) and attachment behavior (Keebaugh 2015). Importantly, the presence of an accumbofrontal white matter tract has recently been reported using diffusion tensor imaging (DTI) in humans (Karlsgodt 2015). This tract connects the NAcc and orbitofrontal cortex, two areas that display altered activity during reward processing in ASD. Here, we used DTI to detect and compare accumbofrontal fractional anisotropy (FA; a measure of white matter integrity) in youth with and without ASD, and relate FA to behavioral measures associated with the ASD phenotype.
Objectives: 1) Compare accumbofrontal structural connectivity in youth with and without ASD. 2) Investigate how accumbofrontal connectivity relates to measures of ASD symptomatology.
Methods: DTI data was acquired in high functioning youth with ASD (N=44) and typically developing youth (N=44) ages 8-17. Data analysis consisted of quality control and removal of volumes with artifacts using DTIPrep (Oguz 2015), eddy current correction, brain extraction, calculation of diffusion parameters (BEDPOSTX), registration to standard space, and probabilistic tractography (PROBTRACKX; Behrens 2007). Binary masks of the left and right NAcc (defined using the Havard-Oxford Atlas) were used as seed regions for probabilistic tractography. For each subject, 5,000 streamlines were initiated from the seed voxels using the contralateral hemisphere as an exclusionary mask; a minimum threshold of 50 streamlines was applied for inclusion in subsequent analyses. The resulting map was binarized and used as a mask to extract FA values for the left and right accumbofrontal tract for each subject, which were compared between diagnostic groups and correlated with behavioral measures of intelligence and social functioning.
Results: In both TD and ASD participants, the left and right NAcc showed structural connectivity with the ipsilateral orbital frontal cortex. There were no significant differences in FA for either the left or right accumbofrontal track when comparing TD and ASD participants (p>0.05). In ASD youth, left (r=0.40, p=0.007) and right (r=0.50, p=0.0005) accumbofrontal FA was associated with higher scores of verbal intelligence. Higher right accumbofrontal connectivity was also associated with less severe scores on the Autism Diagnostic Observation Schedule (ADOS; Lord 2000) social (r=-0.36, p=0.02) and social/communication (r=-0.32, p=0.03) subscales in youth with ASD. There were no significant behavioral correlations in TD youth.
Conclusions: These findings indicate that structural connectivity between the NAcc and orbital frontal cortex is intact in youth with ASD, and that higher levels of FA is associated with less severe verbal and social/communication impairment. This work suggests that structural connectivity of the reward network may be an important biomarker, helping to explain variability of symptomatology in youth with ASD.

33 **179.033** Structural Features of the Mid Fusiform Sulcus in Autism Spectrum Disorders

C. Ammons, *M. E. Winslett, J. Bice, P. Patel and R. K. Kana, University of Alabama at Birmingham, Birmingham, AL*

Background: A landmark paper published recently identified a minor sulcus bisecting the fusiform gyrus (FG) into lateral and medial subdivisions (Weiner et al., 2014). The "mid-fusiform sulcus" (MFS) was shown to be a stable characteristic in healthy individuals, present across ages and identifiable in right and left hemispheres of the brain. Furthermore, this macroanatomical feature was related to a microanatomical division between cytoarchitectonic regions FG1 and FG2 occurring at the fundus of the MFS in 90% of cases (Weiner et al., 2014). Despite the importance of the FG in face processing and social cognition as well as the considerable literature demonstrating abnormal FG activation in ASD (Nomi & Uddin, 2015), no systematic investigation of MFS structure has been undertaken in an ASD population.
Objectives: To characterize the anatomical organization of the MFS in children and adults with ASD and compare and contrast it with that in TD participants.
Methods: Structural MRI data from 49 subjects (23 ASD; 26 TD) collected on a Siemens 3T scanner were analyzed for this study. The sample consisted of 41 males and 8 females (4 ASD, 4 TD). Participant ages ranged from 9 to 40 years (ASD mean=21.13, TD mean=19.62) with no significant group differences [t(47)=.67, p=.51]. IQ ranged from 80 to 140 (ASD mean=113, TD mean=113) with no significant group differences [t(47)=.17, p=.68]. Each hemisphere was analyzed independently resulting in a total sample size of 98 hemispheres. Identification and classification of MFS in each hemisphere was performed using criteria established in Weiner et al. (2014). Criteria included 1) an "omega" shape on T1 coronal slices created by the deeper Collateral sulcus medially and Occipital-Temporal sulcus laterally; and 2) visible sulcus representation on the inflated brain surface. Identifiable MFS were classified into one of four surface patterns using *Freesurfer* 2D rendering and rough correspondence with an *fsaverage* brain MFS label created for this project. These patterns reflect a combination of fractionation and contiguity with surrounding sulci.
Results: The MFS was identifiable through inspection of the inflated surface and T1 image in 97% of hemispheres. ASD or TD group membership was not associated with unidentifiable MFS. Of the 95 hemispheres with identifiable MFS the following classification patterns emerged: 1) In both TD and ASD groups, unfractionated MFS patterns were slightly more common across hemispheres (56% ASD; 59% TD); 2) MFS which are independent of neighboring sulci are slightly more common across groups and hemispheres (53% ASD, 55% TD); 3) Classification of MFS gross anatomy was similar between ASD and TD groups (ASD: IA-14, IB-11, IIA-11, IIB-9; TD: IA-17, IB-10, IIA-13, IIB-10).
Conclusions: The MFS can be reliably identified in the ASD population. Its macroanatomical structure appears to follow largely similar patterns seen in TD individuals. Planned follow-up analyses include addition of another 65 subjects to increase power as well as quantitative indices of sulcal length and depth measurement. Further elaboration of structural features of the MFS in ASD will be important for future investigations into structure-function relationships in this critical region of the social brain.

34 **179.034** Structural Language Abilities Are Related to Cortical Structure and Covariance in Autism Spectrum Disorders

M. Sharda[1], *N. E. Foster*[1,2], *A. Tryfon*[1,2], *K. A. R. Doyle-Thomas*[3], *E. Anagnostou*[3,4], *A. C. Evans*[2], *L. Zwaigenbaum*[5], *J. D. Lewis*[2], *J. P. Lerch*[6], *K. L. Hyde*[1,2] *and .. NeuroDevNet ASD Imaging Group*[7], *(1)International Laboratory of Brain, Music and Sound Research, University of Montreal, Montreal, QC, Canada, (2)Montreal Neurological Institute, Montreal, QC, Canada, (3)Bloorview Research Institute, Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada, (4)University of Toronto, Toronto, ON, Canada, (5)University of Alberta, Edmonton, AB, Canada, (6)Mouse Imaging Centre, Hospital for Sick Children, Toronto, ON, Canada, (7)NeuroDevNet, Vancouver, BC, Canada*

Background: Autism spectrum disorders (ASD) are characterized by significant difficulties in language and communication. Recent changes in diagnostic criteria define language difficulties as distinct from core communication symptoms. Neuroimaging evidence suggests that language impairments in ASD may be related to atypical connectivity between fronto-temporal brain areas (Courchesne et al, 2007). However, the relationship of language and communication abilities to brain structure remains unknown.
Objectives: The objectives of the current study were to measure cortical thickness and anatomical covariance associated with language and communication in ASD

compared with typically developing (TD) controls.
Methods: Participants were 46 ASD and 50 TD males, matched on age (mean=12.8 years, SD=3.06), with IQ>75. ASD group was diagnosed using ADI-R and ADOS. Structural language and communication abilities in ASD were assessed using CELF-4 (Clinical Evaluation of Language fundamentals, Semel et al, 1996) and CCC-2 (Children's Communication Checklist-2, Bishop, 1998), respectively. High-resolution T1-weighted images obtained for all participants were analyzed using the CIVET pipeline (Ad'dabagh et al, 2006) to calculate cortical thickness (20mm smoothing). Seed-based analysis of anatomical covariance was performed to measure the Pearson correlation coefficient, across subjects, between cortical thickness at a seed vertex and all other vertices to generate a group map of covariance (Evans, 2013). Seed loci known to recruit the language structural covariance network (SCN) were selected in left inferior frontal gyrus (IFG), left superior temporal pole (STP) and their right hemisphere homologues. Statistical analyses were performed using vertex-wise general linear interaction models with age, site, full-scale IQ and brain volume as nuisance variables and vertex-wise seed thickness as variable of interest. Modulation of SCN strength by language and communication ability in ASD was measured by adding terms for CELF-4 and CCC-2 scores in the models respectively. All results were corrected for multiple comparisons at $p<0.05$ using random field theory.
Results: Results showed increased cortical thickness in ASD versus TD in left fronto-temporal regions. SCNs for both groups were mapped from 4 seed loci. While SCNs for controls reflected intrinsic connectivity networks described in earlier studies, SCNs for ASD showed widespread disruption, especially for the left STP seed. A direct comparison of the SCNs between TD and ASD revealed reduced covariance of the left STP seed with a region in the right frontal loci in ASD, suggesting decreased bilateral interactions of the left hemisphere language network. Furthermore, alterations in both cortical thickness and covariance were modulated by structural language ability as measured by CELF-4 of the ASD group but not communicative function (as measured by CCC-2).
Conclusions: Our findings reflect distinct differences in cortical structure and covariance of fronto-temporal regions in ASD, which are best explained by their structural language abilities but not communicative abilities. These differences further indicate the importance of structural language abilities in the study of altered fronto-temporal cortical structure and covariance in ASD. They also suggest that diagnostic specifiers, such as language, can be useful tools for understanding heterogeneity while maintaining the generalizability of findings in brain structural differences, much more than either symptom severity or cognitive ability.

35 **179.035** The Basal Ganglia Has Altered Inhibitory Receptor Expression in Autism

K. Ganapathy Subramanian[1], *C. Brandenburg*[2] *and G. J. Blatt*[2], *(1)Hussman Institute for Autism, Baltimore, MD, (2)Hussman Institute for Autism, Inc., Baltimore, MD*

Background:
The basal ganglia (BG) is a collection of sub-cortical nuclei that contain mainly inhibitory GABAergic medium spiny neurons (MSN's). The BG projects to the thalamus and has reciprocal connections with multiple cortical regions and the cerebellum. Parts of the BG are implicated in OCD, habit formation, motor, speech and language disorders. Thus, the BG is an ideal region of interest to examine the neurochemical basis of repetitive, stereotyped behavior and social communication difficulties observed in autism. This is the first study to examine changes in inhibitory circuits and receptors in specific regions of the BG in individuals with autism. Previously, Wegiel et al. 2014 reported volumetric and neuronal density changes in BG regions.
Objectives:
Determine levels of expression of inhibitory $GABA_A$ receptors in functional subdivisions of the BG in autism. Specifically, the dorsal striatum consisting of caudate and putamen, and the ventral striatum including the core and shell territories of nucleus accumbens (NAcc) were quantified.
Methods:
Sixteen post-mortem cases (8 autism and 8 control) were examined in select regions of the BG in age-matched control (mean=22.6±2.9 years) and autism (mean=22.9±3.0 years) cases. Sampled regions in the dorsal striatum included projection fields from the anterior cingulate cortex (ACC) and dorsolateral pre-frontal cortex (dlPFC) in caudate and putamen. Sampled regions in the ventral striatum included projection fields from ventromedial pre-frontal cortex vmPFC and orbitofrontal cortex (OFC) to the NAcc core and shell, areas that play a critical role in reward related behaviors. Cryostat cut 20 µm sections from these regions of interest were mounted on gelatin coated glass slides and incubated with tritiated flunitrazepam ([^{3}H]-flunitrazepam 5 nM, specific activity = 79.8 Ci/mmol, Perkin Elmer) before they were loaded into X-ray cassettes with tritium standards and apposed to tritium-sensitive film ([^{3}H]-hyperfilm) for four weeks at room temperature. Two sections per case were used for determining total binding with the tritiated ligand and one section was used for non-specific binding with a competitive displacer (Ro-15-451, 15 nM). After exposure, the films were developed and digitized to quantify measurements of binding in femtomoles per milligram of tissue for the ligand. Analysis was performed using student's t-test.
Results:
Tritiated flunitrazepam binding was found to be significantly increased in the caudate region of the dorsal striatum in subjects with autism compared to controls ($p=0.015$). Additionally, significantly increased benzodiazepine binding site density was found in the region of caudate that receives putative projections from the ACC ($p=0.03$).
Conclusions:
The results from this initial study suggest that there are significant increases in the expression of inhibitory $GABA_A$ receptors in the striatum of subjects with autism. Normally, the limbic ACC input that specifically targets the striatal interneurons plays an important role in BG efferent projections. In autism cases, increased $GABA_A$ receptors in the ACC recipient region of the caudate may be compensatory to an increase in excitatory input(s) and/or may represent an overexpression of receptors due to decreased GABA availability in this region. In either case, there is likely a disturbance of inhibitory/excitatory balance within BG circuitry in autism.

36 **179.036** The Number of Parvalbumin-Expressing Chandellier and Basket Cells Are Differentially Decreased in Medial Prefrontal Cortex in Autism

V. MartiÂnez Cerdeno, *J. Ariza Torres, E. Hashemi and H. Rogers, UC Davis, Sacramento, CA*

Background:
Cortical interneurons have been linked with the altered balance of excitation / inhibition in the cerebral cortex that is present in autism. However, a specific subtype of interneuron had not been correlated with autism until we discovered that the number of parvalbumin (PV) expressing interneurons was decreased in the prefrontal cortex in autism. PV+ interneurons are the primary cortical interneuron that directly innervates the pyramidal neuron soma or axon initial segment. There are two PV+ interneuron subtypes: Basket (Bsk) cells and Chandellier (Ch) cells. Bsk cells innervate the soma and proximal dendrites of pyramidal neurons, while Ch cells innervate the initial segment of pyramidal neuron axon. Both Bsk and Ch cells are fast-spiking neurons that innervate a large number of pyramidal neurons, and therefore even a small decrease in Ch or Bsk cell number could critically impair pyramidal neuron output and regional cortical function. These cells account for only 1% of total neurons in the cerebral cortex, with Bsk cells more numerous than Ch cells.
Objectives:
We investigated whether one subtype of the PV+ cells, the Bsk or Ch cell, or both, was decreased in the medial prefrontal cortex (Brodmann areas (BA) 46, 47, and 9) in autism.
Methods:
A specific marker that differentiates Bsk from Ch cells has not been devised. However, we have designed a method that allows us to discern between these two cell types. Our method is based on the differential expression of *Vicia villosa* lectin (VVA) by Bsk and Ch cells. VVA lectin belongs to a family of tetrameric glycoproteins that binds to N-acetylgalactosamine, which is present in the perineuronal net surrounding Bsk cells. While the vast majority of Bsk cells can be labeled using VVA, Ch cells do not express VVA. We used PV and VVA double labeling, and based on exclusion distinguished Ch cells from Bsk cells in cortical slices of prefrontal cortex in autism and control groups. We then quantified the number of each cell type (PV+/VVA+; PV+AVV-) present in each Brodmann area in our tissue samples and compared data between autism and control groups.
Results:
We found that PV+ Ch cells (VVA-) but not PV+ Bsk cells (VVA+) are decreased in prefrontal BA46 and BA47, while both PV+ Chk and PV+ Bs cells are decreased in prefrontal BA9.
Conclusions:
The changes in PV+ Ch and PV+ Bsk cells reported here may reflect altered information processing within the PFC and could contribute to the cognitive impairments seen in autism.

37 **179.037** The Rates of Incidental Perivascular Space (PVS) Findings on MRI Among Infants at High- and Low-Risk for ASD: Preliminary Results from the IBIS Study

R. F. Slomowitz[1], *J. Pandey*[2], *M. D. Shen*[3], *S. Das*[4], *L. MacIntyre*[4], *J. Wood*[5], *J. E. Maldarelli*[6], *K. Botteron*[7], *S. Dager*[8], *A. M. Estes*[9], *L. Zwaigenbaum*[10], *H. C. Hazlett*[11], *M. Styner*[3], *D. Shaw*[12], *R. T. Schultz*[6], *J. Piven*[3], *R. McKinstry*[13] *and .. The IBIS Network*[3], *(1)Psychology, The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (2)Children's Hospital of Philadelphia, Philadelphia, PA, (3)University of North Carolina at Chapel Hill, Chapel Hill, NC, (4)McGill Centre for Integrative Neuroscience, Montreal Neurological Institute, Montreal, QC, Canada, (5)The Children's Hospital of Philadelphia, Philadelphia, PA, (6)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (7)Psychiatry and Radiology, Washington University School of Medicine, St. Louis, MO, (8)University of Washington School of Medicine, Seattle, WA, (9)University of Washington Autism Center, Seattle, WA, (10)University of Alberta, Edmonton, AB, Canada, (11)Carolina Institute for Developmental Disabilities, University of North Carolina at Chapel Hill, Chapel Hill, NC, (12)Seattle Children's Hospital, Seattle, WA, (13)Washington University School of Medicine, St. Louis, MO*

Background: Prior research has highlighted an increased frequency of incidental findings in the MRI scans of children diagnosed with ASD. However, little research has

explored the frequency of incidental MRI findings in infants who are at high familial risk for autism. While no differences in the frequency of incidental MRI findings have been reported in infants at high (HR) and low risk (LR) for ASD at 6 months of age, it is possible that differences in the frequency of incidental MRI findings between these groups become apparent later in infancy.
Objectives: We examined the frequency with which incidental findings occur in HR and LR infants at 6, 12, and 24 months of age. We examined how findings at different ages relate to subsequent diagnostic outcomes.
Methods: Participants are part of an ongoing multi-site study (The Infant Brain Imaging Study) and underwent MRI scans at 6, 12, and 24 months (Total N=324; 239 HR, 85 LR). Diagnostic outcome of ASD was determined at 24 months of age by expert clinicians. The final sample was composed of three groups: N=49 HR infants who were diagnosed with ASD (HR-ASD); N=190 HR infants who were not diagnosed with ASD (HR-neg); and N=85 LR control infants (LR-neg). A neuroradiologist at each site (blind to risk status and diagnosis) reviewed and classified each scan, and each scan classification was confirmed by a second neuroradiologist. For the purposes of this study, each scan was classified as being either Abnormal or Typical by the presence and degree of perivascular spaces (PVS). The degree of PVS was rated on a five-point scale: none, minimal, mild, moderate, and marked. The rate of Abnormal vs. Typical scans at 24 months was compared between groups using Chi-squared tests.
Results: The rate of abnormal scans at 24 months was higher in the HR-ASD compared to the HR-neg and LR-neg groups: 63.27% of scans in the HR-ASD group were classified as abnormal, compared to less than 40% of scans in the HR-neg and LR-neg groups. The ratio of abnormal vs. normal scans in the HR-ASD group was significantly higher compared to both the HR-neg group ($\chi^2 = 11.15$, $p < .001$) and LR-neg group ($\chi^2 = 7.44$, $p < .01$). PVS were found in >60% of abnormal scans at 24 months across all groups.
Conclusions: The examination of MRI scans across diagnostic outcomes demonstrated that abnormal findings at 24 months were significantly more common in HR-ASD children, compared to HR-neg and LR-neg children. Interestingly, for all three diagnostic groups, PVS were the most frequent findings across all abnormal scans. Analyses of other incidental findings and correlations between MRI findings and clinical characteristics are currently underway and will be presented.

Table 1

	Radiology Review Result	
Time Point & Risk Status	Normal	Abnormal
HR+		
6 HR+	42.11% (16)	57.89% (22)
12 HR+	52.27% (23)	47.73% (21)
24 HR+	36.73% (18)	63.27% (31)
HR-		
6 HR-	55% (77)	45% (63)
12 HR-	54.55% (96)	44.55% (80)
24 HR-	63.16% (120)	36.84% (70)
LR-		
6 LR-	43.59% (34)	56.41% (44)
12 LR-	59.74% (46)	40.26% (31)
24 LR-	61.18% (52)	38.82% (33)

Table 2

	Risk Status Group & Diagnostic Outcome		
Radiology Results (6, 12 & 24 months)	HR+	HR-	LR-
PVS in Normal 6mo. Scans	0.00%	0.00%	0.00%
minimal	0.00%	0.00%	0.00%
mild	0.00%	0.00%	0.00%
moderate	0.00%	0.00%	0.00%
PVS in Abnormal 6mo. Scans	13.64% (3)	9.52%(6)	18.18% (8)
minimal	9.09% (2)	6.35% (4)	13.64% (6)
mild	4.55% (1)	3.17% (2)	4.55% (2)
moderate	0.00%	0.00%	0.00%
PVS in Normal 12mo. Scans	4.35% (1)	2.08% (2)	0.00%
minimal	4.35% (1)	2.08% (2)	0.00%
mild	0.00%	0.00%	0.00%
moderate	0.00%	0.00%	0.00%
PVS in Abnormal 12months Scans	61.9% (13)	47.5% (38)	32.26% (10)
minimal	33.33%(7)	35%(28)	22.58% (7)
mild	23.81%(5)	11.25%(9)	3.23% (1)
moderate	4.76%(1)	1.25% (1)	6.45% (2)
PVS in Normal 24mo. Scans	5.56% (1)	2.5% (3)	1.92% (1)
minimal	5.56% (1)	2.5% (3)	1.92% (1)
mild	0.00%	0.00%	0.00%
moderate	0.00%	0.00%	0.00%
PVS in Abnormal 24mo. Scans	70.97%(22)	70% (49)	63.63% (21)
minimal	35.48%(11)	44.29% (31)	42.42% (14)
mild	29.03% (9)	25.71% (18)	18.18% (6)
moderate	6.45%(2)	0	3.03% (1)

38 **179.038** The Relationship Between Temperament and Brain Development in Infant Siblings with Autism Spectrum Disorder

S. J. Paterson[1], *J. J. Wolff*[2], *M. R. Swanson*[3], *J. T. Elison*[2], *L. Zwaigenbaum*[4], *A. M. Estes*[5], *K. Botteron*[6], *H. C. Hazlett*[7], *J. Pandey*[8], *R. T. Schultz*[9], *J. Piven*[3] *and .. The IBIS Network*[3], *(1)Department of psychology, Temple university, Philadelphia, PA, (2)University of Minnesota, Minneapolis, MN, (3)University of North Carolina at Chapel Hill, Chapel Hill, NC, (4)University of Alberta, Edmonton, AB, Canada, (5)University of Washington Autism Center, Seattle, WA, (6)Psychiatry and Radiology, Washington University School of Medicine, St. Louis, MO, (7)Carolina Institute for Developmental Disabilities, University of North Carolina at Chapel Hill, Chapel Hill, NC, (8)Children's Hospital of Philadelphia, Philadelphia, PA, (9)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA*

Background:
Differences in temperament profiles are already present at 6 months in infants who develop autism spectrum disorder (ASD) and are some of the disorder's earliest behavioral signs (Zwaigenbaum et al., 2005; del Rosario et al., 2013; Paterson et al., 2014). Brain imaging in these same infants has revealed that differences in white matter development are also present by 6 months (Wolff et al., 2012). However, the relationship between brain development and temperament in infants at risk for ASD has yet to be examined.
Objectives:
Given the correspondence of timing of these atypical brain and behavioral phenomena, we aimed to characterize the association between white matter structural connectivity and individual differences in temperament at 6 and 12 months in infant siblings who received a diagnosis of ASD at age two years.
Methods:
Thirty-seven infants who developed ASD (HRPos) and eighty-three infants with typically developing siblings (LR) were assessed longitudinally in a larger, multi-site study of brain and behavioral development in ASD. Temperament was assessed at 6 and 12 months using the IBQ-R (Gartstein & Rothbart, 2003). Diffusion tensor imaging data were collected during natural sleep. Five white matter pathways were selected and deterministically segmented in common atlas space (see Verde et al. 2014). These were the: genu of the corpus callosum, uncinate fasciculus, cingulum, superior cerebellar peduncle (SCP) and the anterior limb of the internal capsule (ALIC). Microstructure was characterized by fractional anisotropy (FA). The relationships between three aspects of temperament: Surgency, Regulatory Control, and Negative Affect, and FA in five white matter fiber pathways at 6 and 12 months were examined using Pearson correlations.
Results:
Preliminary analyses found no correlations between white matter pathways and temperament concurrently at 6 months. However, significant concurrent correlations between white matter and temperament were found at 12 months in both groups. In addition, correlations were found between 6-month white matter microstructure and 12-month temperament data, between higher FA in the genu and higher negative affect,($r = .044$, $p<.05$), FA in the SCP at 6 mo and decreased surgency at 12 mo in the HRPos group ($r = -.047$, $p<.01$), and between FA in the cingulum at 6 months and Negative Affect at 12 month in the low risk group ($r =.033$, $p<.01$).

Conclusions:
These data suggest that there are indeed relationships between neurobiology and temperament in infants at high risk for ASD. Brain differences at 6 months correlate with behavior at 12 months, but concurrent relationships are not yet present at 6 months, probably because there is not yet enough variability in temperament. Tracts such as the uncinate, which links the anterior temporal lobe with the orbito-frontal cortex, are likely to play a role in self-control and orienting behavior. These are important for aspects of temperament such as regulatory capacity. These findings of differences in neurobiology and temperament appear before many of the major symptoms of ASD and are likely to have important implications for the development of the disorder. Further examination of a larger dataset is underway and will include trajectory analysis.

39 **179.039** Understimulation in Autism: A Preliminary Diffusion Tensor Study Using Tract-Based Spatial Statistics

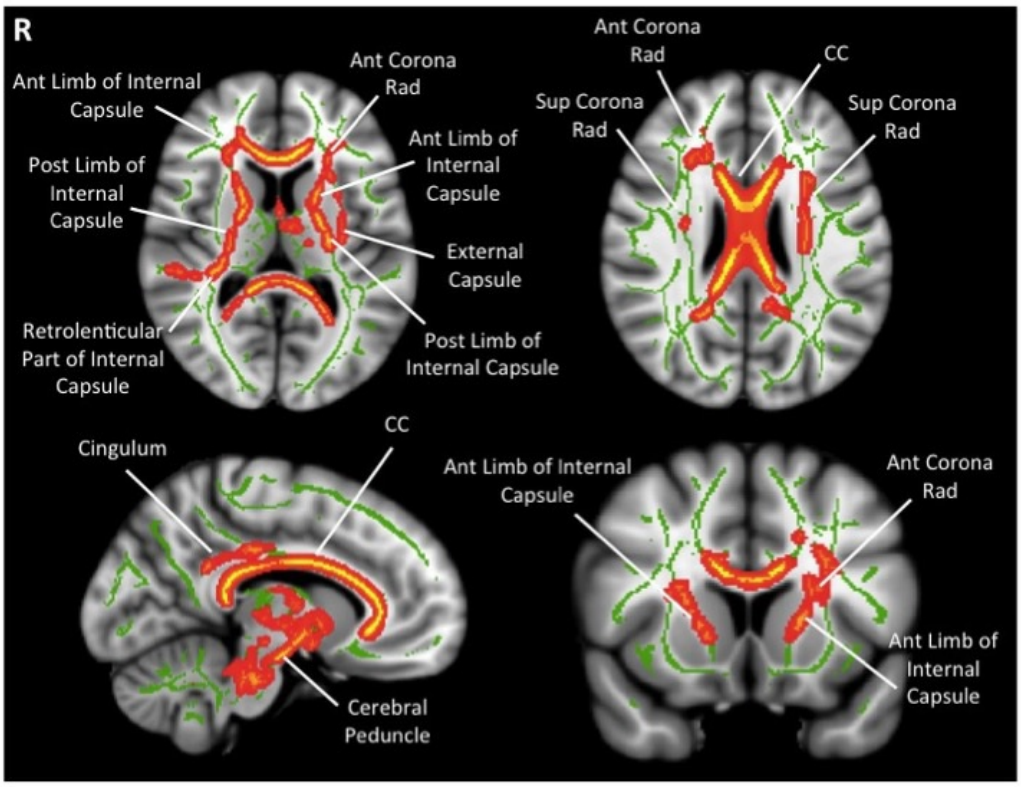
S. M. Kaku, *R. D. Bharath, G. Venkatasubramanian, S. Bansal, S. C. Girimaji and S. Srinath, National Institute of Mental Health and Neurosciences, Bangalore, India*

Background:
Autism is known to be influenced by a plethora of environmental influences. Among the many environmental factors, understimulation in the early stages of brain growth is also known to contribute. There is evidence suggesting widespread aberrations in neural connectivity implicating underconnectivity as a theory explaining the underlying neurobiology of autism.
Objectives:
In this study we tried to explore the possible connectome differences between those with autism and understimulation as we have frequently observed a spurt of initial improvement once the intervention starts, thus having better short term outcome as compared to those who develop autism even though adequately stimulated.
Methods:
22 subjects with autism aged 3-8 years were recruited for the study from the Child and Adolescent Psychiatry services at a tertiary care centre in India. They were divided into 2 groups with 11 children in each group, depending on whether they had understimulation as a major environmental factor. The case group were those with understimulation who were clinically classified as those with >4 hours/day television time, social isolation, precious child, etc. Those with adequate stimulation were classified as controls. Subjects were group-matched on age, cognitive functioning, sex, and handedness. DTI data were acquired using a 3T scanner. FSL, including TBSS, was used to process and analyse DTI data where FA was chosen as the primary measure of fiber tract integrity.
Results:
Clinical data established no significant differences between the two groups of children with autism even with respect to comorbidities, medication prescribed, family history etc. Connectivity differences, similar to previous studies demonstrating long range connectivity dysfunction, though not at significance levels, were observed between the two groups. Aberrant connectivity was mainly noticed in areas related to the fronto-parietal and fronto-temporal networks and few areas in the occipital cortex.
Conclusions:
At the preliminary level, this study validates the established evidence of long range cortical connectivity dysfunction in autism. We hypothesize that autism which is known to exhibit a heterogeneous symptom profile also possibly demonstrates specific neural correlates for sub categories of the disease population like those with understimulation. It also could be possible for these correlates to act as neuroanatomical indicators of short term outcome. The results of this study though small, indicate possible differences in brain connectivity patterns across the autism group which need further evaluation with larger groups of children with autism with differing symptom profiles.

40 **179.040** What's the (white) Matter in Autism Spectrum Disorder

V. M. Vogan[1], *B. R. Morgan*[1], *R. Leung*[2], *E. Anagnostou*[3] *and M. J. Taylor*[4], *(1)The Hospital for Sick Children, Toronto, ON, Canada, (2)Psychology, University of Toronto, Toronto, ON, Canada, (3)University of Toronto, Toronto, ON, Canada, (4)Diagnostic Imaging, The Hospital for Sick Children, Toronto, ON, Canada*

Background: Autism Spectrum Disorder (ASD) is characterized by complex underlying neuropathology that is not fully understood. There is evidence of early dysregulated brain growth in children with ASD, which may have profound effects on neural connectivity. A large body of research has pointed to atypical functional and structural networks in ASD, with evidence for both functional underconnectivity and overconnectivity. Diffusion tensor imaging (DTI) studies have shown widespread white matter abnormalities in children with ASD, which may disrupt neural circuitry, impacting crucial cognitive processes, such as working memory. However, previous studies have been limited by sample size and comprehensive diffusion analyses.
Objectives: To explore white matter development in a large sample of children with and without ASD using DTI, and the relations between various DTI metrics and cognitive processes, such as working memory.
Methods: 60-direction diffusion data was acquired on a 3T Siemens Trio MRI scanner with a 12-channel head coil. Subjects included 61 children with ASD (51 male) and 69 age- and sex-matched healthy control (51 male) children (ages 7-15). Values for fractional anisotropy (FA), mean diffusivity (MD), axial diffusivity (AD) and radial diffusivity (RD) were calculated. Tract based spatial statistics (TBSS) was used to define subject-specific FA skeletons, which were used as masks to examine differences in FA, MD, AD and RD. FSL Randomise was used to statistically evaluate these differences. Associations (Pearson's) between FA in select tracts and working memory, as measured by the Working Memory Test Battery, were examined in a subgroup of children with (n= 39) and without ASD (n = 34).
Results: Compared to controls, children and adolescents with ASD showed widely distributed reduced FA and AD, with no group differences in MD or RD values. Both groups showed age-related changes, but there was no interaction between age and group. Regions of reduced FA included the corpus collosum, cerebral peduncle and projection fibres (corona radiata, internal capsule, posterior thalamic radiation). Similarly, regions of reduced AD included the corpus collosum, cingulum, cerebral peduncle, corona radiata, internal capsule and external capsule. In control children only, FA of the bilateral superior fronto-occipital fasciculus showed a positive association with working memory ($p<0.05$, uncorrected).
Conclusions: In one of the largest samples studied with DTI and ASD, our findings highlight widespread atypical white matter in children with ASD that persists well into adolescence. Altered white matter structure was not limited to specific networks, and was observed primarily in the corpus callosum and thalamocortical fibres—tracts crucial for interhemispheric exchange and higher order information processing. Widespread white matter impairment in ASD is consistent with the view that ASD is a disorder of generalized complex information processing. The relation between patterns of white matter integrity and specific aspects of cognition in ASD remains elusive.



Regions of reduced FA in children with ASD relative to control children. Red/yellow= significant voxels at p <0.01 TFCE-corrected. Mean FA skeleton overlaid in green.

41 **179.041** White Matter Microstructure Is Associated with Auditory and Tactile Processing in Children with and without Sensory Processing Disorder

***Y. S. Chang**, M. Gratiot, J. Owen, A. Brandes-Aitken, S. Desai, S. S. Hill, E. J. Marco and P. Mukherjee, University of California in San Francisco, San Francisco, CA*

Background: Sensory processing disorders (SPD) affect 5-16% of school-aged children, and can cause downstream deficits of intellectual and social development. While sensory processing differences are now widely recognized in children with autism, children with sensory deficits who do not meet autism criteria for language and social deficits remain virtually unstudied. In a previous, small-scale diffusion tensor imaging (DTI) study, we demonstrated that children with SPD have altered white matter microstructure primarily affecting the posterior cerebral tracts, which subserve basic sensory processing and integration. This altered microstructural integrity was further shown to correlate with parent report measures of atypical sensory processing.

Objectives: In this present study, we seek to investigate prior findings in a larger, mixed-gender cohort, and to further explore auditory and tactile in depth.

Methods: Whole-brain diffusion tensor imaging (DTI) with 64 directions and b=2000 s/mm^2 were acquired in 41 children with SPD (33M/8F), and 41 typically developing children (TDC) (28M/13F), all aged 8-12 years and matched for IQ and handedness. Maps of fractional anisotropy (FA), mean diffusivity (MD), and radial diffusivity (RD) were derived for each subject. Each map was then skeletonized and registered to the same space using tract-based spatial statistics, allowing for the calculation of voxel-wise statistics along the white matter skeleton. All voxel-wise statistics were performed with regression of motion. Group differences were assessed with nonparametric permutation testing, and corrected for multiple comparisons using threshold-free cluster enhancement. Sensory correlations with FA along the white matter skeleton were assessed using the parent report metrics of the Sensory Profile auditory and tactile scores, along with direct behavioral measurements of auditory and tactile processing, derived respectively from the Acoustic Index of the Differential Screening Test for Processing (DSTP) and the Graphesthesia subtest of the Sensory Integration Praxis Tests. In post-hoc analyses, general linear models were constructed to assess the confounding effects of group (TDC vs SPD), age, and gender for each of these sensory correlations.

Results: As in our prior work, significant posteriorly biased decreases of FA, and elevations of MD and RD, were found in the SPD cohort relative to TDC. There were robust correlations of FA with both parent report and direct measurements of tactile and auditory processing. However, for the parent report metrics, these correlations were heavily driven by group differences (TDC vs SPD), and regression lines of the metrics vs FA differed between TDC and SPD. In contrast, the DSTP and Graphesthesia correlations were most strongly driven by FA, with TDC and SPD mapping along similar regression lines. These results suggest that direct measurements of sensory processing map more closely to the underlying biology, as revealed by DTI, than their corresponding subjective report metrics.

Conclusions: To our knowledge, this work is the first to demonstrate a relationship between direct measurements of tactile and non-linguistic auditory function with white matter microstructural integrity -- not just in SPD, but also in typically developing children. We also confirm our prior DTI results demonstrating altered white matter microstructure in children with SPD in a larger mixed-gender cohort.

42 **179.042** White Matter Microstructure in ASD and ADHD: A DTI Study

ABSTRACT WITHDRAWN

Background:
Autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD) are neurodevelopmental disorders. Previous researches have shown high rate of ADHD comorbidity (30-50%) in individuals with ASD. According to the Diagnostic and Statistical Manual of Mental Disorders—5th edition (DSM-5), ASD and ADHD can be diagnosed together.

Structural and functional magnetic resonance imaging (MRI) has shown brain abnormalities in ASD and ADHD. Recent neuroimaging technique makes it possible to investigate white matter fiber structure using Diffusion Tenor Imaging (DTI). Not only the localized brain abnormality, but impaired structural brain connectivity are considered to be related the core feature of ASD and ADHD. However, there has been no neuroimaging research that investigated the white matter microstructure in ASD with ADHD.

Objectives:
The aim of the present study is to reveal the commonality and difference of white matter microstructure between ASD with and without ADHD.

Methods:
A total of 89 participated in this study; 41 ASD without ADHD (ASD-), 20 ASD with ADHD (ASD+), 28 Normal Controls (NC). Two medical specialists diagnosed ASD and ADHD according to DSM-5 criteria. All participants do not have mental retardation. All participants are adults (age > 20 years old). The three groups did not differ statistically in their chronological age and estimated IQ.

MRI scans were conducted using a 3.0 Tesla Siemens scanner. DTI data were processed using programs in the FMRIB Software Library (FSL) version 5.0. The FA map of each subject was calculated using the DTIFIT program implemented in FSL. TBSS (Tract-Based Spatial Statistics) was used for voxelwise statistical analysis. All FA data were normalized into a common space and averaged to create a mean FA image. FSL Randomise performed group comparison of FA maps. The statistical threshold was defined at $p < 0.0000001$ (uncorrected for multiple comparisons).

Results: The two disorder groups showed reduction of FA extensively in anterior corpus callosum (CC) compared to NC group. Several previous studies have found the lower FA of CC in both ASD and ADHD. This finding suggested reduced FA of CC in ASD regardless of ADHD comorbidity. Lower FA of bilateral superior longitudinal fasciculus (SLF) in ASD+ compared to ASD-. The SLF is a part of attentional network. Several previous studies have found lower FA of SLF in both ASD and ADHD. The finding suggested that the lower FA of SLF in ASD is contributed by ASD+, not by ASD-. The FA of right sagittal stratum including inferior longitudinal fasciculus (ILF) and inferior fronto-occipital fasciculus is lower in ASD- compared to ASD+. The ILF is considered to play important role in recognition of facial expressions. The finding suggested that there is some difference in the neural substrate of social disability between ASD- and ASD+.

Conclusions: Compared to NC, ASD+ and ASD- had lower FA in anterior CC. Between ASD+ and ASD-, FA value is different in some regions such as SLF and ILF. The present study suggested that the neural substrate of ASD- and ASD+ has some commonality and difference in the white matter microstructure.

Poster Session
180 - Early Development (<48 months)
11:30 AM - 1:30 PM - Hall A

43 **180.043** A New "Geopref Test" with Complex Social Stimuli

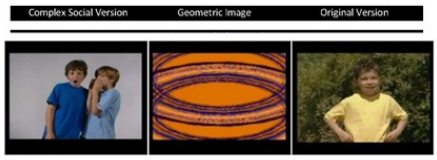
A. Moore[1], *C. Carter*[2], *D. Cha*[2], *S. Pence*[2], *A. Yousef*[3], *M. Wozniak*[3], *E. Courchesne*[2] *and K. Pierce*[2], *(1)University of California, San Diego, La Jolla, CA, (2)Neuroscience, UCSD Autism Center of Excellence, La Jolla, CA, (3)Neuroscience, University of California San Diego, La Jolla, CA*

Background:
There is increasing appreciation of autism as a highly heterogeneous disorder in terms of symptom profiles, outcomes, and most likely etiologies. Using eye-tracking technology we recently showed that a subset of ASD toddlers exhibit heightened visual fixation toward geometric, rather than social, images (Pierce et al. (2011, 2015)). It is unclear, however, if the effect identified in previous studies using the "GeoPref Test" was specific to the stimuli used, or would generalize across different stimuli. The current study evaluated the robustness of the Geometric Preference phenomenon identified previously by creating a new test, the "Complex-Social GeoPref Test" that varied the stimulus presentation total length, scene length, and complexity of social images. In this way we will be able to determine if eye-tracking technology can identify a specific ASD subtype that persists regardless of stimulus type.
Objectives:

1. To determine if our previously described phenomenon of increased fixation towards geometric images in a subset of ASD toddlers persists using a new stimulus set.
2. Examine the degree to which percent fixation on geometric images is related to ASD symptom severity.

Methods:
243 toddlers (71 ASD, 72 TD, 100 Non-ASD contrast) ranging in age from 12-48 months participated. Children were recruited primarily through the One-Year Well-Baby Check-Up (see Pierce et al., 2011). Once enrolled, children are evaluated periodically until they receive a final diagnosis at age 3. Each evaluation included the ADOS and Mullen, as well as eye-tracking. Eye-tracking data were collected while children viewed a 90-second video from 60cm distance on a 17" computer monitor using the Tobii T-120Hz system.
Results:
Differences were found in percent fixation on geometric images using an ANOVA across 6 diagnostic groups (F=12.88, P<.001), see Figure 1. Pairwise follow-up comparisons with Bonferroni correction revealed that the ASD group showed significantly greater fixation towards geometric images than other contrast groups (ASD vs TD and DD, p<.001; ASD vs other contrast groups, p<.05).
As we demonstrated in our previous studies, increased fixation on the Complex-Social GeoPref Test's geometric images as defined by > 69% fixation towards geometric images is associated with increased symptom severity, see Table 1.
Conclusions:
Debate and controversy regarding the replication of findings from the biological sciences and psychology have been common in recent years (Paschler & Wagenmakers (2012)). In contrast, the Geometric Preference effect has now been replicated multiple times in both direct, identical replication and in this conceptual replication with varied social stimuli, suggesting that toddlers with unusual visual attention profiles may represent a biologically stable, unique subtype. Future analyses will examine data from ASD children receiving multiple GeoPref tests that suggests that those with a consistent Geometric Preference may differ in clinical symptom severity compared to those with a consistent Social Preference. Experience dependent mechanisms play an important role during early development, and therefore toddlers with a persistently abnormal visual attention profile who prefer geometric images may potentially have a poorer prognosis than those who prefer social images.

Figure 1. (A) Sample images from each Geometric Preference Test. The geometric image is common to both versions.



(B) Scatterplot of 6 diagnostic groups showing individual and mean scores.

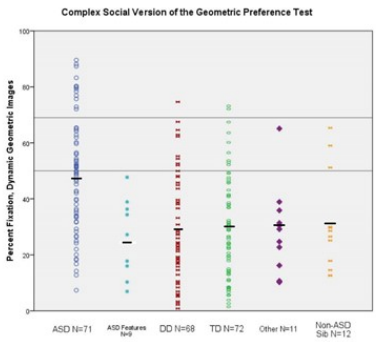


Table 1.

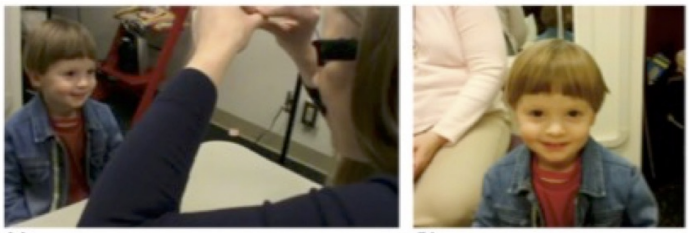
	ASD Geometric Responder (N=13), Mean (Std.Dev.)	ASD Social Responder (N=14), Mean (Std. Dev.)	Independent Samples T-test, P-value
Mullen Visual Reception T-score	36.2 (10.1)	37.0 (14.0)	NS
Mullen Fine Motor T-score	36.6 (12.6)	35.9 (12.6)	NS
Mullen Receptive Language T-score	20.8 (11.8)	31.6 (14.5)	P<.05
Mullen Expressive Language T-score	21.2 (12.1)	29.9 (14.3)	P=.1 (NS)
ADOS Social Affect score	15.9 (3.3)	12.3 (4.4)	P<.05
ADOS Restricted Repetitive score	3.8 (2.5)	3.3 (1.6)	NS
ADOS Total score	19.6 (4.5)	15.6 (4.1)	P<.05

44 **180.044** A Novel Method for Quantifying Eye-to-Eye Gaze during Naturalistic Social Interactions Finds Preliminary Differences Between ASD and TD Toddlers

S. R. Edmunds[1], *A. Rozga*[2], *Y. Li*[2], *L. V. Ibanez*[1], *E. A. Karp*[1], *J. M. Rehg*[2] *and W. L. Stone*[1], *(1)Department of Psychology, University of Washington, Seattle, WA, (2)Georgia Institute of Technology, Atlanta, GA*

Background: Monitor-based eye tracking studies indicate that young children with ASD show atypical patterns of attention to internal features of the face, particularly the eyes. These findings have not been replicated in the context of more ecologically valid live social interactions, owing largely to a reliance on coding gaze behavior from videos recorded by stationary room camcorders and use of "gaze to face" as a proxy for "gaze to eyes." Children's eye contact during social interactions was measured that by instrumenting their social partner with a pair of glasses that contain an outward facing (point of view, PoV) camera (Pivothead Kudu Black) in the nose bridge (Figure 1). Coding gaze based on the PoV video produces more reliable estimates of toddlers' looks to the partner's eyes (vs. the face in general) than coding based on videos from stationary camcorders (Edmunds et al., 2014).
Objectives: To compare patterns of gaze to and away from a social partner's eyes and face during a live play interaction in toddlers with ASD and typically developing (TD) toddlers. We hypothesized that toddlers with ASD would look less frequently to the adult's eyes and face and look away longer compared to TD children, and that more instances of gaze to eyes would be detectible using the PoV camera than the camcorders, as the PoV camera will more likely capture the toddlers' entire face and support more accurate gaze coding.

Methods: Seven toddlers with ASD (*M*=33.5 mos; *SD*=3.5 mos) and eight TD toddlers (*M*=34.6 mos; *SD*=6.0 mos) participated in a 5-minute structured interaction routine with an examiner wearing a PoV camera. Interactions were also recorded simultaneously by three tripod-mounted camcorders that captured different angles. Onsets and offsets of three categories of eye gaze—to eyes, face (not eyes), and away—were coded for the PoV and camcorder videos by separate pairs of coders who were blind to the toddlers' diagnostic status. Overall Kappas for frame-level agreement were *k*=.67 for the PoV camera and *k*=.49 for the camcorders (Figure 2a).
Results: Multivariate ANOVAS examined the effect of diagnosis on looks to eyes, face, and away as correlated dependent variables. As measured by the PoV camera, toddlers' rate of looks varied by diagnosis, $F(4,10)=4.55$, $p=.02$. ASD toddlers looked at the examiner's eyes and face less frequently than did TD toddlers, $F(1,14)=6.11$, $p=.03$ and $F(1,14)=16.44$, $p<.00$ respectively. Toddlers' average duration of looks away varied by diagnosis, $F(4,10)=4.70$, $p=.02$. ASD toddlers had longer average looks away from the examiner, $F(1,14)=22.21$, $p<.001$. In contrast, as measured by the camcorders, ASD and TD toddlers did not differ in their overall rate of looks or average duration of looks to the examiner's eyes (Figure 2b), face, or away.
Conclusions: The PoV camera, but not the camcorders, found differences in TD and ASD toddlers' eye-to-eye gaze during social interactions. This approach is unobtrusive, easily deployed in multiple settings, and cost-effective compared to monitor-based eye tracking. Future directions include replication with larger samples, examining use in natural settings, and developing automated coding of toddlers' gaze from PoV videos.



(a) (b)

Figure 1. Two different views of the same video frame. *(a)* View recorded by one of three cameras mounted on a tripod; *(b)* View recorded by camera embedded in the glasses worn by the interacting adult.

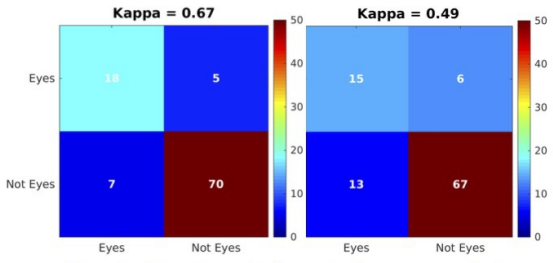


Figure 2a: Kappa for coders' frame-level agreement on looks to eyes versus other areas is higher using the PoV camera (left) compared to traditional camcorders (right).

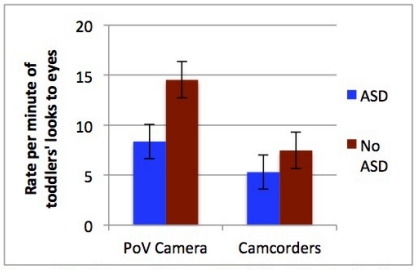


Figure 2b: Rate per Minute of Toddlers' Eye-to-Eye Gaze

45 **180.045** Accuracy of Parental Report As Compared to Standardized Assessment: A Comparison of the Ages and Stages to the Mullen and ADOS

T. Hamner[1], *C. Klaiman*[2] *and S. Richardson*[1], *(1)Marcus Autism Center, Atlanta, GA, (2)Emory University, Atlanta, GA*

Background: The need for early detection of developmental delays in young children is critical. Early intervention is key for children with ASD where it has been shown to alter developmental trajectories and improve lifetime outcomes (Orinstein et al., 2014; Zwaigenbaum et al., 2015). There is a push for effective, parental self-report screening measures to help identify developmental delays and ASD. One of the more commonly used measures is the Ages and Stages Questionnaire (ASQ). However, previous research has revealed mixed findings regarding the ASQ as a developmental screener with some studies showing poor agreement with the Bayley Developmental Scales (Veldhuizen et al., 2014) and others, especially across cultures, finding the ASQ to be a strong predictor of developmental delays (Juneja et al., 2011). Additionally, there is a need to evaluate the use of this measure for children with ASD.
Objectives: The goal of this study is to assess the relationship between the ASQ and standardized assessments for children with ASD.
Methods: 51 children (47 males) who received an initial ASD diagnosis following evaluations conducted as part of a research study. All children were between the ages of 16-43 months (mean = 29.71) and referred based on parent concerns and/or recommendation from pediatrician or early interventionist. Parents completed the ASQ and children were evaluated with the Mullen Scales of Early Learning and the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2).
Results: ASQ scales were significantly correlated with T-scores from the Mullen, with significant associations between the ASQ problem solving scale and Mullen visual reception, fine motor, expressive, and receptive language domains (*r's*=.53, .49, .46, and .64 respectively, all p's<.01). The ASQ fine motor scale was associated with Mullen visual reception, fine motor, and expressive language domains (*r's*=.29, .28, and .35 respectively, all p's<.05). The ASQ communication scale was associated with Mullen visual reception, fine motor, receptive, and expressive language domains (*r*=.54, .32, .68 and.70 respectively, all p's<.05). ASQ social-emotional scale was associated with Mullen visual reception, fine motor, receptive and expressive language domains (*r*=.42, .33, .36, .45 respectively, all p's<.01). The ASQ communication scale was negatively correlated with the ADOS social affect score (r=-0.39, p<.05) and ADOS total score (r=-.83, p<.05).
Conclusions: Findings reveal that the ASQ is a good predictor of delays in development for children with ASD. Results provide support for the use of parent-report measures in identifying children requiring referrals for evaluations and parent perceptions regarding their children's skill level in the specific domains of nonverbal problem solving, fine motor, and communication skills. The social-emotional scale was also associated with Mullen performance; however, this scale did not predict specific autism symptomatology on the ADOS. Instead, the communication scale of the ASQ is indicative of social and communication ASD red flags. Practitioners are encouraged to pay close attention to the communication scale when considering whether a referral for an ASD specific evaluation is necessary. Overall, the ASQ appears useful to identify developmental delays but an autism specific screener is also indicated given the more limited associations with the ADOS.

46 **180.046** Action Prediction in Infants at-Risk for Autism: Neural and Behavioral Findings

R. Braukmann[1,2], *C. van den Boomen*[3,4], *N. M. Munsters*[3,4], *H. Bekkering*[2], *J. K. Buitelaar*[1] *and S. Hunnius*[2], *(1)Radboud University Medical Centre, Nijmegen, Netherlands, (2)Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behaviour, Nijmegen, Netherlands, (3)Utrecht University, Utrecht, UT, Netherlands, (4)University Medical Centre Utrecht, Utrecht, Netherlands*

Background:

Recently, theoretical approaches on the underlying mechanisms of ASD suggest that abnormalities in forming and updating predictions about the environment might underlie several of the diverse deficits (van der Cruys et al.,2014; Pellicano & Burr,2012). The ability to predict others' behavior is important for social functioning, and research has indeed demonstrated prediction difficulties in ASD. Not only do children with ASD show behavioral impairments in action prediction (Zalla et al.,2010; Fabbri-Destro et al.,2009), abnormalities of the neural representation of others' actions in the motor system involved in forming predictions have also been reported (Cattaneo et al.,2007; Obermann et al.,2005).
Objectives:
Difficulties in predicting complex action sequences in older individuals with ASD might arise through abnormalities during the early development of action processing. In this study, we investigated whether deficits in processing and prediction can be observed already in infants at risk for ASD, by assessing action prediction abilities longitudinally in infants at high (HR) and low (LR) familial risk. From six months onwards, typically developing (TD) infants show more predictive eye movements towards the goal of usual compared to unusual everyday actions (Hunnius & Bekkering,2010). In addition, differential activation of the neural motor system during observation of usual compared to unusual actions in 12-month-old TD infants indicates that the infant motor system is already involved in action processing and forming predictions about observed actions (Stapel et al.,2010). In this study, we implement comparable experimental designs to study potential prediction abnormalities in HR infants.
Methods:
Action prediction was studied using eye-tracking at 10 months and EEG at 14 months. In both experiments, infants were presented with videos displaying an actor using everyday objects either in usual or unusual ways (Figure 1). In Experiment1, we used eye-tracking to assess the participants' ability to predict the action goal. In Experiment2, we investigated the infants' motor system response to the observed actions using EEG.
Results:
Preliminary eye-tracking data from 20 participants (15HR, Experiment1) suggests that HR infants perform similar to controls (Figure 2A). Both groups show predictive eye movements, anticipating more frequently to the correct goal location. Preliminary EEG data from 6 HR participants (Experiment2) suggests motor system activation during both action observation conditions (Figure 2B). Whereas previous research in TD infants suggests enhanced activation for unusual compared to usual actions (Stapel et al.,2010), in the HR group of the current study a conditional difference seems to be small or absent. Data collection is ongoing and results from a complete sample will be presented at the conference.
Conclusions:
Our preliminary data suggest that HR infants show similar behavioral signatures of predicting goal-directed actions as controls. In addition, their motor system is activated during action observation, but differential activation for the unusual compared to usual actions currently seems to be small or absent. If these observations hold in the complete sample, the dissociation of behavior and neural processing implies that while HR infants are able to predict simple goal-directed actions behaviorally, the neural processes associated with the formation of predictions are impaired.

Figure 1. Illustration of the experimental stimuli. Participants were presented with videos of a female actor manipulating everyday objects (a phone or a cup) either in a usual (i.e. moving the phone to the ear/ the cup to the mouth; top) or in an unusual way (i.e. moving the cup to the ear/ the phone to the mouth; bottom).

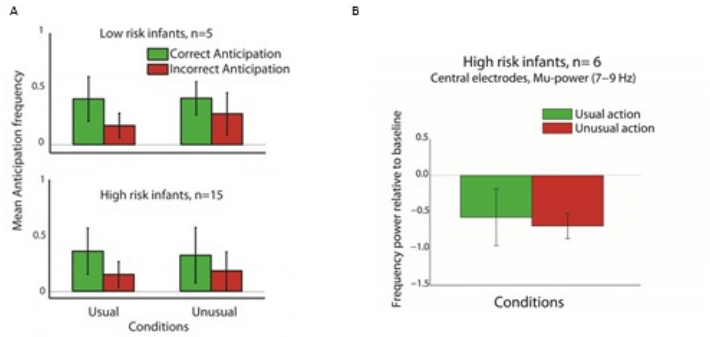


Figure 2. Preliminary data suggest that the groups of HR and LR infants performed similar in Experiment 1 (A). All infants seem to predict the correct goal location more frequently in both conditions. In Experiment 2 (B), HR infants show motor system activation during action observation, indicated by a suppression of central mu-frequency power for both conditions compared to baseline (see Marshall & Meltzoff, 2011). Differences between the two conditions seem to be small or absent.

47 **180.047** Adaptive Functioning in High-Functioning and Low-Functioning Preschool Children with Autism Spectrum Disorders

I. C. Chen *and C. C. Wu, Department of Psychology, Kaohsiung Medical University, Kaohsiung City, Taiwan*

Background:
In past studies, few studies examined the adaptive functioning in high-functioning and low-functioning preschool children with autism spectrum disorders (ASDs).
Objectives:
This study examined adaptive functioning of children with ASDs using the Adaptive Behavior Assessment System-II (ABAS-II) which is based on Taiwanese norm. Specific purposes included examination of (1) the difference of adaptive functioning between children with high-functioning autism spectrum disorders (HFASDs), with low-functioning autism spectrum disorders (LFASDs) and with developmental delay (DD); (2) the patterns of adaptive functioning in children with HFASDs, with LFASDs, and with DD.
Methods:
The participants, aged 2-5, were assigned into three groups according to Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR) and Mullen Scale of Early Learning. The ABAS-II was used to assess each child's adaptive functioning, including Conceptual, Socialization, and Practical domains. Children were diagnosed with ASDs according to DSM-IV-TR, whose developmental quotient (DQ), mental age (MA) divided by chronological age (CA), was above .70, belong to HFASDs group (n = 70) in contrast to DQ below .70 were in LFASDs group (n = 54). And, children whose DQ was below .70, but weren't diagnosed with ASDs were assigned to DD group (n = 39). Children in LFASDs group and DD group were matched on CA, MA, and DQ.
Results:
Results indicate that, first, in Socialization and Practical, children with LFASDs had significant deficits compared to children with DD and with HFASDs; In Conceptual, children with LFASDs and with DD were rated significantly lower than children with HFASDs, but no difference between children with LFASDs and with DD whose DQ were

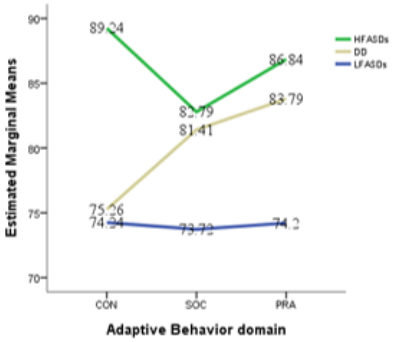
matched. Second, there were interaction effects between the three groups and the three adaptive domains. Socialization is the relative weakness in children with HFASDs in contrast to all three adaptive domains has significant deficits in children with LFASDs. In addition, Conceptual was the relative weakness in children with DD.
Conclusions:
The results of this study provide us more details of adaptive functioning of preschool children with ASDs or DD, including both within-subject and between-subject profiles by using culture-appropriate scales. It's not surprising that children with ASDs had lower scores on Socialization domain, considering social interaction is the core deficit of ASDs. Besides, we found that caregivers had tended to give the relatively lower scores on ABAS-II if their children had a poor cognitive ability. The results showed on LFASDs and DD groups. However, children with LFASDs got poor adaptive behavior scores on all of the three domains, but DD group got a significant lower score on Conceptual. It reflects that the main deficit of children with DD is cognitive ability, so that caregivers scored lower on Conceptual domain which is more relevant to cognitive ability. These results would be helpful for classifying ASDs in a more precise way. Furthermore, it provides more information to early diagnosis and designing early interventions.

Table 1 Demographic characteristic and adaptive functioning of the three groups

	HFASDs (n = 70)	LFASDs (n = 54)	DD (n = 39)	F	*Post hoc* (Tukey HSD)
CA (months)					
Mean (SD)	37.76(5.00)	35.69(6.20)	36.41(5.95)	2.14	
Range	25.00-47.00	26.00-46.00	25.00-47.00	(.121)	
MA (month)					
Mean (SD)	33.44(6.97)	20.52(5.36)	22.72(4.31)	83.86***	LFASD < HFASD
Range	20.00-53.25	11.50-29.25	13.50-32.75	(.000)	DD < HFASD
DQ					
Mean (SD)	.88(.12)	.58(.11)	.62(.06)	147.06***	LFASD < HFASD
Range	.71-1.20	.30-.75	.45-.70	(.000)	DD < HFASD
CON					
Mean (SD)	89.24(14.04)	74.24(14.25)	75.26(11.60)	23.10***	LFASD < HFASD
Range	56.00-141.00	43.00-107.00	49.00-107.00	(.000)	DD < HFASD
SOC					
Mean (SD)	82.79(15.92)	73.72(13.68)	81.41(15.57)	5.90**	LFASD < HFASD
Range	45-139	46-98	52.00-118.00	(.003)	LFASD < DD
PRA					
Mean (SD)	86.84(16.17)	74.20(13.77)	83.79(13.89)	11.40***	LFASD < HFASD
Range	49-136	44-108	49.00-121.00	(.000)	LFASD < DD

*p < .05, **p<.01, ***p < . 001

Figure 1 The patterns of adaptive behaviors in the three groups



48 **180.048** Agreement Between Early Intervention Staff Impressions and Screening Tools for Autism Spectrum Disorder

N. Rasuratnam[1], *M. Penner*[2], *C. L. Saul*[3], *J. A. Brian*[4] *and W. Roberts*[5], *(1)ISAND, Scarborough, ON, Canada, (2)Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada, (3)Community and Health Services, York Region Early Intervention Services, Newmarket, ON, Canada, (4)Bloorview Research Institute, Toronto, ON, Canada, (5)University of Toronto, toronto, ON, Canada*

Background:
Early diagnosis of autism spectrum disorder (ASD) is important so that early intervention (EI) can begin as soon as possible. Early identification of ASD allows for earlier access to EI, during a time when neural plasticity is at its peak. Further research is needed to optimize identification of children with possible ASD through EI systems, including evaluating the role of standardized screening tools.
Objectives:
The objective of this study was to determine the agreement between ASD-targeted screening tools and the clinical impressions of EI clinicians.
Methods:
This study was carried out through York Region Early Intervention Services (YREIS), in Ontario, Canada. The screening tools used were the Modified Checklist for Autism in Toddlers – Revised with Follow-Up Interview (M-CHAT-R/F) and the CSBS DP Infant-Toddler Checklist (ITC). 235 packages containing the ASD-specific screening tools were distributed to families through YREIS' intake staff according to three age groupings: children 9-15 months received the ITC, children 16-24 months received the ITC and MCHAT-R/F, and children 25-30 months received the MCHAT-R/F. The MCHAT-R/F questionnaires were scored and those over the cut-off (score of 3 or higher) underwent the follow-up interview. During the intake process, the EI clinician (blinded to the results of the questionnaire) also filled a clinical opinion sheet indicating whether they suspected the child had ASD. The consistency between the EIS clinical opinions and the screening tools were measured using a kappa statistic.
Results:
Of the 235 distributed packages, 57 were returned back to YREIS (24% response rate). Of the 57 packages, 51 were completed. YREIS clinicians identified concerns about ASD in 25 of the 51 participants (49%). Of the completed MCHAT-R/F's, 11 of 39 (28%) were positive (indicating concern), compared with 14 of 26 ITC questionnaires (54%). In the comparison between clinical opinion and the ITC in 26 participants, kappa was calculated to be 0.429, demonstrating fair agreement. Agreement was calculated for the MCHAT-R only and clinical opinion in 46 participants, which showed a kappa of 0.136 (slight agreement). The kappa for the full M-CHAT-R/F (39 participants) and clinical opinion was 0.238 (fair agreement). The agreement between one positive screening tool and clinical opinion (51 participants) was 0.280, demonstrating fair agreement.
Conclusions:
The results of this study show a disappointing level of agreement between EI staff and ASD-targeted questionnaires. There was a higher rate of concern in the EI staff when compared with the M-CHAT-R/F. The ITC has lower specificity for ASD, which may explain the higher proportion of identified concerning cases when compared with the M-CHAT-R/F. These results suggest that combined use of clinical opinion and screening tools is likely to maximize the proportion of cases of suspected ASD identified through EI intake processes, with a trade-off of lower specificity.

49 **180.049** Analysis of Alpha Power in 9-Month Old Infants at High-Risk of ASD

A. Miquelajauregui*, C. Ponting, A. Marin, J. Frohlich and S. S. Jeste, Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA*

Background: Previous studies found differences in frontal alpha waves characterizing infants at high-risk (HR) for ASD when compared to low-risk (LR) age-matched groups. In particular, decreased frontal alpha power and altered hemispheric asymmetry have been described during the first year of life (Tierney et al., 2012; Gabard-Durnam et al., 2015). Interestingly, the developmental trajectories of alpha asymmetry proceeded in opposite directions between groups: whereas LR infants showed an initial relative right frontal power at 6 months, HR infants presented left frontal asymmetry initially, decreasing with age at 12 and 18 months (Gabard-Durnam et al., 2015).
Objectives:
Given the differences described for alpha bandwidth between HR and LR infants, we aimed to examine alpha power at 9 months, around the time when alpha asymmetry shift is predicted to take place. We thus asked whether alpha power differed between HR and LR groups in frontal and posterior regions.
Methods:
Resting EEG data at 9 months of age were collected from HR infants (n=25; F: 37.5%; M: 62.5%; including 4 ultra high-risk subjects, defined as having more than one sibling with ASD), and LR infants (n=16; F/M: 50%) using high-density 128-hydrogel nets (EGI inc). In NetStation, data were filtered at 1–50 Hz, divided into 1 sec. segments and re-referenced using an average reference. Segments containing artifacts were visually inspected and removed from the analysis. Regions of interest (ROIs) were defined as

described before (McEvoy et al. 2015). We calculated absolute alpha power at 6-9 Hz, a well-defined band for infant alpha EEG (Stroganova et al., 1999; Marshall et al., 2002).
Results:
Absolute alpha power was analyzed at frontal and posterior locations. Independent samples t-test revealed a slight trend towards decreased frontal alpha in HR compared to LR (mean ± SEM: 11.14 ± 1.3 vs.12.96 ± 2.0, respectively; p=0.43, t=0.80), with no significant differences at posterior sites (HR: 14.12 ± 1.4, LR:13.60 ± 1.9; p=0.72, t=0.36). Although frontal hemispheric asymmetry scores (right-left) were similar (HR: -0.25 ± 0.73; LR: -0.75 ± 1.6; p=0.92, t=0.11); posterior-frontal asymmetry scores showed highly significant differences (HR: 2.97 ± 0.56; LR: 0.65 ± 0.66; p=0.013, t=2.60). In spite of being limited by our sample size, UHR infants generally followed the trend of their assigned group (HR).
Conclusions:
Overall, our data suggest that alpha power is a useful indicator of ASD risk in infancy. The significant reduction in posterior-frontal scores, together with the trend towards reduced frontal alpha, indicate that relevant rearrangements in the distribution of alpha occur at this critical developmental age.

50 **180.050** Assessment of Intelligence: A Comparison of Intellectual and Adaptive Functioning in Preschool Autistic Children

D. Girard[1], *V. Courchesne*[2], *E. Danis*[1], *M. Descamps*[1] *and I. Soulières*[1], *(1)University of Quebec in Montreal, Montreal, QC, Canada, (2)University of Montreal, Montréal, QC, Canada*

Background: DSM-5 autism diagnosis must specify whether there is an accompanying intellectual deficiency, but few intellectual tests are available for children under age 3. Available tests to assess cognitive development mostly consist of developmental scales that may not accurately represent the potential of young autistic children, whose developmental paths are highly atypical. Indeed, school-aged autistic children perform differently depending on the test used to assess their intelligence (Dawson et al., 2007) and present a discrepancy between intelligence and adaptive level (Charman et al., 2011). Typically used tests in preschool years are Vineland Adaptive Behavior Scales (VABS) and Mullen Scales of Early Learning (MSEL). The differences and resemblances in the performance of ASD preschoolers on those two tests is not well documented.
Objectives: 1) To compare performance of young autistic (ASD), developmentally delayed (DD) and typically developing (TD) children on MSEL and VABS, respectively used as indicators of IQ and adaptive level in young autistic children. 2) To examine the difference between the similar subscales in VABS and MSEL in each group (e.g. receptive language, expressive language and fine motor subscales). 3) To explore the MSEL subscale profile in each group.
Methods: Recruitment is ongoing, and the goal is to reach groups of 40 ASD, 40 DD and 40 TD. To date, the sample includes 29 ASD, 12 DD and 31 TD children aged 18 months to 5 years old. No exclusion criteria were applied in the clinical groups.
Results: MSEL global score was significantly higher than VABS global score in autistic (p<.001) and DD (p<.01) children, but not in TD children (p=.211). As expected, ASD and DD children performed significantly lower than typical children on both tests (p<.001). On expressive language subscales, performance on MSEL was significantly lower than performance on VABS in ASD (p<.001) and DD children (p<.05), but not in TD children (p=.573). On receptive language subscales, there was a main effect of Test (p<.01), VABS score being significantly higher than MSEL score. There was also a main effect of the group, ASD and DD children scoring lower in receptive language than typical children (p< .001). Finally, ASD (p<.001) and DD (p<.05) children performed significantly lower on MSEL subscale assessing fine motor abilities than on the corresponding VABS subscale. In MSEL, visual reception scores were significantly higher than the three others in the ASD group, while there was no significant difference among subscales in the TD group.
Conclusions: These preliminary results indicate that intellectual potential can be judged very differently depending on the type of test used in preschool children with developmental delays and/or ASD. Clinical groups performed better on MSEL compared to VABS global scores, but the reverse when comparing similar subscales from the two tests (receptive and expressive language, and fine motor abilities). This suggests that the information reported by the caregiver may differ substantially from performance in a formal evaluation setting. Hence, the two assessment methods (self-reported vs. observed) are both important and should be interpreted with prudence, especially in preschool children with atypical development.

51 **180.051** Atypical Relationship Between Anxiety and Approach-Withdrawal Behavior in Young Children with Autism

H. J. Nuske[1,2], *D. Hedley*[2] *and C. Dissanayake*[2], *(1)Children's Hospital of Philadelphia, Philadelphia, PA, (2)Olga Tennison Autism Research Centre, La Trobe University, Melbourne, Australia*

Background:
Prevalence rates of anxiety disorders in children with autism are much higher than in typically developing children. There is also significant symptom overlap between the anxiety and autism disorders, for example, in social withdrawal and avoidant behavior.
Objectives:
Here we attempt to disentangle the unique contribution of anxiety to behavioral response to threat by examining approach and avoidance/withdrawal behavior in the context of mildly aversive social and non-social stimuli, in children with and without autism. We hypothesized that children with autism would exhibit more avoidant behavior in response to social, but not non-social aversive stimuli, compared to typically developing children. We also hypothesized an interaction between anxiety symptoms and stimulus, such that children with higher levels of anxiety would respond similarly to both social and non-social stimuli.
Methods:
A total of 70 children aged 2-4 years participated in our study, with 41 children with autism (32 M) and 29 typically developing controls (22 M). Results are from the first videos coded (by coders blind to diagnostic group): 12 children with autism and 15 typically developing children (presentation will include analyses of entire group). Social and non-social approach-withdrawal was assessed using the Stranger task of the Laboratory – Temperament Assessment Battery (LabTAB) (a 'stranger' enters the room and interacts with the child) and the Unpredictable Mechanical Toy task of the LabTAB (battery-operated toys are presented to the child). Total time (in seconds) that children were engaged in proximity-related behavior (time spent approaching vs. avoiding the stranger and toys) was coded, as was the total time (in seconds) that children attended to vs. away from the stimuli. We created two approach-avoidance indices by determining the ratio of time (seconds) spent approaching vs. avoiding the stimulus and looking at vs. away from the stimulus (i.e., we calculated separate proximity and attention indices). A low index value (less than 50) indicated a relatively greater proportion of time engaged in withdrawal behavior/gaze aversion and a high index value (greater than 50) indicating a relatively greater proportion of time engaged in approach behavior/stimulus attention. Anxiety symptoms were assessed with the Early Childhood Inventory-5.
Results:
Proximity Index. As predicted, children with autism exhibited similar patterns of approach vs. avoidant behavior as did the control children in the non-social condition (p=0.19, η^2=0.07), and increased avoidance in the social condition (p<0.01, η^2=0.40) (see Figure 1).
Attention Index. Children with autism looked less to the stimuli than the typically developing group overall, $F(1, 26)= 7.47$, p =.01, η^2 =.23 and showed more gaze avoidance with social than non-social stimuli (p< .001, η^2= .62) (Figure 2). Interestingly however, higher symptoms of Generalized Anxiety Disorder in the autism group were marginally related to *increased* attention in the social condition (r= .55, p= .07) a pattern not seen in the typical developing children (r= -.48, p= .17).
Conclusions:
These preliminary results suggest an atypical relationship between anxiety and socially-directed attention in autism, indicating a pattern of vigilance in this group not seen in the typical children (pending final analyses).

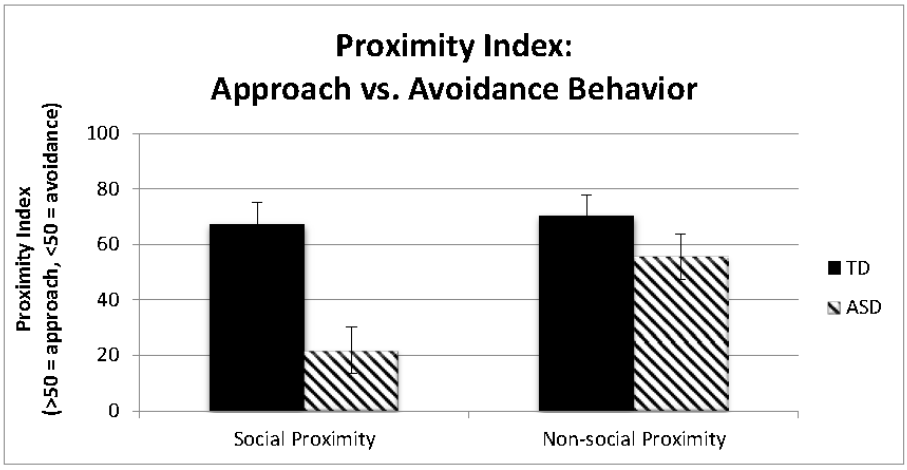


Figure 1. Proximity towards or away from social and non-social anxiety provoking stimuli for children with and without autism (higher scores signify increased proximity to the stimulus). Error bars = standard error.

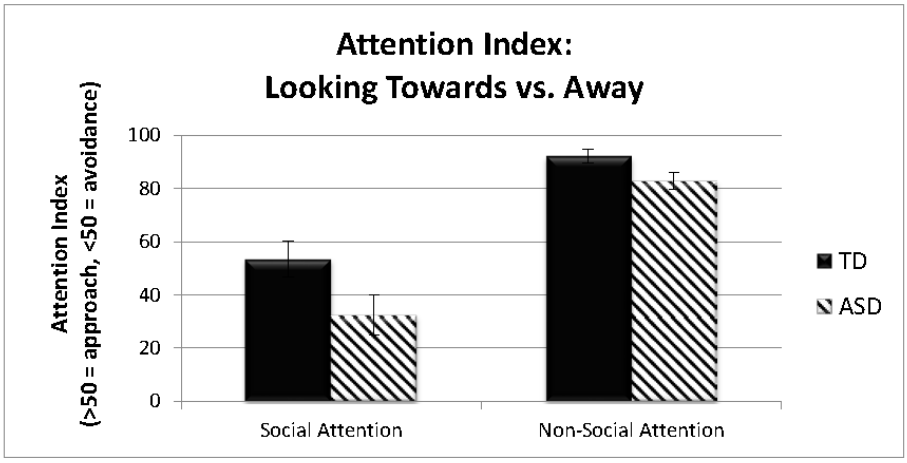


Figure 2. Attention towards or away from social and non-social anxiety provoking stimuli for children with and without autism (higher scores signify increased attention to the stimulus). Error bars = standard error.

52 **180.052** Atypical Visual Attention and Autism Severity in Infants at High Risk for Autism Spectrum Disorders

***D. Reisinger**, A. Brewe and J. E. Roberts, Psychology, University of South Carolina, Columbia, SC*

Background: Early visual attention control is a foundational developmental skill important for social engagement in infancy across typical and clinical populations. Evidence suggests that individuals with Autism Spectrum Disorders (ASD) have a primary impairment in social functioning shown to manifest in early infancy with reduced eye contact, atypical gaze behaviors, and atypical attention disengagement (Elsabbagh, 2013). Furthermore, developmental changes between the ages of 6 to 12 months in their disengagement of visual attention may cause longer attention shifts that has been shown to predict later ASD diagnoses (Ibanez et al., 2008). Infants with fragile X syndrome (FXS) and infants with an older sibling diagnosed with ASD (ASIBs) are at high risk for developing ASD; thus, investigating early deficits in visual attention can help characterize the infant phenotype of FXS and ASIBs and serve as a potential prognostic indicator of ASD risk.
Objectives: Characterize the relationship of initial latency to disengage from a non-social stimulus and frequency in attention shifts across FXS and ASIBs at 12 months of age and the potential predictive value of these attention patterns to ASD severity at 24 months.
Methods: Participants included infant males with FXS (n=13), ASIBs; n=26), and a typically developing group (TD; n=18) assessed at 12 and 24 months of age. A toy play epoch from the Laboratory Temperament Assessment Battery (LabTAB; Goldsmith & Rothbart, 1996) reflected duration of attention to a social stimulus (mother/examiner), initial latency to disengage attention from the toy, and frequency of visual shifts in attention to the non-social stimuli (e.g., shifts away and to the toy). Behaviors were coded

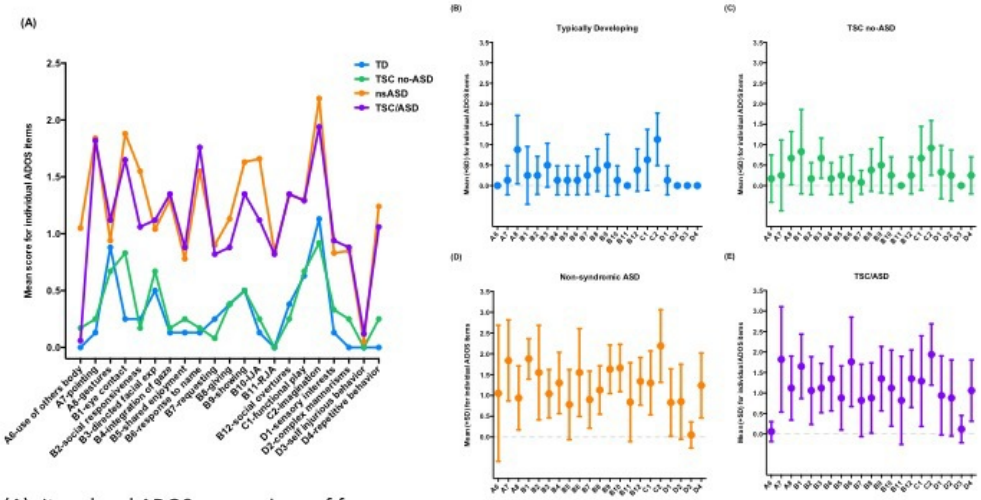
offline with a kappa of > 0.80. The Mullen controlled for developmental level, and the autism severity score from the Autism Diagnostic Observation Schedule-2 at the 24-month assessment represented autistic behavior.
Results: Developmental level was included in all models. No group differences were found in the duration of gaze to the social stimuli, $F(2,53)=2.48$, $p=0.09$, partial $\eta^2= 0.09$, or in their latency to disengage from the non-social stimulus, $F(2,53)=1.84$, $p=0.17$, partial $\eta^2= 0.06$. Group differences were found in attentional shifts, $F(2,53)=5.88$, $p=0.005$, partial $\eta^2= 0.20$, indicating infants with FXS had less attentional shifts ($M=8.52$, $SD=2.06$) than infant ASIBs ($M=16.81$, $SD=1.35$) and TD infants ($M=16.79$, $SD=1.56$). No differences were found between ASIB and TD infants ($p>0.05$). Regression analyses indicated that attention to the social stimuli predicted later ASD severity, $F(2,23)=3.46$, $p=0.04$, $R^2 = 0.16$ while latency to disengage did not predict later ASD severity, $F(2,23)=2.23$, $p=0.13$, $R^2=0.09$. A trend was evident for attentional shifts predicting ASD severity, $F(2,23)=3.18$, $p=0.06$, $R^2=0.15$. No group effects emerged for these regressions.
Conclusions: Results suggest that infants with FXS had less attention shifts than both ASIB and TD infants. Furthermore, our results support that decreased attention to social stimuli at 12 months was associated with autism symptoms at 24-months-of-age across groups. These findings suggest that atypical visual attention may be a phenotypic feature for infants with FXS and ASIBs and highlight the potential value of visual attention as a prognostic indicator of autism risk in these populations.

53 **180.053** Autism Symptoms Profiles in Toddlers with Tuberous Sclerosis Complex

S. S. Jeste[1], *K. J. Varcin*[2], *G. Hellemann*[3], *A. Gulsrud*[4], *C. Kasari*[5], *M. Sahin*[6], *J. Y. Wu*[7] *and C. A. Nelson*[8], *(1)Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA, (2)Harvard Medical School, Boston Children's Hospital, Cambridge, MA, (3)Psychiatry and Biobehavioral Sciences, UCLA Center for Autism Research and Treatment, Los Angeles, CA, (4)UCLA Semel Institute for Neuroscience & Human Behavior, Los Angeles, CA, (5)University of California Los Angeles, Los Angeles, CA, (6)Department of Neurology, Boston Children's Hospital, Boston, MA, (7)UCLA, Los Angeles, CA, (8)Boston Children's Hospital/Harvard Medical School, Boston, MA*

Background: TSC is one of the most commonly occurring single-gene disorders associated with ASD, with rates of ASD in TSC approaching 60% (Bolton, 2002; Jeste, 2008). Given the high rate of ASD in TSC and the fact that TSC is often diagnosed in utero or in early infancy (Datta, 2008) prior to the onset of social communication delays, TSC has been considered a model system for understanding mechanisms underlying ASD (Tsai, 2012; Tye, 2013; Davis, 2015). However, the specific phenotypic profile of ASD in TSC and the extent to which it converges with non-syndromic ASD has not been well established (Moss, 2009; Van Eeghen, 2013). Moreover, given our findings of non-verbal cognitive function predicting ASD in infants with TSC (Jeste et al, 2014), we hypothesized that a distinctive autism symptom profile would emerge in TSC characterized by non-verbal communication impairments and global developmental delay.
Objectives: To determine the extent to which deficits associated with ASD in TSC overlap with those in toddlers with non-syndromic ASD by examining item-level symptom profiles from a play-based diagnostic measure of ASD (the Autism Diagnostic Observation Schedule [ADOS]) and, second, to examine the clinical characteristics of toddlers with TSC and ASD by comparing cognitive function and epilepsy severity between toddlers with and without an ASD diagnosis.
Methods: This is the endpoint analysis from the first longitudinal investigation of autism risk factors in infants with TSC. Measures included the Autism Diagnostic Observation Schedule (ADOS), the Mullen Scales of Early Learning (MSEL), and for the TSC group, clinical epilepsy variables. Four groups were compared for the primary analysis: TD, TSC/no ASD, TSC/ASD, nonsyndromic ASD. A repeated measures analysis of variance (ANOVA) was performed with the between subjects factor of group and within subjects factors of each ADOS item in the social communication and repetitive behavior/restricted interest domains. Within TSC group comparisons on epilepsy characteristics and cognitive domains were performed using independent samples t tests.
Results: Children with TSC and ASD demonstrate a profile of social communication impairment that, at the behavioral level, has almost complete convergence to that of children with non-syndromic ASD. There were no individual markers that distinguished the two groups. This convergence was observed despite the high comorbidity between ASD and cognitive impairment in the TSC group. Within the TSC group, although there were trends towards greater seizure severity in those children with TSC/ASD, there were no statistically significant differences in epilepsy characteristics between those with and without ASD.
Conclusions: This study supports the clinical diagnosis of ASD in young children with TSC and demonstrates remarkable convergence of autism symptoms between TSC/ASD and non-syndromic ASD, despite greater cognitive impairment in children with TSC. Our results necessitate a study of early intervention in toddlers with TSC, with treatment strategies targeting social communication function as well as broader developmental domains, before the onset of autism symptoms.

Item level comparison of ADOS scores across groups
TD, TSC/no ASD, TSC/ASD, ns ASD



(A) Item level ADOS comparison of four groups
(B) TD group (with SD)
(C) TSC/no-ASD (with SD)
(D) Non-syndromic ASD (with SD)
(E) TSC/ASD (with SD)

54 **180.054** Behavioral Indicators of Social Fear in Preschool-Aged Children with ASD and Siblings of Children with ASD

A. L. Hogan-Brown*, J. Scherr and J. Roberts, Psychology, University of South Carolina, Columbia, SC*

Background: Social anxiety is one of the most common comorbidities of autism spectrum disorder (ASD), with at least 20% of children with ASD meeting diagnostic criteria for social anxiety disorder (for review, see White et al., 2009). Though there is some evidence that social anxiety develops in early childhood in both typically developing children and children with ASD (Davis et al., 2011), very few studies have sought to characterize early behavioral indicators of social anxiety in young children with ASD. Because elevated symptoms of social anxiety are associated with poorer social and academic outcomes in ASD as well as typical populations, identifying early behavioral indicators of social anxiety (e.g., social fear) is of critical importance for early treatment of anxiety symptoms and optimization of outcomes. This study examined social fear in preschool-aged children with ASD and typically developing controls.
Objectives: To examine social fear in preschool-aged children with ASD and younger siblings of individuals with ASD, contrasted with typically developing controls.
Methods: The study included 75 children (24 ASD, 10 siblings without ASD, and 41 TD), aged 23 to 70 months. The Stranger Approach epoch of the Laboratory Temperament Assessment Battery (Lab-TAB; Goldsmith & Rothbart, 1996) was used to elicit behavioral indicators of social fear (e.g., gaze). ASD symptoms were assessed concurrently using the Autism Diagnostic Observation Scale - 2 (ADOS-2) and/or the Childhood Autism Rating Scale (CARS). Results include the first videos coded (24 ASD and 41 TD).
Results: Preliminary results indicated that groups differed on avoidant gaze (i.e., averting gaze away from the stranger), $p < .05$. More specifically, children with ASD

demonstrated more avoidant gaze relative to TD controls. ASD symptom severity, as measured by the CARS, was correlated with proportion of time looking away from the stranger, $r = .33$, $p < .01$. In sum, findings suggest that early behavioral signs of social anxiety are present at elevated levels in children with ASD by the time they reach preschool age. These data are being extended by inclusion of additional participants, a high-risk sibling group, and integration of the ADOS-2.
Conclusions: Findings suggest that early behavioral signs of social anxiety (e.g. avoidant gaze behavior when approached by a stranger) are present at elevated levels in children with ASD by the time they reach preschool age.

55 **180.055** Behavioral Intervention Improves Social Communication Skills in Infants with Tuberous Sclerosis Complex

A. Gulsrud[1], *S. S. Jeste*[2], *N. Tu*[3], *S. Huberty*[4], *C. K. McCracken*[5] *and C. Kasari*[3], *(1)UCLA Semel Institute for Neuroscience & Human Behavior, Los Angeles, CA, (2)Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA, (3)University of California Los Angeles, Los Angeles, CA, (4)Psychiatry and Biobehavioral Sciences, UCLA Center for Autism Research and Treatment, Los Angeles, CA, (5)University of California, Los Angeles, El Segundo, CA*

Background: Tuberous Sclerosis Complex (TSC) is an autosomal dominant disorder strongly associated with cognitive impairment, behavioral disturbances, and autism spectrum disorders (ASD), with rates of ASD ranging from 30-60% (Jeste, 2008). Young children with TSC demonstrate specific delays in nonverbal cognition, visual attention and social communication, making these important targets for intervention (Jeste, 2014). Despite this developmental profile, no studies have investigated the efficacy of behavioral interventions in this population. The current pilot study integrates infants and toddlers with TSC ages 12-36 months into an existing early intervention study of the Joint Attention, Symbolic Play, Engagement and Regulation (JASPER), which targets social communication function in infants and toddlers at high risk for ASD (NIMH 2P50HD055784-06 PI: Kasari). The JASPER intervention (a) targets the foundations of social-communication (joint attention, imitation, play), (b) uses naturalistic strategies to increase the rate and complexity of social-communication and (c) includes parents as implementers of the intervention to promote generalization across settings and activities and to ensure maintenance over time.
Objectives: To examine the effects of the experimental intervention (JASPER) on the primary outcome of joint engagement and secondary outcome of parental strategy use in TSC infant-toddlers compared to IQ matched non-TSC infant-toddlers at risk for ASD.
Methods: Participants included five infant-toddlers with TSC and five IQ matched non-TSC infant-toddlers at-risk for ASD. Infant-toddlers were approximately 19 months old, with the TSC group consisting of slightly older children. Average IQ was 75.4 (sd=24.1) and 70.2 (sd=17.1), respectively for TSC and non-TSC children; $t(8) = -.39$, $p = .70$. All children received the experimental JASPER intervention. Parents and children came to UCLA twice per week for 2.5 hours per session across the 8 weeks. A 10 minute parent- child play interaction was videotaped prior to and immediately following an 8 week intervention. The total time in mutually shared play routines and parent use of JASPER strategies were coded.
Results: A paired samples t-test revealed that the TSC group increased in total time spent in jointly engaged play routines ($t(4) = -3.5$, $p = .03$) from pre to post treatment. Similarly parents improved in their implementation of the JASPER intervention by increasing their use of joint attention gesturing ($t(4) = -3.6$, $p = .02$) and the quality of their play routines ($t(4) = -4.3$, $p = .01$) across the intervention period. The non-TSC group showed similar findings in increased time in play routines ($t(4) = -2.6$, $p = .06$), and parents use of joint attention ($t(4) = -5.0$, $p = .01$), and overall quality of play routine ($t(4) = -9.5$, $p = .001$). The pre to post intervention change was in the same order magnitude for the TSC group compared to the non-TSC group at-risk for ASD.
Conclusions: This study provides preliminary evidence for the effectiveness of a targeted social-communication intervention for young children with TSC. Similar to children at-risk for ASD, children with TSC increased their time spent jointly engaged in play with their parents and parents were able to improve their use of social communication strategies. Replication with a larger sample sizes is underway that investigates both behavioral and biological markers of treatment outcome.

56 **180.056** Can Joint Attention Skills be Measured Reliably? Dutch Effect Study of Jasper-Training

M. E. Buruma[1] *and* ***E. M. Blijd-Hoogewys***[2], *(1)Infant team, INTER-PSY, Groningen, Netherlands, (2)Autism Team, INTER-PSY, Groningen, Netherlands*

Background:
Infants with autism spectrum disorders (ASD) have problems with social interaction, communication and play (Zwaigenbaum et al., 2013). Early intervention can lead to better long-term outcomes (Dawson et al., 2010). Early stimulation of joint attention (JA) skills, in particular, is associated with better language, communication and social outcomes (Warreyn et al., 2014; White et al., 2011).
The JASPER training (Kasari et al., 2006) focuses on Joint Attention Symbolic Play Engagement and Regulation in young children. During play sessions, parents learn how they can encourage JA and play skills in their child. They learn how to recognize, model, connect and expand these skills. If applicable, parents also learn how they can support their child in regulating its emotions.
Objectives:
Is the Dutch version of the JASPER training effective in infants with ASD?
Can we develop an observation standard to reliably assess JA amelioration?
Methods:
Infants with ASD, developmental delays and limited spoken language (2-4 years old, ADOS-2, BSID-II) participated in the JASPER training. There were 15 weekly sessions: 10 play sessions (30-45 minutes, with child & parent(s)) and 5 evaluation sessions (60 minutes, with parent(s) only). All JASPER play sessions were videotaped and later used during the evaluation sessions with parents.
There were two control groups: a clinical non-JASPER group (infants with ASD who did not receive the JASPER training) and a typically developing group (TD).
Pre- and post-treatment, parents filled in the ESCBQ (Early Social Communicative Behavior Questionnaire) and the PICS (Pictorial Infant Communication Scale), as measurements for JA and other early social communicative behaviors.
Results:
The data collection is ongoing (N = 20 have been collected).
Preliminary results of a small group of infants with ASD (n = 4) show that specific skills improved significantly at post-treatment, in comparison with the clinical non-JASPER group, as measured by 4 ESCBQ subscales (Mann Whitney: z(-2.081), z(-1.875), (z(-1.979), z(-1.732); $p < .05$; eye contact, emotion, gaze following and showing respectively) and all 3 PICS subscales (Mann Whitney: z(-1.955), z(-1.949), z(-2.453); $p < .05$; initiating JA, initiating behavior request, and responding to JA respectively). Though, their skills are still at a significant lower level than that of TD children (ESCBQ total score; z (-1.874), $p < 0.05$; no data available concerning BICS).
In order to really capture the amelioration of early social communicative behaviors through parent child interactions, a qualitative coding system needed to be developed. Originally, 46 categories were formulated in MediaCoder, based on literature study and clinical experience. The statistical analyzes proved multiple categories to be unreliable, difficult to operationalize and/or poor on inter- and intra-variability. Therefore, the subsequent qualitative coding system consists of 15 child and 5 parent categories. Currently, all JASPER videotapes of another small group of infants with ASD (n=4) are being coded with this new coding system.
Conclusions:
The first results concerning the JASPER intervention study are promising and in line with former findings (Kasari et al., 2006, 2008, 2010, 2012, 2014; Stickles-Goods et al., 2013). A qualitative coding system is being developed. Further research is warranted.

57 **180.057** Capturing the Moment: Using the Autism Observational Scale for Infants (AOSI) to Assess the Developing Phenotype in a Prospective Sample of High Risk Children for ASD

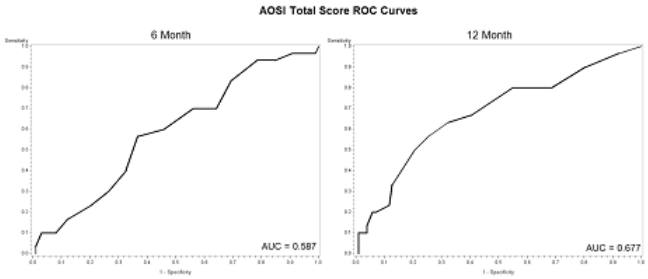
J. Pandey[1], *E. Schriver*[2], *S. Ozonoff*[3], *R. Landa*[4], *S. E. Levy*[1], *A. T. Pomykacz*[5], *C. R. Hess*[6], *M. V. Hsu*[7], *M. D. Fallin*[8], *I. Hertz-Picciotto*[9], *L. A. Croen*[10] *and C. J. Newschaffer*[2], *(1)Children's Hospital of Philadelphia, Philadelphia, PA, (2)A.J. Drexel Autism Institute, Philadelphia, PA, (3)UC Davis MIND Institute, Sacramento, CA, (4)The Kennedy Krieger Institute, Baltimore, MD, (5)Center for Autism Research, Children's Hospital of Philadelphia- Center for Autism Research, Philadelphia, PA, (6)Center for Autism and Related Disorders, Kennedy Krieger Institute, Baltimore, MD, (7)Kaiser Permanente ASD Center, San Jose, CA, (8)Wendy Klag Center for Autism and Developmental Disabilities, JHBSPH, Baltimore, MD, (9)Dept of Public Health Sciences, School of Medicine, UC Davis MIND Institute, Davis, CA, (10)Division of Research, Kaiser Permanente, Oakland, CA*

Background: Following the development of high-risk (HR) sibling cohorts allows for the identification of earlier differences in those who later develop ASD, and can serve as an indicator of early life development. While certain markers have been documented, the cascade of symptom development with environmental influences is not reported and is important for early intervention. The Autism Observational Scale for Infants (AOSI) is an experimenter-led assessment that measures early behavioral markers of ASD between 6 -18 months. The measure captures atypical social communication, non-social behaviors, temperament and repetitive behavior markers, yielding a Total Score (TS).
Objectives: To assess the predictive accuracy of AOSI scores for ASD classification at 36 months in a HR infant cohort and to examine accuracy across variable AOSI cutoff scores.
Methods: Participants represented a subset of HR children in the Early Autism Risk Longitudinal Investigation (EARLI). Infants (n=132) were given the AOSI at 6 and/or 12 months of age and an ASD diagnostic evaluation at 36 months. Diagnostic outcomes were determined by two clinicians using clinical best estimate, utilizing information from the Mullen Scales of Early Learning and Autism Diagnostic Observation Schedule (ADOS-2). ANOVAs were conducted to assess the difference in AOSI TS at 6 and 12 months, receiver operatic characteristic (ROC) analyses examined how well AOSI TS predicted diagnostic outcome when comparing ASD/NON-ASD samples combined, and then comparing NTD/TD separately. Spearman Correlations compared 36 month ADOS Comparison Scores to the AOSI TS at both 6 and 12 months.

Results: At 36 months, 30 children (23%; 26 males) met DSM-5 ASD criteria; 38 had other delays (non-typically developing; NTD); and 64 were developing typically (TD).Twelve month AOSI TS predicted 36 month ASD status better than 6 month AOSI TS. There was a difference in AOSI TS across the three outcome groups at 12 months (Kruskal-Wallis, p=0.004), but not at 6 months (ANOVA, p=0.12). AOSI 12 month scores (cutoff point = 6 using distance closest to (0,1) and Youden criteria) had a sensitivity of 0.63 and specificity of 0.68 (Area under Curve (AUC) =0.68; PPV=0.37, NPV=0.83) when comparing children with ASD to Non-ASD samples overall. At 12 months, when comparing ASD vs. TD and ASD vs. NTD, the AOSI had a higher sensitivity (vs. TD=0.61, vs. NTD= 0.57) and specificity (vs. TD=0.77, vs. NTD=0.62). The AOSI score had little predictability at 6 months when comparing ASD to Non-ASD (AUC=0.59). 36 month ADOS Comparison Scores were significantly correlated to the AOSI TS at 12 months (r=0.24; p=0.008), but not 6 months (r=0.08; p=0.33).
Conclusions: Our findings are consistent with previous reports of emergence of behavioral symptoms over time as the AOSI differentiated children with ASD from NTD/TD better at 12 months than 6 months. Additionally, the 12-month AOSI better differentiated ASD from TD than NTD, which is not surprising given the overlap in behavioral presentation between ASD and NTD groups. Along with overall diagnostic classification, the 36-month ADOS was significantly correlated with the AOSI at 12 months, supporting the emergence of the ASD behavioral phenotype over time.

EARLI Sample Characteristics – 6, 12, and 36 months			
	6 months*	12 months*	36 months*
Age at Visit (6mo N=128, 12mo N=132, 36mo N=123)	6.2 (1.5)	12.3 (0.74)	36.6 (0.99)
Gender			
Males	74 (57.8%)	75 (56.8%)	68 (55.3%)
Female	54 (42.2%)	57 (43.2%)	55 (44.7%)
AOSI Total Score (6mo N=128, 12mo N=132)	10.6 (4.3)	5.3 (4.1)	--
Mullen Early Learning Composite Standard Score (6mo N=127, 12mo N=132, 36mo N=120)	99.1 (12.3)	102.6 (15.0)	98.7 (20.8)
ADOS-2 Total Score (Algorithm)			
Module 1 No Words (N=2)	--	--	17.5 (7.8)
Module 1 Some Words (N=29)	--	--	10.0 (6.8)
Module 2 (N=92)	--	--	5.1 (4.2)
ADOS-2 Overall Calibrated Severity Score (N=123)	--	--	3.2 (2.5)

*Mean (SD) for continuous variables; n (%) for frequencies



58 **180.058** Children with Persistent, Idiopathic Feeding Difficulties: An at Risk Group for Developing Autism Spectrum Disorder?

P. Warreyn[1], *E. Van de Sijpe*[1] *and I. De Groote*[2], *(1)Ghent University, Ghent, Belgium, (2)Ghent University Hospital, Ghent, Belgium*

Background:
Feeding and eating problems, e.g., food selectivity associated with taste or texture, are often reported in children with autism spectrum disorder (ASD; Field et al., 2003; Sharp et al., 2013). These feeding problems have also been linked to autism severity (Aponte et al., 2015) and are often among the first concerns reported by parents (Olsson et al. 2013). Following up infants with persistent feeding difficulties may therefore be an additional strategy to learn about early markers of and developmental trajectories into ASD. However, to our knowledge, no such studies have been conducted yet.
Objectives:
The aim of the current study was to assess ASD risk in a group of young children referred for persistent, idiopathic feeding difficulties.
Methods:
In a period of 4 years, 32 young children (20 boys) between 12 and 73 months old, were referred to the University infant and child psychiatric unit (ICPU) with persistent feeding difficulties after medical (e.g., reflux) or organic (e.g., swallowing problems) causes were excluded by a specialised paediatric unit. Demographic characteristics (gender, age), history of the feeding problems (age and type), medical history (pregnancy and birth complications, developmental problems), details of the current feeding problems and contextual factors were linked with infant- and child psychiatric diagnosis of the children.
Results:
For 4 children, the parents refused a full assessment at the ICPU. Of the 28 remaining children, 4 (14%) were diagnosed with ASD (all boys), and an additional 7 (25%; 4 girls) received a working diagnosis of ASD (and will be followed up further). There were no differences between the children with (working diagnosis of) ASD and those without ASD in age of first concern, age at first consultation in the ICPU, complications during pregnancy or birth and contextual factors. Children with (working diagnosis of) ASD were less likely to have had problems with liquid food or with food intake before the age of 4 months ($\chi^2 = 8.866$, $p < .05$ and $\chi^2 = 4.196$, $p < .05$, respectively), but problems at other ages with other types of food were equally likely in both groups. At the moment of assessment at the ICPU, however, children with (working diagnosis of) ASD were more likely to still have problems with solid food, with or without lumps ($\chi^2 = 5.916$, $p < .05$ and $\chi^2 = 3.962$, $p < .05$, respectively). They were also more likely to have a language delay ($\chi^2 = 11.733$) or to be sensory overreactive ($\chi^2 = 5.051$, $p < .05$).
Conclusions:
Children with persistent, idiopathic feeding difficulties are at increased risk for ASD. In the children with ASD, the feeding difficulties usually started when solid food was introduced, and these problems with solid food were more persistent than in children without ASD. The current pilot study has implications for the early detection of ASD risk, and for the treatment of a subgroup of children with feeding difficulties.

59 **180.059** Circadian Profiles of Infants from Families with a History of Autism

G. L. Glickman[1], *E. M. Harrison*[1] *and K. R. Dobkins*[2], *(1)Center for Circadian Biology, University of California, San Diego, La Jolla, CA, (2)Department of Psychology, University of California, San Diego, La Jolla, CA*

Background: Sleep problems and irregular hormone profiles are extremely common in children with Autism Spectrum Disorder (ASD), suggesting impairments in the circadian timing system. While sleep and circadian disturbances have also been observed in adolescents and adults with ASD, early development of these physiological functions has not yet been examined. Since ASD is only diagnosed reliably after 2-3 years of age, we are taking the innovative approach of examining sleep and hormone rhythms in infants at greater risk for developing ASD because they have an older sibling with the disorder.
Objectives: Sleep and circadian rhythms are being rigorously characterized in these high-risk infants as well as in infant siblings of typical children at three different ages that represent important milestones in the early development of the circadian system: 3, 9 and 12 months.
Methods: At each age, sleep-wake patterns are examined with actigraphy, sleep diary and a modified version of the Sleep Habits Questionnaire, and fluctuations in melatonin and cortisol are examined across one mid-week day via assessment of saliva at 5 time points (8 AM, 9 AM, 10 AM, 6 PM and 9 PM). Patterns of light exposure, an important environmental factor that regulates both sleep and circadian rhythms, are also being measured, using both diary information and photosensors embedded within the actigraph devices.
Results: Thus far, seven consecutive days of sleep diaries and actigraphy as well as one day of serial salivary sampling have been collected for each infant (N=14, n=3 high-risk at mean±SD age=94.5±6.4 days; n=11 low-risk, mean±SD age= 95.3±10.5 days). Actigraphy data to date shows statistical differences between high- and low-risk infants

in terms of mean sleep latency, with high-risk infants taking significantly longer to fall asleep (t=2.63, p<0.05). In addition, preliminary analysis of diary measures indicates that sleep is more asymmetrically distributed across the 24 h day in high-risk infants, with more sleep during morning hours, as compared with low-risk infants (t=4.24, p <0.01). Though still underpowered, the patterns of results also reveal greater light exposure and poorer sleep efficiency in high- versus low-risk infants. Salivary melatonin and cortisol assays are currently underway, providing data that will allow for the determination of phase angle relationships between sleep and hormone rhythms.
Conclusions: Sleep and circadian rhythm abnormalities may be observed at even the earliest stages of development in infants with a family history of ASD. Ultimately, a better understanding of the sleep and circadian dysfunction that often co-occur with ASD may help guide treatment strategies and minimize the negative impact of these disturbances on both the children and their families.

60 **180.060** Comparison of Children with ASD at 3 Years of Age Ascertained from Community Screening in Primary Care Versus from a Prospective Infant Sibling Cohort

T. N. Day[1], *A. M. Wetherby*[2], *C. Nottke*[2], *A. Delehanty*[3], *A. M. Iosif*[4] *and S. Ozonoff*[5], *(1)Clinical Psychology, Florida State University, Tallahassee, FL, (2)Florida State University Autism Institute, Tallahassee, FL, (3)Communication Science & Disorders, Florida State University, Tallahassee, FL, (4)Public Health Sciences, University of California Davis, Davis, CA, (5)UC Davis MIND Institute, Sacramento, CA*

Background: Prospective research of infants at high-risk (HR) for ASD due to having an older sibling with ASD has provided critical information about early signs and developmental characteristics of ASD. HR infant sibling studies have shown that early signs are distinguishable at 12-18 months in infants later diagnosed with ASD suggesting that early detection is possible. However, the developmental level of infant sibling cohorts (Ozonoff et al., 2015) appears to be substantially higher than community samples ascertained from primary care using current autism-specific screening tools (Eaves et al., 2006; Robins et al., 2014; Stenberg et al., 2014), demonstrating a possible sampling bias toward missing higher-functioning toddlers with ASD. In a review of current evidence for ASD screening, priorities for future research included examining how broadband and autism-specific screening tools can be used together to improve screening accuracy and the need for large representative HR and low-risk (LR) samples to strengthen generalizability of findings (Zwaigenbaum et al., 2015).
Objectives: To compare phenotypic presentations of children diagnosed with ASD at 3 years of age from two large prospective samples, one ascertained from community screening (CS) in primary care using a broadband screen for communication delay followed by autism-specific screening and the other ascertained from HR and LR infant siblings (IS).
Methods: Children in the CS sample were recruited from over 10,000 children screened at 9-18 months in primary care settings using the Infant-Toddler Checklist (ITC; Wetherby & Prizant, 2002), a broadband screen of communication delay, followed by inviting positive screens and randomly selected negative screens for an ASD screening using the Systematic Observation for Red Flags (SORF; Wetherby et al., 2004). Children in the IS sample were recruited at 6-9 months of age and comprised of 175 HR and 111 LR infants. Children from both the CS (*n*=464) and IS (*n*=286) samples were invited for an evaluation to make a best-estimate clinical diagnosis using the ADOS, Mullen, and Vineland around 3 years of age; 204 CS and 32 IS children (30 HR, 2 LR) were diagnosed with ASD.
Results: No significant differences were found between children with ASD ascertained from the CS (*n*=204) and IS (*n*=32) samples on any scale of the ADOS or Mullen. On the ADOS, the mean Social Affect total for both groups was 10.9 and the Restricted Repetitive Behavior total 4.2 and 4.0 for the CS and IS groups, respectively. The Mullen Early Learning Composite had a mean of 74.8 (*SD*=23.8) for the CS group and 76.4 (*SD*=18.9) for the IS group. T-scores on the four Mullen subscales were also equivalent.
Conclusions: These findings demonstrate similar autism severity and developmental level in two large prospective samples, one ascertained from CS using a broadband screen for communication delay followed by ASD screening, and the other ascertained from an IS sample. The similar phenotypic expression on the ADOS and Mullen around 3 years of age provides initial support for the use of broadband and autism-specific screening tools together to improve screening accuracy and the generalizability of HR infant sibling research.

61 **180.061** Determining Predictors of Improved Cognitive Function in Children with ASD Between 3 and 6 Years of Age. Which Toddlers Improve?

ABSTRACT WITHDRAWN

Background: Longitudinal Investigation of the cognitive development of children with ASD offers a promising way to identify clinically significant subgroups. Here, we focus on cognitive phenotypes, defined by IQ, which constitutes one of the greatest sources of heterogeneity within ASD and is among the strongest predictors of outcome. By leveraging the extensive behavioral data in the APP, we seek to extend past cross-sectional outcome studies that suggest associations between early social motivation, adaptive language functioning, psychopathology and repetitive behaviors, and later cognitive functioning.
Objectives: To: (1) present descriptive information about the ASD symptoms, adaptive functioning, and psychopathology measurements in the APP cohort; (2) explore an ASD phenotype derived from IQ-based developmental trajectories during the formative 3 to 6 year period; and (3) examine the association between measurements of social reciprocity, language functioning, attention dysregulation, and repetitive behaviors at 3 years of age and IQ trajectory.
Methods: Participants were 93 individuals with ASD. To identify cognitive developmental trajectories, the PROC TRAJ macro in SAS was used on an adjusted DQ score derived from the Mullen Scales and the DAS-II. Univariate and multivariate nomial logistic regression models were then employed to investigate unique and composite predictors of trajectory membership using measurements from the ADOS-2, Vineland Adaptive Behavior Scales, Achenbach System of Empirically Based Assessment, and the Repetitive Behavioral Scales-Revised.
Results: Three distinct trajectories of intellectual development were identified. The first consisted of individuals with IQs ≤ 75 at both times (**Greater challenges**: n=34; 37%). The second was comprised of individuals with IQs ≥ 80 at both times (**Lesser challenges**: n=23; 25%). A third group exhibited IQs < 80 at T1, and had scores of ≥ 80 at T3 with increases of ≥ 1 standard deviation (**Changers**: n=36; 38%). Univariate logistic regression showed that more severe ADOS-2 social reciprocity symptoms at T1 predicted membership in the **Greater Challenges** vs. both **Lesser Challenges** (odds ratio = 2.00, 95% CI: 1.48 – 2.69) and **Changers** (odds ratio = 1.44, 95% CI: 1.16 – 1.80) groups (both p <.001). Similarly, children with better language functioning on the T1 Vineland were more likely to be in the **Changers** (odds ratio = 1.06, 95% CI: 1.02 – 1.11, p <.01) or the **Lesser Challenges** (odds ratio = 1.15, 95% CI: 1.08 – 1.22, p <.001) versus the **Greater Challenges** group. Findings remained significant when social reciprocity and language functioning were entered in a multivariate logistic regression model (all p <.03). No associations were found with attention, hyperactivity, and repetitive behaviors.
Conclusions: The high proportion of young children experiencing robust early cognitive development provides is hopeful for families. It also suggests that low early social reciprocity and adaptive language are risk markers and treatment targets for intensive early intervention. Analyses of the mechanisms of intervention are ongoing. We are also conducting a middle childhood follow-up using behavioral and neuroimaging assays of memory, executive control, language, academic performance, and anxiety to extend the investigation of ASD phenotypes into the understudied, middle childhood period.

62 **180.062** Differences in EEG Power at 3 Months Distinguish Infants at High-Versus Low Risk for ASD

K. J. Varcin[1], *A. R. Levin*[2], *H. M. O'Leary*[3], *H. Tager-Flusberg*[4] *and C. A. Nelson*[5], *(1)Harvard Medical School, Boston Children's Hospital, Boston, MA, (2)Boston Children's Hospital, Boston, MA, (3)Neurology, Boston Children's Hospital, Boston, MA, (4)Boston University, Boston, MA, (5)Boston Children's Hospital/Harvard Medical School, Boston, MA*

Background:
In the context of increasing evidence for the efficacy of early intervention in improving developmental outcomes, there is both significant interest and a need to delineate early risk markers of atypical development that may facilitate earlier intervention. An emerging body of evidence from prospective studies of infants at high familial risk for ASD suggests that alterations in brain development are present from 6 months of age, prior to the emergence of the first behavioral signs of ASD (Jones et al., 2014). To date, early neural markers *within* the first six months of life have been scarcely explored.
Objectives:
In an effort to guide the identification of early risk markers in ASD, we aimed to (1) identify whether infants at high-risk for ASD show altered intrinsic oscillatory patterns by 3 months of age compared to infants at low-risk and (2) explore whether early neural activity is associated with behavioral, cognitive, and social communicative outcomes across early development.
Methods:
Participants in the current study were part of an ongoing, prospective study examining infant siblings at high (HRA) versus low (LRC) familial risk for ASD. At 3 months of age, we collected continuous, high-density baseline electroencephalographic (EEG) recordings (HRA n = 25; LRC n = 14). Average frontal EEG power was calculated within the delta, theta, alpha, beta and gamma bands (as defined previously by Tierney et al., 2012). Cognitive development was assessed at 6 and 12 months using the Mullen Scales of Early Learning (MSEL) and early ASD markers were assessed at 9 and 12 months using the Autism Observation Scale for Infants (AOSI).
Results:
The HRA group had significantly lower power in the high-alpha (U = 78.00, z = -2.840, p = .004) and beta (U = 67.00, z = -3.162, p = .001) bands, with a trend in the low-alpha (U = 93.00, z = -2.401, p = .016) and gamma bands (U = 88.00, z = -2.547, p = .010). A Kruskal-Wallis H test revealed significant differences in frontal power between outcome groups (LRC no-ASD [n = 8], HRA-ASD [n = 7], HRA no-ASD [n = 15]) in the beta band (H(2) = 6.31, p = .043) and a trend in the gamma band (H(2) = 5.60, p = .061). This effect was driven by significant differences between the LRC no-ASD and HRA-ASD groups. Frontal EEG power at 3-months, for all infants, was positively correlated with gross motor and expressive language skills across the first year of life (ps < .05) and inversely correlated with AOSI total score at 9 months (i.e., higher 3mo EEG power was associated with fewer ASD risk markers).
Conclusions:

Our findings suggest that frontal EEG power, as early as 3 months of age, offers potential to predict ASD risk as well as the development of gross motor and expressive language skills. On a broader scale, this finding is consistent with the well-established concept that across neurologic disorders brain-based changes may be detectable on imaging well before behavioral changes become manifest.

63 **180.063** Differential Habituation to Social Scenes in Toddlers with ASD, Non-ASD Developmental Delays, and No Delays

N. Ludwig[1], *R. A. Williamson*[2], *R. K. Ramsey*[2], *L. B. Adamson*[2] *and D. L. Robins*[3], *(1)Georgia State Univeristy, Atlanta, GA, (2)Psychology, Georgia State University, Atlanta, GA, (3)Drexel University, Philadelphia, PA*

Background: Studies have shown slowed rates of behavioral and neural-based habituation to static facial stimuli in individuals with autism spectrum disorder (ASD) across the lifespan. Slowed rates of habituation to faces in toddlers is associated with more symptoms; however, little is known about habituation to other kinds of social stimuli and how habituation rates compare to toddlers with non-ASD delays. Such data may be useful in identifying early behavioral markers of ASD and informing targeted interventions.
Objectives: The current study examines whether differences emerge in behavioral habituation during a dynamic social attribution task between children with ASD, non-ASD developmental delays (DD), and those without developmental delays (TD). This study also aims to examine whether these differences are moderated by modality of task presentation (i.e., puppet show vs. computerized cartoon) given studies suggesting that computerized learning may be more effective for children with ASD than live-based learning.
Methods: This preliminary sample included 18 toddlers (16 male, m_{age}=22.7mo, *SD*=3.7), six with ASD, seven with DD (i.e., language disorder or global developmental delay), and five typically developing (TD).
Toddlers were presented with both a live puppet show and computerized cartoon (order counterbalanced) of alternating helping and hindering social scenes featuring geometric shapes (10s each) on separate days. Scenes were presented until habituation criterion was reached (i.e., the sum of looking time on three consecutive presentations is less than half of the sum of the looking time on the first three presentations, with a maximum of twelve presentations).
Results: The pattern of findings suggest that children in the ASD and DD groups require additional habituation trials in the puppet version (ASDm_{trials}=10.5, *SD*=2.5; DDm_{trials}=9.9, *SD*=2.8) compared to the TD group (m_{trials}=7.8, *SD*=1.6) whereas all groups require a similar number of trials in the computerized version (ASDm_{trials}=8.5, *SD*=2.3; DDm_{trials}=9.0, *SD*=2.4; TDm_{trials}=9.0, *SD*$_{trials}$=3.0). Additionally, data suggest that children with ASD look longer at the puppet scene during habituation (m_{time}=82.9, *SD*=2.3), compared to the DD and TD groups (DDm_{time}=67.6, *SD*=42.9; TDm_{time}=56.8, *SD*=36.3), but that this difference is absent during the computerized version (ASDm_{trials}=62.9, *SD*=28.5; DDm_{trials}=68.0, *SD*=30.8; TDm_{trials}=81.7, *SD*=58.4). Effect sizes for the interaction between diagnosis and modality (puppet vs. cartoon) for the number of habituation trials and total looking time were medium (η_p^2=.12) and large (η_p^2=.94), respectively. Not surprisingly in this small sample, conventional levels of statistical significance were not reached; however, medium to large effects suggest that significant differences will emerge as additional children are recruited.
Conclusions: Preliminary findings suggest that there may be differential behavioral habituation rates to non-facial social stimuli, and that this may be moderated by the modality in which stimuli are presented. More data are needed to examine whether these medium to large effects become significant. Future research should compare habituation rates of social vs. nonsocial stimuli in these groups and modalities and explore the utility of behavioral habituation as an early behavioral marker of ASD.

64 **180.064** Diminished Autonomic Response to Social Partners in Infants Later Diagnosed with Autism Spectrum Disorder

C. McCormick*, S. J. Sheinkopf, T. P. Levine, L. L. LaGasse and B. M. Lester, Brown Center for the Study of Children at Risk, Women & Infants Hospital The Warren Alpert Medical School of Brown University, Providence, RI*

Background: The core behavioral symptoms of autism spectrum disorder (ASD) emerge developmentally and are not reliably observed within the first year of life (Jones et al., 2014). Even sensitive measures, like those generated from eye-tracking techniques, have not yet identified consistent reliable differences between children with and without ASD until the second year of life. Biological measures, such as respiratory sinus arrhythmia (RSA), hold great potential for detecting predictors of an ASD outcome before behavioral differences emerge. RSA is a measure of heart rate variability that indicates the body's readiness to engage with environmental stimuli (Grossman & Taylor, 2007). RSA response patterns have been linked to social functioning in children with ASD (Sheinkopf et al., 2009). Differential patterns of RSA response may be part of the underlying biology of ASD and, therefore, be detectable within early infancy.
Objectives: To identify early patterns of behavioral and RSA responses in infants later diagnosed with ASD.
Methods: Two groups of infants were compared: infants with an ASD outcome (N = 8) and matched controls (N = 186). Infants were seen as part of their participation in the Maternal Lifestyle Study (MLS), a longitudinal study of the effects of drug exposures on long term developmental outcomes. At four months infants completed the face-to-face still-face (FFSF) protocol with their mother. The FFSF begins with the caregiver and infant in face to face interaction (play), followed by a period when the caregiver is instructed to face the infant relatively expressionless (still face), and ending with a reunion episode of normal face to face interaction (reunion). Infants were also observed in a face to face play interaction with a novel female examiner immediately following the caregiver interaction (stranger). ECG was collected to measure RSA. ECG post-processing incorporated automated artifact detection and correction routines. RSA was calculated from the resulting "cleaned" time series data using Porges' method. Infant behaviors (passive-withdrawn, protest, object-environment, social monitor, and social positive engagement) were coded from video.
Results: A general linear mixed model of the FFSF paradigm revealed no significant group differences on RSA during interactions with the mothers between infants with an ASD outcome and controls. Both groups of infants demonstrated a decrease in RSA during the still face phase compared to the play phase ($p < .05$). No significant behavioral differences were detected. However, in response to play with a stranger, an ANOVA revealed that the infants with an ASD outcome had lower RSA than controls ($p < .05$). During the interaction with a stranger, lower RSA response was associated with more protesting behaviors ($p < .01$), whereas higher RSA response was associated with more social monitoring ($p = .001$).
Conclusions: Infants later diagnosed with ASD exhibited greater autonomic reactivity during interactions with an unfamiliar adult than did comparison infants. There were no differences between groups during interactions with mothers. Physiological dysregulation, as indicated here by a lower RSA response, may function as an early biological marker of difficulties with social interactions before differences in behavioral responses are detectable.

65 **180.065** Does Infant Temperament Predict Autistic Traits in Toddlers? Findings from a Prospective Longitudinal Study of Singaporean Toddlers

A. Chew[1], *C. S. Chee*[2], *D. A. Goh*[3], *D. Gan*[3], *S. B. Lim*[4], *P. Agarwal*[5], *B. Broekman*[6,7], *A. Rifkin-Grabol*[6], *S. M. Saw*[8], *Y. S. Chong*[9], *K. Kwek*[10], *P. D. Gluckman*[6,11], *M. Meaney*[6,12] *and* ***I. Magiati***[1], *(1)Department of Psychology, National University of Singapore, Singapore, Singapore, (2)Child Development Unit, Department of Pediatrics, National University Health System, Singapore, Singapore, Singapore, (3)Department of Psychology, National University of Singapore , now at the Ministry of Social and Family Development, Singapore, Singapore, Singapore, (4)Department of Child Development, KK Women's and Children's Hospital, Singapore, Singapore, (5)Department of Neonatology,, KK Women's and Children's Hospital, Singapore, Singapore, (6)Singapore Institute for Clinical Sciences, Agency for Science, Technology and Research (A* STAR), Singapore, Singapore, (7)Department of Psychological Medicine, National University Health System, NATIONAL UNIVERSITY OF SINGAPORE, Singapore, Singapore, (8)Saw Swee Hock School of Public Health, National University of Singapore, National University Health System, Singapore, Singapore, (9)Singapore Institute for Clinical Sciences, Agency for Science, Technology and Research (A* STAR), Singapore; Department of Obstetrics and Gynaecology, Yong Loo Lin School of Medicine, National University of Singapore, National University Health System, Singapore, Singapore, (10)Department of Maternal Fetal Medicine, KK Women's and Children's Hospital, Singapore, Singapore, (11)Liggins Institute, University of Auckland, Auckland, New Zealand, (12)Ludmer Centre for Neuroinformatics and Mental Health and Department of Psychiatry, McGill University, Montreal, Canada*

Background:
Limited but emerging evidence suggests that early temperament or temperament trajectories may be different in children who are later diagnosed with ASD. However, most existing research is methodologically limited by cross-sectional studies and small sample sizes and to our knowledge, no study has yet examined temperament in relation to ASD symptoms in infants younger than 6 months. Conceptualizing ASD as the extreme of a normal distribution of autistic traits in the general population allows us to investigate variation in autistic traits and their relationship to infant temperament within larger prospective longitudinal studies.
Objectives:
The current study examined infant temperament as a predictor of autistic traits in a large community sample of unselected toddlers, using a prospective longitudinal design with multiple time-points. Differences in temperament characteristics were examined both cross-sectionally at each time point and longitudinally in terms of changes in temperament trajectories over time.
Methods: 649 infants were recruited from two major public hospitals in Singapore and followed up at regular intervals from approximately 12 weeks gestation to 3 years of age as part of a large longitudinal study of growth and development (GUSTO; Growing Up in Singapore Towards healthy Outcomes). Caregivers completed the Carey Temperament Scales at 3 (N=645), 9 (N=539), and 18 (N=445) months; and the Quantitative Checklist for Autism in Toddlers (Q-CHAT) at 18 (N=368) and 24 months (N=365). 174 caregivers completed all temperament and autistic trait measures at all timepoints.
Results:
Correlational analyses showed that rhythmicity, distractibility and adaptability at most earlier time-points were positively associated with later autistic traits, with small to medium effect sizes. In regression analyses, infants' low distractibility and high threshold were the strongest unique predictors of autistic traits. Low persistence and high threshold were the strongest unique predictors of social autistic traits, as compared to greater persistence which predicted non-social/ behavioral autistic traits. Toddlers with higher autistic traits at 24 months showed a developmental pattern of consistently lower rhythmicity between 3 and 18 months, consistently decreasing persistence and

increasing threshold to stimulation from 3 months to 18 months, as compared to their peers with low autistic traits at 24 months who displayed more stable levels of persistence and threshold from 9 to 18 months.
Conclusions:
This study provides preliminary evidence that at least some temperament differences as early as 3 months are associated with later sub-clinical autistic traits in the general population. Studying infant temperament in the context of autistic traits may provide further insight into how early developmental pathways of those who later go on to have high rates of autistic-like behaviors may deviate from those observed in toddlers with fewer autistic traits. Such knowledge may further and inform our understanding of early development in the extreme end of the continuum of autistic traits.

66 **180.066** Early Behavioral Fear in Infants and Preschoolers at High Risk for Autism: Fragile X Syndrome Versus Autism

J. Roberts[1], *J. Scherr*[1], *A. L. Hogan-Brown*[1], *D. Reisinger*[2] *and S. L. O'Connor*[1], *(1)Psychology, University of South Carolina, Columbia, SC, (2)University of South Carolina, Columbia, SC*

Background: Young males with fragile X syndrome (FXS) are at high risk for both autism spectrum disorders (ASD) and anxiety disorders with up to 70% and 80% meeting diagnostic criteria, respectively. Likewise, infants with an older sibling with ASD of unknown etiology are at high risk for ASD and anxiety with nearly 20% meeting criteria for ASD and 40% of those with ASD diagnosed with an anxiety disorder. Despite the high association of anxiety with FXS and infants with siblings, few studies have examined early indicators of anxiety in either group, and no work has examined the specificity of early anxiety indicators in FXS to those in infant siblings. Given that features of ASD and anxiety overlap considerably, disentangling the association of ASD and anxiety features in FXS and infant siblings is important to address the latent heterogeneity in ASD and to direct targeted treatments in both high risk groups.
Objectives: To investigate social and non-social fear in infants and young children with FXS, contrasted with infant siblings of children with ASD and typically developing controls.
Methods: 76 boys (2-5 years) participated in our initial preschool study representing 29 with FXS, 11 with idiopathic ASD, and 36 typical controls. An additional 68 infants (12–24 months) completed our infant extension, representing 25 with FXS, 22 infant siblings, and 29 typical controls with 20 having data coded at this time and coding scheduled to be completed by 12/2015. Social and non-social fear were measured using gaze from the Stranger and Scary Spider epochs of the Laboratory – Temperament Assessment Battery at 12 and 24 months and at preschool age (stranger only). Autism symptoms were assessed using the severity score from the Autism Diagnostic Observation Schedule 2 and Childhood Autism Rating Scale -2 with anxiety symptoms estimated using the anxiety subscale of the Child Behavior Checklist. We anticipate increased sample sizes for the presentation.
Results: Data indicate that preschool males with FXS display a similar proportion of gaze towards the stranger as the ASD group (32% and 25% of time, respectively) with both being lower than typical controls (45%; p=.01). There were nonsignificant relationships between stranger gaze and autism symptom severity or parent rated anxiety symptoms in the preschoolers (p>.05). For infants, no differences were found between FXS (48%), autism siblings (58%), and typical infants (83%) on the proportion of time spent looking at the spider (p>.05). In contrast, results approached significance for the FXS group to gaze longer to the stranger (52%) than the autism siblings (32%; p=0.07); FXS and autism siblings were both similar to typical controls (p>.05).
Conclusions: Results from this study suggest that children with FXS and siblings of children with ASD may demonstrate different developmental trajectories of social and non-social fear. Though non-social fear does not appear to discriminate children with FXS from other children in infancy, children with FXS and children with ASD do demonstrate elevated social fear later in development, at preschool age.

67 **180.067** Early Play Behaviors in Infants at Risk for Autism

J. E. Flanagan[1], *B. B. Demchick*[2], *R. J. Parente*[3], *J. Delany*[2], *L. A. Crabtree*[4], *P. D. LaVesser*[5] *and R. Landa*[6], *(1)SPD Foundation, Centennial, CO, (2)Towson University, Towson, MD, (3)Psychology, Towson University, Towson, MD, (4)Towson University, Lutherville, MD, (5)University of Colorado, Denver, CO, (6)The Kennedy Krieger Institute, Baltimore, MD*

Background: Few studies have found early markers of autism that are associated with later diagnosis. Various studies examined early play behaviors after nine months of age but none have looked at early play behaviors during mid-infancy. Early play behaviors include the ability to move and explore one's environment, play with objects, and attend and interact with a caregiver. These play abilities may provide valuable information about sensory, motor, cognitive, and social functioning that may predict risk factors for ASD.
Objectives: This study examined the relation between early play behaviors at age 6 to 7 months and 36-month outcome classification of ASD in high and low risk infants.
Methods: A retrospective analysis of longitudinal data was collected from a cohort of 58 infant participants by coders blinded to child's diagnostic category. Play skills were rated from videotapes of administration of the Mullen Early Learning Scale and a Peek a boo task. The Revised Knox Preschool Play Scale was used to code these dimensions of play: gross motor skills, fine motor skills, early imitation and early social and communication behaviors (e.g. participation) during interactions (Knox, 1997, 2008). Researchers operationally defined play categories and established reliability in their scoring. Social and communication behaviors associated with a diagnosis of ASD were determined at age 3 by expert clinical researchers using the DSM IV TR criteria (2000) for autistic disorder and pervasive developmental disorder not otherwise specified along with performance on the following diagnositic assessments: The Autism Diagnostic Observation Schedule, Mullen Scales of Early Learning Receptive and Expressive Language Scales, and Preschool Language Scale.
Results: A Mann-Whitney U test was run to determine if there were differences in play scores between the infants with ASD and infants without an ASD diagnosis. Distributions of the scores were not similar, assessed by visual inspection. Play score for infants later diagnosed with ASD at age 3 had lower play abilities at 6 months compared to infants without an ASD diagnosis (U = 130, z = -2.29, p < 0.05, r = 0.31). Analysis of the play dimensions revealed that infants with ASD had a lower imitation score (U = 145.5, z = -2.26, p < 0.05, r = 0.31) and participation score (U = 138, z = -2.30, p < 0.05, r = 0.31) compared to the NonASD group.
Limitations: Play skills were observed retrospectively during the administration of a standardized assessment rather than in a naturalistic play context. In addition, there were only a small number of infants diagnosed with ASD in the sample.
Conclusions: Play behaviors may be early indicators of developmental disruption in infants later diagnosed with ASD. Findings suggest the need to move beyond standard assessments that focus on the accomplishment of gross or fine motor tasks to look also at the quality of interaction with a caregiver during early play, which may serve as potential indicators of ASD.

68 **180.068** Early Predictors of Restricted and Repetitive Behaviors in Toddlers at-Risk for ASD

S. F. Fontenelle, *D. Macris, K. K. Powell, S. Macari and K. Chawarska, Yale Child Study Center, Yale University School of Medicine, New Haven, CT*

Background: Developmental theory suggests that RRBs in children with Autism Spectrum Disorder (ASD) may function to occupy and soothe oneself, which may interfere with new experiences and learning (Leekam, Prior, & Uljarevic, 2011). Previous findings also suggest that severity of RRB symptoms might be linked with limited communicative skills. Specifically, increases in language levels were associated prospectively with decreases in RRBs in 2 to 3-year-olds with ASD (Subramanian and Weismer, 2012). Despite potential clinical and theoretical importance of the relationship between communication skills and RRBs, evidence in this area remains scant. The current study seeks to extend the literature by examining the association between language acquisition and RRBs in the second year of life, a critical developmental period for communication skills and emergence of RRBs.
Objectives: Examine the association between early language skills and RRBs in younger siblings of children diagnosed with ASD. We hypothesize that RRBs and dynamic language acquisition will predict later levels of RRBs in high-risk siblings.
Methods: Participants were 98 high-risk infants followed prospectively at 12, 18, 24, and 36 months. The sample consisted of toddlers with ASD (n = 16), developmental delays (n = 36), and no clinical features (n= 46). Comprehensive evaluations were conducted at each time point. Language skills were assessed with the MSEL (e.g., age equivalent (AE) scores). RRBs were assessed through clinical observations with the ADOS (e.g., RRB total scores). Rate of skill acquisition was calculated by determining the change in AE scores between visits divided by the time that passed between visits (Klintwall, Macari, Eikeseth, & Chawarska, 2015). The hypothesis was evaluated using multiple regression analysis with RRB at 24 months as the predicted variable, and EL rate acquisition and RRB levels at 12 and 18 months as predictors. Analyses were conducted on the combined HR sample to evaluate associations between RRB and language development across the spectrum of risk.
Results: The dependent variable for the high-risk cohort was a measure of clinically-observed RRBs at 24 months (M=1.21; SD = 1.36; Min = 0; Max = 7). Mean RRBs at 12 and 18 months were .96 and 1.29, respectively. Rates of EL growth between 12 and 18 months and 18 and 24 months were 1.05 and 1.59, respectively. Multivariate regression analysis revealed the model significantly accounted for 26% of the variance in 24-month RRB scores ($F(9, 84) = 4.612$, p = .000; adjusted R^2 = .259), with 12-month RRB scores (β = .247, p = .034) and 18-24 month EL Acquisition Rate scores (β= -.423, p = .007) making significant contributions.
Conclusions: The results suggest that higher level of RRBs at 12 months and lower rates of language acquisition between 18 and 24 months predict higher levels of RRBs at 24 months in high-risk siblings. These results highlight the role of expressive language development in the emergence of RRBs in high-risk toddlers and underscore the importance of intervention targeting language development in high-risk toddlers between 18 and 24 months of age.

69 **180.069** Evidence for Language Phenotypes in Children with ASD Based on Varied, Longitudinal Assessment Measures

L. Naigles[1], *A. M. Mastergeorge*[2], *R. T. Johnson*[3], *C. W. Nordahl*[4] *and D. G. Amaral*[5], *(1)University of Connecticut, Storrs, CT, (2)University of Arizona, Tucson, AZ, (3)UC Davis M.I.N.D. Institute, Sacramento, CA, (4)University of California at Davis, Sacramento, CA, (5)UC Davis The M.I.N.D. Institute, Sacramento, CA*

Background: Language assessment is challenging in young children with ASD, yet is crucially important for designing interventions and predicting outcomes. Standard scores situate children with ASD in relation to their TD peers, yet specifics of which aspects of language are known vs. unknown are lacking. Moreover, language-brain comparisons may suffer because children of comparable standard scores may be at different stages of language development; specifics of language growth also become hard to document. We hypothesize that scrutiny of *raw* scores from standardized assessments might be revealing concerning children with ASD's actual levels of language knowledge, plus relationships among their early language, brain development, and language growth.
Objectives: 1) To examine how raw Mullen (MSEL) scores might distinguish language knowledge in a large group of 3-year-olds with ASD, and 2) to investigate relationships among these scores, acquired MRI data and subsequent language levels.
Methods: 239 families of children with ASD participated in the APP study of autism phenotypes at three years old (M_{age} = 35.06 months; $M_{MullenVR\text{-}T}$=28.88, *SD*=12.97); 98 of these provided additional data at 5 years (M_{age}=68.63 months; $M_{DAS\ NV\ SS\text{-}score}$=81.39, *SD*=27.51). Three-year-olds were administered the MSEL and CDI; five-year-olds were administered the ADOS, DAS Verbal-Comprehension, EOWPVT and PPVT. 104 of the 3-year-olds underwent structural MRI imaging, enabling DTI analyses.
Results:
Based on the MSEL receptive and expressive language, the 3-year-olds were divided into three language subgroups based on raw scores: *Nonverbal*, *WordLearner*; *Words&Grammar*. Subgroups' language scores differed (p<.05); however, *Nonverbal* and *WordLearner* subgroups differed only marginally on MSEL VR (p<.10) and *WordLearner* and *Words&Grammar* groups did not differ on ADOS scores. Fractional anisotrophy (FA) in the DTI analyses varied in several tracts according to these subgroups; that is children in the *Nonverbal* group manifested the lowest FAs in the left inferior longitudinal fasciculus (ILF).
The 5-year-olds were divided into four subgroups based on standard scores: *Low Verbal* , *High Verbal*, *Low Normal*; and *Possible SpecificLanguage Impai*ment . Comparison of the children at T1 vs. T2 revealed stability: *Words&Grammar* children at T1 predominantly scored as *HighVerbal* at T2. However, 28 children who were *Nonverbal* at T1 scored in one of the three higher subgroups at T2.
Conclusions: 3-year-olds' raw MSEL language scores revealed subgroups that implicated graded vocabulary development. The DTI findings supported this interpretation, as children at lower vocabulary levels manifested less mature white matter tracts, particularly tracts connecting visual and auditory cortex. These children may exhibit impaired word-object mappings. Many of the 5-year-olds remained at similar verbal levels relative to their chronological age. However, a significant minority demonstrated marked improvement. Ongoing analyses consider the children's actual speech, comparing lexical with grammatical functioning and potential neural correlates thereof.
Understanding language profiles of young children with ASD provides important information about stability and variability in language symptomatology and furthers our understanding of emergent language phenotypes.

70 **180.070** Evidence for Metabolomic Phenotypes Based on Analysis of Plasma from the APP Cohort

A. Smith[1], *R. Alexandridis*[1], *R. Burrier*[1], *P. West*[2], *L. A. Egnash*[3], *J. King*[1], *D. D. Li*[4], *D. G. Amaral*[5] *and E. Donley*[1], *(1)Stemina Biomarker Discovery, Madison, WI, (2)BioAnalytical Chemistry, Stemina Biomarker Discovery, Madison, WI, (3)Client Services and Operations, Stemina Biomarker Discovery, Madison, WI, (4)University of California at Davis, Sacramento, CA, (5)UC Davis The M.I.N.D. Institute, Sacramento, CA*

Background: Metabolomics has the potential to identify predictive and actionable biomarker profiles from a child's inherited biochemistry as well as capture the interactions of the gut microbiome with dietary and environmental factors that contribute to ASD. Identification of common metabolic profiles in children with ASD creates an opportunity to develop metabolic based diagnostics that enable early diagnosis and identification of metabolic subtypes that can facilitate intervention and lead to a better understanding of the biochemical changes associated with ASD.
Objectives: 1) To identify predictive metabolic signatures which distinguish ASD from typically developing (TD) children enrolled in the Autism Phenome Project. 2) To discover metabolic subtypes of ASD as defined by differentially abundant metabolic features that can identify a subset of ASD individuals with a high positive predictive value and specificity.
Methods: Plasma was obtained from 180 children with ASD at the time 1 assessment time point and from 93 age-matched TD children. Samples were analyzed using 4 orthogonal HILIC and C8 LC/HRMS-based methods as well as GC/MS. Data from the patient samples were split into a training set, utilized for identification of biomarkers, and an independent validation test set used for evaluation of the diagnostic signatures. Univariate, multivariate, machine learning and heuristic methods were applied to the training set to identify predictive metabolic features. The predictive molecular signatures were evaluated in the validation test set to determine their classification performance.
Results: Computational models were created that classified the ASD and TD samples in the validation set with a maximum accuracy of 79% and AUC of 0.80. Differentially abundant features (p value < 0.05) from the models were identified as metabolites derived from multiple biochemical processes which included lysophospholipids, hormone sulfates, and amino acids. Two metabolites, 3-Carboxy-4-methyl-5-propyl-2-furanpropionic (CMPF) and an unknown metabolite related to CMPF exhibited a large differential abundance (> 6 fold, p val < 1e-6) in a subset of subjects with ASD. These metabolites discriminates 14% of the ASD population in the APP study and may describe a metabolic subtype of ASD.
Conclusions:
Non-Targeted metabolomic profiling of children with ASD revealed predictive metabolic signatures able to discriminate individuals with ASD from TD individuals and suggests the presence of metabolic subtypes. Applying this paradigm to identify metabolic signatures associated with ASD and elucidating their biochemical implications may be useful in directing therapy on a personalized basis. Work is currently under way to compare these metabolic phenotypes with behavioral and neuroimaging data acquired in the APP. These results form the basis for additional work with the goals of 1) developing diagnostic tests to detect ASD in children to improve their outcomes through personalized treatment, 2) gaining new knowledge of biochemical mechanisms involved in ASD and 3) identifying biomolecular targets for new modes of therapy.

71 **180.071** Examining the Relation Between Walking and Receptive Language in Infants at Heightened Risk for Autism Spectrum Disorder

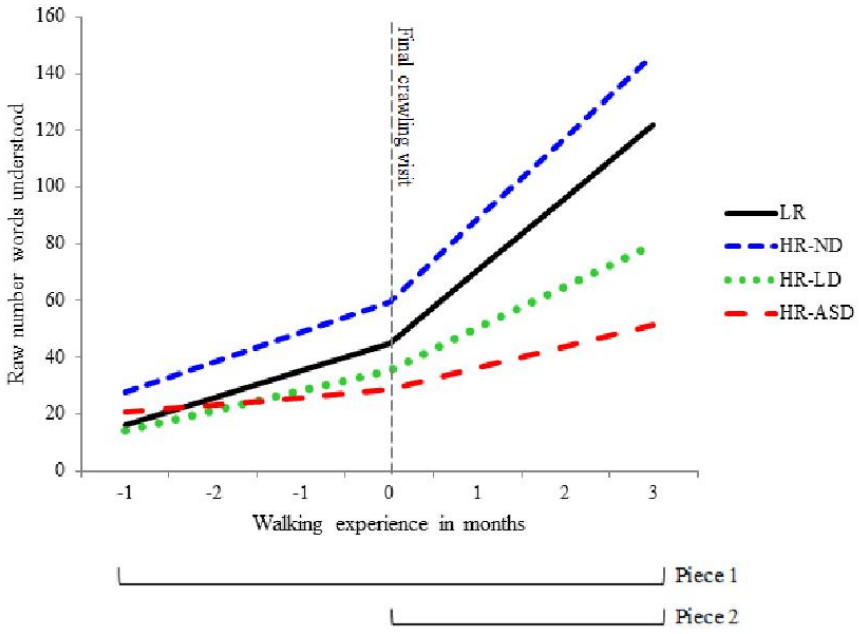
K. L. West, *N. B. Leezenbaum, J. B. Northrup and J. M. Iverson, University of Pittsburgh, Pittsburgh, PA*

Background: The onset of walking appears to be a point of inflection for communicative development in typically developing infants (e.g. Clearfield, 2011). Notably, research shows the acquisition of this milestone is accompanied by an increase in receptive language, independent of age (e.g. Walle & Campos, 2013). The present study examined whether this relation may be disrupted in the infant siblings of children with autism spectrum disorder (ASD; High Risk; HR)—particularly among infants who go on to receive an ASD diagnosis—given that there is ample evidence of substantial variability in language and motor development in HR infants (e.g. Gamliel, Yirmiya & Sigman, 2007; Iverson & Wozniak, 2007).
Objectives: To examine changes in the *Words Understood* measure of the MacArthur-Bates Communicative Development Inventory (CDI; Fenson et al., 1993) longitudinally across the transition to walking in infants with no family history of ASD (Low Risk; LR) and three groups of HR infants: No Diagnosis, Language Delay, and ASD.
Methods: Participants included 81 HR infants who were visited at home monthly from 5-14 months and a comparison group of 25 LR infants. This study focused on CDI data beginning 4 months prior to infants' walk onset and ending 3 months after walk onset. To establish walk onset, parents recorded infants' motor milestones, and an experimenter confirmed them at each visit. At 36 months, 15 HR infants received an ASD diagnosis (HR-ASD). Twenty-six HR infants with language delays were identified (HR-LD). Forty HR infants did not meet ASD or LD criteria (No Diagnosis; HR-ND).
Results: A two-level piecewise Hierarchical Linear Model was used to examine change in receptive language (RL) over time within individuals, and change across individuals within outcome classifications. The piecewise model allowed us to estimate growth in RL over the entire trajectory (piece 1; all time points) as well as change in growth from the final crawling visit forward (piece 2). Results revealed that the slope of growth following walk onset significantly explained variance in receptive language, even when variance explained by the overall slope (piece 1) was accounted for. This replicates previous findings that walk onset marks an inflection point in receptive language.
To examine group differences, dummy variables for outcome classification were included on the intercept and slopes for HR-ND, HR-LD, and HR-ASD infants, with a LR reference group. To control for age, age at walk onset was included in the model. Results revealed that HR-ASD infants displayed marginally slower growth than the LR group overall (piece 1), and significantly less change in growth following walk onset (piece 2). While the HR-ND group did not differ from the LR group, the HR-LD group demonstrated marginally reduced change in growth following walk onset compared to their LR peers.
Conclusions: For infants with no diagnosis—regardless of risk status— walk onset corresponded to increased RL growth. However, this pattern was significantly attenuated for HR-ASD infants. One possible explanation is that in typical development, the ability to walk influences underlying mechanisms of language acquisition, but this relation may diverge in ASD.

Table 1. Fixed Effects	Coefficient	s.e.
For INTRCPT1, π_0		
Mean LR intercept, β_{00}	44.76***	8.72
HR-ND, β_{01}	14.59	10.82
HR-LD, β_{02}	-9.35	12.2
HR-ASD, β_{03}	-16.23	14.76
For Piece 1 slope, π_1		
Mean LR slope, β_{10}	9.50***	2.10
Age at walk onset, β_{11}	-0.40	0.48
HRND, β_{12}	1.09	2.60
LD, β_{13}	-2.35	2.97
ASD, β_{14}	-6.81~	3.63
For Piece 2 slope, π_2		
Mean LR slope, β_{20}	16.25***	3.19
Age at walk onset, β_{21}	-1.90~	1.13
HRND, β_{22}	2.30	3.78
LD, β_{23}	-8.59~	4.57
ASD, β_{24}	-11.32*	5.51

Note: df = 109 for level 1 variance, and df = 108 for level 2 variance
~p<.10, *p<.05, **p<.01, ***p<.001

Figure 1.



72 **180.072** Examining the Role of Inhibitory Control in the Emotion Regulation Strategies Employed By Toddlers with and without ASD

L. DiNicola[1], *S. Macari*[1], *L. Flink*[2], *S. F. Fontenelle*[1], *G. Greco*[3], *P. Heymann*[1], *E. Hilton*[1], *S. S. Lansiquot*[4], *A. Milgramm*[1], *K. K. Powell*[1] *and K. Chawarska*[1], *(1)Yale Child Study Center, Yale University School of Medicine, New Haven, CT, (2)Sidney Kimmel Medical College, Thomas Jefferson University, Philadelphia, PA, (3)Boston Children's Hospital, Harvard Medical School, Boston, MA, (4)School of Nursing, Columbia University, New York, NY*

Background: Emotion regulation (ER) involves the modification of emotional expressions and behaviors (Fuster et al., 2008). Children with autism spectrum disorder (ASD) exhibit marked ER difficulties, particularly in frustrating contexts (Jahromi et al., 2012), but the mechanisms underlying these ER problems are unclear (Mazefsky et al., 2013). Within typically developing (TD) preschool-aged children, executive functioning (EF) skills, particularly those involved in inhibitory control, appear to influence ER abilities (Carlson & Wang, 2007). The potential relationship between ER and inhibitory control in young children with ASD has yet to be explored.
Objectives: (1) Determine if differences in inhibitory control appear during toddlerhood between children with and without ASD. (2) Examine the relationship between inhibitory control skills and ER strategies employed within frustrating contexts.
Methods: 24 toddlers aged 18-24 months, 14 with ASD (M_{age} = 21.42 months) and 10 TD (M_{age}= 20.28 months) completed the Laboratory Temperament Assessment Battery, Locomotor Version (LabTAB; Goldsmith et al., 1999). LabTAB includes three frustrating tasks: (1) restraint within a car seat, (2) removal of a toy from reach, and (3) blocked access to a toy through a parent's physical restraint. During each task, behavioral measures of negative affect (ratings of facial, bodily and vocal anger) and ER strategies (occurrence of disengagement, self-soothing, self-stimulating, social overtures, undirected bids for attention, and physical comfort-seeking) were coded by blind

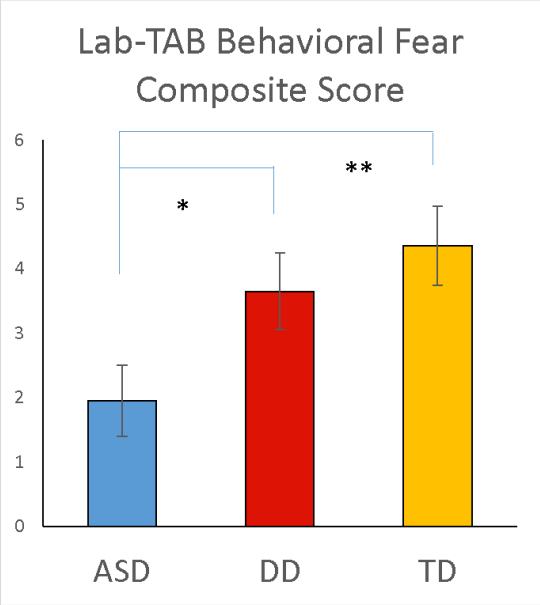
raters. ER scores indicating the proportion of trials in which each strategy was employed were derived, excluding trials in which no negative affect was observed. Inhibitory control skills were reported by parents through the Early Childhood Behavior Questionnaire (ECBQ; Putnam, Gartstein, & Rothbart, 2006).
Results: Toddlers with ASD had significantly lower inhibitory control scores ($M = 2.67$) than TD toddlers ($M = 3.69$), $F(1, 22) = 8.469$, $p < 0.01$. For each ER strategy, between-group comparisons indicated no significant differences in occurrence scores. Pearson's r correlations were performed between the ECBQ inhibitory control scores and each ER score within each diagnostic group. No significant correlations were found for toddlers with ASD. However, within the TD group, inhibitory control scores were significantly correlated with both disengagement ($r = 0.65$, $p < 0.05$) and physical comfort seeking ($r = 0.62$, $p = 0.056$).
Conclusions: Differences in inhibitory control skills between individuals with ASD and TD emerge as young as toddlerhood. Toddlers in both diagnostic groups appear to employ similar ER strategies within frustrating contexts; however, the mechanisms underlying the use of these strategies may diverge between groups early in development. Within our sample, TD toddlers with higher inhibitory control scores were more likely than intragroup peers to disengage from the source of frustration and seek physical comfort from a parent. This suggests an early-emerging link between the ability to control behavior in everyday situations and the coping strategies chosen within frustrating contexts for TD toddlers but not those with ASD. Elucidating these differences may provide clues pertaining to ER impairments associated with ASD and may inform pathways to treatment. Full-sample analyses of 50 toddlers will be presented at IMFAR.

73 **180.073** Fear Reactivity in Toddlers with ASD: Diminished Response and Atypical Associations with Visual Attention

S. Macari[1], *L. DiNicola*[1], *G. Greco*[2], *F. Shic*[1], *L. Flink*[3], *S. S. Lansiquot*[4], *K. K. Powell*[1], *S. F. Fontenelle*[1] *and K. Chawarska*[1], *(1)Yale Child Study Center, Yale University School of Medicine, New Haven, CT, (2)Boston Children's Hospital, Harvard Medical School, Boston, MA, (3)Sidney Kimmel Medical College, Thomas Jefferson University, Philadelphia, PA, (4)School of Nursing, Columbia University, New York, NY*

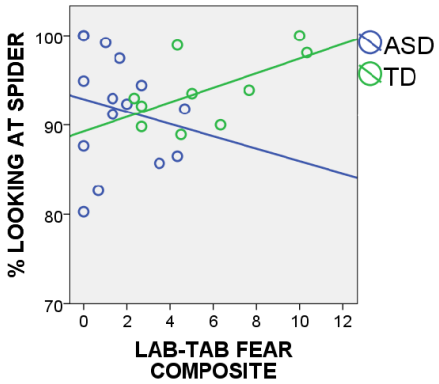
Background:
Among children with autism spectrum disorders (ASD), comorbid anxiety is common, affecting up to 80% of children. Anxiety symptoms are already more prevalent in 3-5-year-olds with ASD compared to preschoolers with other psychiatric disorders. In typically-developing children, individual differences in attention and proximity to a threatening stimulus are associated with social inhibition and anxiety. Little is known about these putative anxiety precursors in toddlers with ASD or relationships with fearful temperament.
Objectives:
To examine emotional reactivity, attention, and approach/escape in toddlers with ASD compared to their non-ASD peers in response to behavioral probes aimed at eliciting fear, and to examine parent-reported fearful temperament and its relationship with in-vivo responses.
Methods:
Participants were 50 age-matched toddlers (M=20 months; SD=2.6) with ASD (n=19), other developmental delays (DD; n=16), or typical development (TD; n=15). We adapted the Laboratory Temperament Assessment Battery/Locomotor version (Lab-TAB; Goldsmith & Rothbart, 1999) for use with toddlers with developmental disabilities. A Fear episode (Scary Spider) was administered; sessions were coded offline by blinded coders for intensity of emotional responses. Composite scores were computed for Fear (facial fear, distress vocalizations, bodily fear, and escape). Parents completed the Early Childhood Behavior Questionnaire (ECBQ; Putnam et al., 2006), including the Fear scale, capturing reactivity and distress to novelty. Duration of attention and approach/escape behavior was also coded for a subset of toddlers (18 ASD, 13 TD).
Results:
There was a significant group difference in the behavioral fear response ($F(2,47)=4.65$, $p=.01$; **Fig1**). Planned contrasts indicated that the ASD group exhibited less intense fearful affect than the TD group ($p<.01$) and the DD group ($p=.04$). There were no group differences on the Fear subscale of the ECBQ ($p=.80$). The ASD and TD groups did not differ in terms of time spent looking at the spider (M=91.1%, SD=6.4 and M=93.8%, SD=4.0, respectively; $p=.37$), and toddlers with ASD spent more time physically approaching the spider than did children with TD ($p=.006$). Visual attention to the spider appears to serve a different function for children with ASD: while TD toddlers with more pronounced *in-vivo* fear responses were more likely to attend to the spider ($r=.60$, $p=.01$), looking was more randomly associated with fear for the children with ASD ($r=-.18$; **Fig2**). Similar patterns of associations between attention to spider and fearfulness were found when considering parent-reported fear (ECBQ, $r=.59$, $p=.05$ in the TD group; $r=.04$ in the ASD group).
Conclusions:
This study suggests a divergent response to threat in toddlers with ASD compared to TD and DD at the level of behavioral fear responsivity and proximity seeking, one that is not evident via parent report of fear. Although the overall duration of looking at a threatening stimulus was similar across diagnostic groups, the patterns of associations with fearful temperament appeared different in the two groups. This study suggests a potential decoupling of affective responses to threat and voluntary attentional strategies for handling such threat in young children with ASD. The factors underlying atypical emotional reactivity in ASD, including attentional, physiological, affective, and cognitive processes require further examination.

Fig 1.



*$p<.05$; **$p<.01$

Fig 2. Correlations between Lab-TAB fear response and attention to threatening stimulus in toddlers with ASD and TD



74 **180.074** Fetal Head Growth in Children with Autistic Traits and Autism Spectrum Disorder

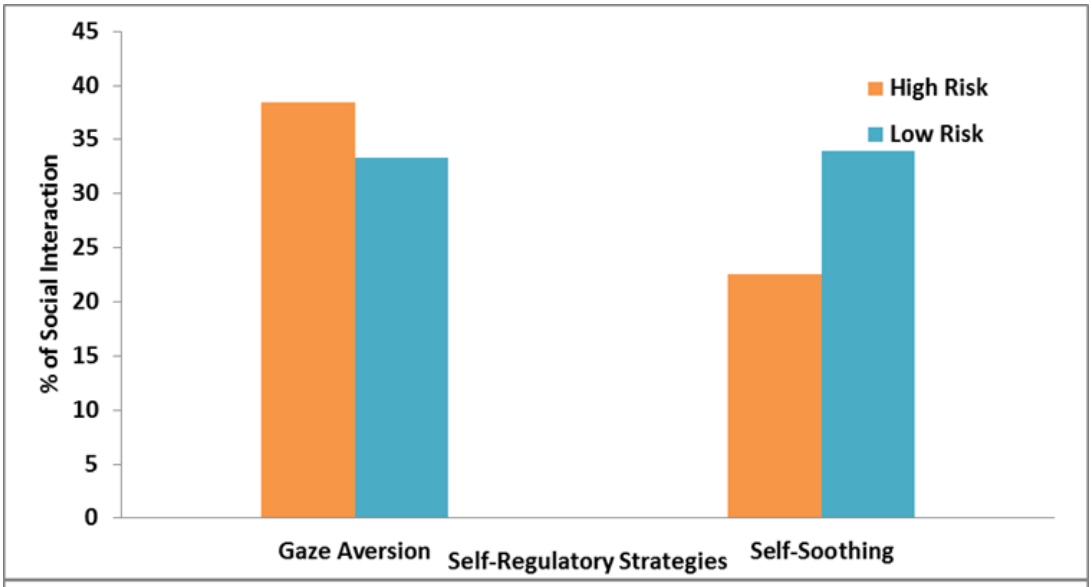
L. M. Blanken[1], *A. Dass*[2], *G. Alvares*[2], *J. van der Ende*[3], *M. Maybery*[4], *C. Dissanayake*[5], *C. Pennel*[6], *M. Hickey*[7], *F. Verhulst*[3], *H. Tiemeier*[3], *A. Whitehouse*[8] *and T. J. White*[9], *(1)Erasmus Medical Center - Sophia Children's Hospital, Leiden, Netherlands, (2)Telethon Kids Institute, West Perth, Australia, (3)Department of Child and Adolescent Psychiatry/Psychology, Erasmus MC-Sophia, Rotterdam, Netherlands, (4)University of Western Australia, Perth, Australia, (5)Olga Tennison Autism Research Centre, La Trobe University, Melbourne, Australia, (6)The University of Western Australia, Crawley, Australia, (7)Department of Obstetrics of Gynaecology and Obstetrics, University of Melbourne, Melbourne, Australia, (8)University of Western Australia, West Perth, WA, Australia, (9)Erasmus University Medical Centre, Rotterdam, Netherlands*

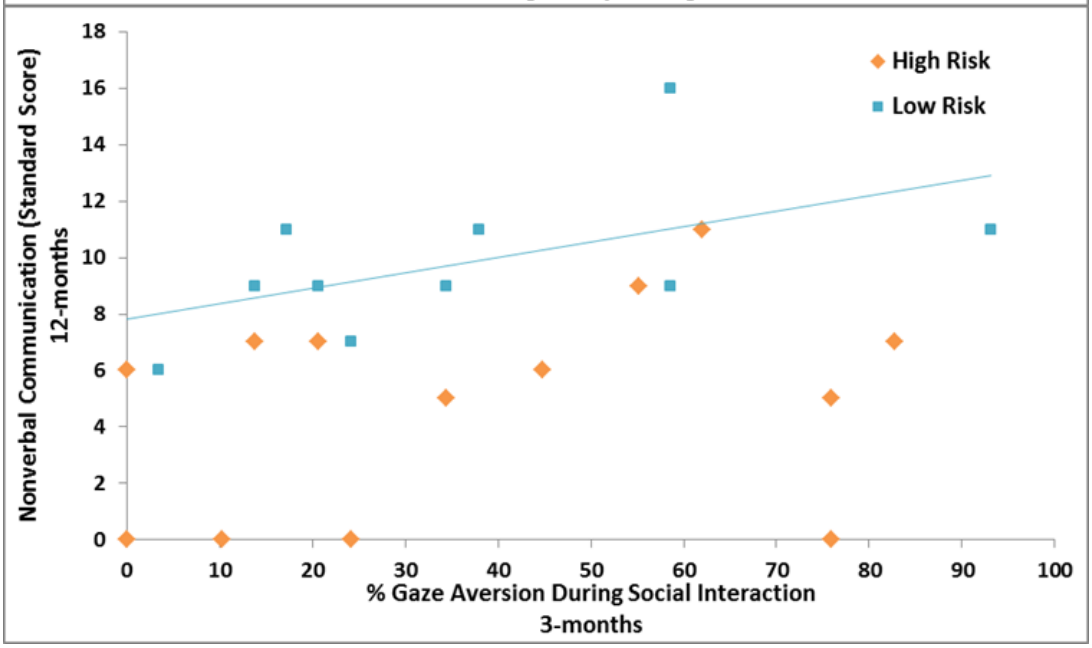
Background: Altered trajectories of brain development are often reported in Autism Spectrum Disorder (ASD), particularly early brain overgrowth in the first year of life (Hazlett, Poe et al. 2011). However, less is known about prenatal head growth trajectories. The few studies available have small sample sizes, typically depend on retrospectively collected ultrasound data and do not include repeated measurements of growth (Whitehouse, Hickey et al. 2011). While there is increasing support for the notion that ASD lies at the extreme end of a continuum of autistic traits, and that characteristics of the neurobiology may form a continuum as well (Blanken, Mous et al. 2015), there are no studies that investigate growth characteristics of the full spectrum of symptom severity (Constantino and Todd 2003).
Objectives: The objective of the current study is to prospectively evaluate prenatal head growth in children from the general population that later develop autistic traits. A second objective is to compare prenatal head growth between children with clinically diagnosed ASD and typically developing children.
Methods: This study included over 5,700 children participating in two large longitudinal prenatal cohorts, including more than 80 children with a confirmed diagnosis of ASD. Fetal head circumference (HC) was measured repeatedly during pregnancy using ultrasound. Autistic traits were measured with the Social Responsiveness Scale and the Autism Quotient. A diagnosis of ASD was based on mother report and confirmed with medical records. Additionally, ultrasounds were retrospectively collected for 45 children with ASD at a clinical research center. Longitudinal HC measurements at three time points were analyzed using a Latent Growth curve model approach to assess the relation of prenatal growth on autistic traits measured later in life.
Results: Preliminary analyses suggested an inverse relationship between prenatal head growth and autistic traits later in life. Children with more autistic traits showed HC growth curves that were characterized by smaller slopes and intercepts.
Conclusions: To our knowledge, this is the first large population-based study looking into prenatal brain growth and autistic traits. Preliminary results suggest that atypical brain growth in ASD may start in utero. Additional analyses comparing prenatal head growth between children with clinically diagnosed ASD and typically developing children will be conducted.

75 **180.075** Gaze Aversion and Self-Soothing at 3-Months and Social-Communicative Outcome at 12-Months for Infants at High- and Low-Risk for ASD: An Exploration of Differences in Self-Regulatory Capacities

J. Bradshaw[1], *S. Shultz*[2], *C. A. Saulnier*[3], *W. Jones*[2] *and A. Klin*[2], *(1)Marcus Autism Center, Children's Healthcare of Atlanta & School of Medicine, Emory University, Atlanta, GA, (2)Department of Pediatrics, Emory University School of Medicine, Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, GA, (3)Department of Pediatrics, Marcus Autism Center, Children's Healthcare of Atlanta, Emory University, Atlanta, GA*

Background: Self-regulation in the face of highly stimulating or distressing events is the primary developmental task for 2-6-months-old infants. Effective self-regulation and self-soothing during social interactions allows for sustained alertness, enhanced learning opportunities, and the development of fluid, coordinated parent-infant interactions. 3-month-old infants primarily use two methods of behavioral regulation: self-regulation through gaze aversion and self-soothing through bringing the hand to the mouth ("hand-to-mouth"). Some studies have suggested that the use of gaze aversion to self-regulate during social interaction is disrupted in 6-month-old high-risk infant siblings (e.g., Ibanez et al., 2008). However little is known about how these regulatory capacities at 3-months may promote later social-communicative abilities for high-risk or even low-risk infants. Understanding the form of self-regulatory capacities in early infancy and the function they serve for later social development will illuminate novel developmental pathways for the emergence of social-communication and development of ASD.
Objectives: The goal of the current study is to investigate self-regulatory strategies used by infants at high- and low-risk for ASD during parent-infant interactions and to associate these patterns with later developing social-communication skills
Methods: Participants included infants at high-risk (HR, N=13) and low-risk (LR, N=12) for ASD followed from 3-months through 12-months of age. At 3-months infants participated in a 30-second parent-infant interaction; parents were not touching or holding their infant to ensure the absence of potential external regulatory mechanisms. Parent-infant interactions were coded for the occurrence of self-regulatory gaze aversion (looking away from the caregiver) and self-soothing ("hand-to-mouth"). At 12-months, the Communication and Symbolic Behavior Scales (CSBS) was administered and the Social subscales were included as a measure of social-communicative ability.
Results: Results revealed no significant differences between groups in the amount of time spent using either self-regulatory strategy. There was a significant association between the use of gaze aversion during parent-infant interactions at 3-months and nonverbal communication at 12-months for LR infants ($r=.71, p<.05$), but not HR infants ($r=-.06$, *ns*). A trend was observed for both HR and LR infants that suggested a negative association between self-soothing and nonverbal communication at 12-months (HR:$r=-.45$, LR:$r=-.53$, *ns*). That is, high rates of self-soothing at 3-months were associated with lower rates of nonverbal communication at 12-months.
Conclusions: This study provides initial results indicating comparable use of self-regulatory strategies for high-risk and low-risk infants and unique relationships to social-communicative outcome. First, results suggest that using gaze aversion to self-regulate during social interactions promotes later social-communicative development for LR infants, but not HR infants. In contrast, self-soothing was marginally, negatively associated with nonverbal social-communication for both groups. Perhaps increased self-soothing is indicative of increased distress in response to social interaction, and thus these infants are less likely to communicate with an unfamiliar examiner in an unstructured setting at 12-months. Future analyses with additional participants will strengthen findings and further elucidate these patterns. Overall, this study highlights a novel approach for exploration of the unfolding of social behavior in very young infants and suggests that early self-regulatory strategies could provide a foundational context for the emergence of social-communication.





77 **180.077** Gaze-Contingent Event Triggering in the Social and Nonsocial Conditions

ABSTRACT WITHDRAWN

Background: Eye movement is more than passive viewing of the world and retrieval of visual input. Particularly in social scenarios, eye movements are important social cues that communicate emotion and shared attention. Most eye-tracking experiments in studies of autism spectrum disorder (ASD) are designed to explore the looking behavior of participants, but fail to consider eye movements as an interactive way for a participant to communicate shared attention.
Objectives: To create a gaze-contingent (GC) paradigm to provide opportunities for participants to trigger an event with their eye movement. To explore the differences in triggering time and looking duration in Social and Nonsocial conditions for children with ASD and typical development (TD).
Methods: Participants included TD children (n = 12 , Age = 38.3 ± 17.34 months) and children with ASD (n = 6, Age = 33.5 ± 8.55 months). Both groups completed 16 trials of Social and 16 trials of Nonsocial GC trials. In the Social condition, an actress sat in the center of the screen with an empty circular area on either side of her. Each condition started with a greeting, after which the trial began. Within each trial, the actress used escalating directional cues consisting of a Gaze Shift, Head Turn, Finger Point to one of the areas, with the last escalation involving a Flashing Red strobe in the target area. Once the participant looked at the target after one of the cues, the appearance of an animated toy in the target area was triggered as a visual reward. If the participant did not respond to any of the cues, the animated toy would appear after a delay. Each of the five steps took 2 seconds, for a maximum of 10 seconds per trial. The Nonsocial condition was constructed by scrambling the image of the actress in the Social condition, controlling for movement duration, motion, and size of moving area. We compared time required for the toddlers to follow the cue and move their gaze to the target area (Triggering time) and total looking duration on the screen (Looking duration).
Results: A Diagnosis x Condition linear mixed model on Triggering time revealed a significant effect of condition ($p < .001$) and diagnosis ($p = 0.02$). Triggering time was shorter in the Social (M = 2.9 s, SD = 0.44) versus the Nonsocial condition (M = 5.1 s, SD = 0.45) and TD children responded faster to the cues than children with ASD. Analysis of looking duration indicated a significant interaction effect ($p < 0.05$). Toddlers with ASD looked significantly longer at the Nonsocial cues compared to the Social cues ($p < 0.001$), but this was not the case for TD toddlers ($p = .502$).
Conclusions: Our preliminary results indicate that children with ASD have a preference for looking at nonsocial compared to social information. Children with ASD evidenced slower responses to directional cues in both conditions compared to typical peers, suggesting that they may need more cueing steps in both the social and nonsocial conditions.

78 **180.078** General Gross and Fine Motor Impairment Vs Specific Deficits in Prospective Control in Three-Year-Olds with Autism Spectrum Disorder

E. Nilsson Jobs[1], *G. Gredebäck*[2], *S. Bolte*[3] *and T. Falck-Ytter*[2], *(1)Psychology, Uppsala University, Uppsala, Sweden, (2)Uppsala University, Uppsala, Sweden, (3)Department of Women's and Children's Health, Pediatric Neuropsychiatry Unit, Karolinska Institutet, Stockholm, Sweden*

Background: Motor impairments are very common in children with Autism Spectrum Disorder (ASD). Whether some aspects of motor control should be seen as core features of the disorder is currently debated Research point to the possibility that atypicalities in prospective control, – i. e. to anticipate future events and adjust ones actions to these events before they occur – are particularly difficult for many people with ASD.
Objectives: The aim of the study was to compare prospective control as well as general gross and fine motor ability in 3-year-olds with and without ASD. We expected that group differences would be particularly pronounced in the prospective control task.
Methods: The general motor tasks consisted of the gross and fine motor subscales of the Mullen Scales of Early Learning (MSEL). The prospective control task was to draw a line from one point to another within an outlined curve-shaped path on paper (named the Way Home Task). In order to succeed on this task, the child has to anticipate the upcoming curves and proactively adjust his/her actions to avoid crossing the lines defining the path boundaries. The number of crosses was used as our measure of (failure) of prospective control. Twenty-eight children, 9 boys and 19 girls between 36-48 months (M= 39,9 months) from a longitudinal study of 'high risk' infant siblings participated

(all children were at high risk for ASD due to having an older sibling with the disorder). Diagnosis according to DSM 5 was decided upon in a professional team according to best practice, based on clinical assessment in a clinical research setting with the Mullen Scales of early learning, ADOS-2, ADI-R, Vineland and clinical observations. Twelve children were diagnosed with ASD and 16 got no diagnosis.
Results: Independent sample t-test showed that there was a significant difference between the groups on the two MSEL motor scales as well as the specific prospective control task (all *P*s < .05, one tailed). Grip type and visual reception subscale on the MSEL did not differ between the groups. However, logistic regression showed that gross motor ability was the only unique statistically significant predictor of diagnostic group, recording an odds ratio of 1.80.
Conclusions: In line with our hypothesis, the groups differed in their performance on the prospective control task. However, the groups also differed on more general fine motor as well as gross motor scales, and only the latter explained a unique portion of the variance in diagnostic status. This study indicates substantial differences in motor development in young children with ASD relative to other at risk children who did not fulfil criteria for diagnosis. With more participants reaching 3 years in our ongoing study, we will be able to more reliably assess the role of specific motor abilities, such as prospective motor control in ASD.

79 **180.079** Identifying Attentional Differences in Children with and without ASD: A Human-Robot Interaction Study

E. C. Barney[1], *L. Boccanfuso*[1], *C. Foster*[1], *C. A. Wall*[1], *B. Scassellati*[2], *K. Chawarska*[1] *and F. Shic*[1], *(1)Yale Child Study Center, Yale University School of Medicine, New Haven, CT, (2)Yale University, New Haven, CT*

Background: The ability to share one's focus of attention with another person is essential for social learning during early development (Carpenter et al., 1998). Children with autism spectrum disorder (ASD) show impairments in joint attention, specifically its initiation (Mundy & Newell, 2007). Typically, the presence or absence of such impairments in children is ascertained by trained clinicians in carefully planned play sessions during the diagnostic decision-making process (Dawson et al., 1998). Although robots are more commonly viewed as an interventional tool for children with ASD (Scassellati et al., 2012), they also have the potential to provide clinically relevant markers to aid in behavioral phenotyping (Scassellati, 2005).
Objectives: To examine behaviors related to the initiation of joint attention (IJA) in toddlers with ASD and with no clinical diagnosis (typical development; TD) during a short, unstructured interaction with a robot.
Methods: This study involved 22 toddlers (n_{ASD} = 11; n_{TD} = 11) matched on chronological age. Participants ranged in age from 20 to 42 months (M= 30.8 months). The human-robot interaction lasted approximately ten minutes and took place in an assessment room with a research assistant and typically a caregiver present. The spherical robot used light, sound, and movement to emulate the emotions of joy, fear, anger, and sadness in a fixed pattern that was at times contingent upon child interaction (Boccanfuso et al., 2015). No restrictions on physical contact were placed. The research assistant engaged the child by asking questions about the robot, but refrained from attributing emotions to it. Percentage of the total interaction time was calculated to assess duration of gaze behaviors and physical contact, while frequency counts were used to measure gesturing behaviors, instances of cooperative play, and gaze alternation between the robot and an adult.
Results: A series of one-way ANOVAs revealed differences between IJA behaviors in the two groups during the robot interaction. The group of children with ASD spent significantly less time looking at others' faces during the interaction than the TD group (F(1,20) = 13.13, p < .01, d = -1.55). Similarly, attempts to share attention by alternating gaze from the robot to an adult and vice versa were significantly lower for toddlers with ASD than TD toddlers (F(1, 20) = 6.61, p < .05, d = -1.10). There was a marginally significant difference between the cooperative play behaviors of the two groups (ASD < TD; F(1, 20) = 6.61, p = .058, d = -.86). No significant between group differences were found for the percent of total interaction time spent looking at the robot, time spent in physical contact with an adult, frequency of pointing behaviors at the robot, or frequency of gestures toward other items in the assessment room.
Conclusions: Our results highlight the differences between children with and without ASD during a brief, unstructured play session with a robot and adult supervisors. The findings are consistent with previous research on IJA, and they suggest a potential auxiliary role for robotics in the early identification of ASD.

80 **180.080** Incongruous Emotions during Fear-Eliciting Tasks in Children with Autism Spectrum Disorder

P. Heymann, *S. Macari, A. Milgramm, L. DiNicola, E. Hilton, K. K. Powell, S. F. Fontenelle and K. Chawarska, Yale Child Study Center, Yale University School of Medicine, New Haven, CT*

Background: Many school-aged children with Autism Spectrum Disorder (ASD) are reported to have unusual fears (e.g., toilets, elevators) and are significantly less likely to be afraid of animals and harm (e.g., knives) than typically-developing (TD) and developmentally-delayed (DD) peers (Mayes et. al., 2013; Evans et al., 2005). Fear of animals, specifically spiders, is one of the most common and biologically-preprogrammed fears in the general population (Davey, 1992). Lacking such fears is both unusual and potentially maladaptive. It is unclear if atypical fear responses are present during the early stages of ASD.
Objectives: To examine emotional reactivity in TD, DD and ASD toddlers in response to potentially frightening stimuli.
Methods: 50 Toddlers (20 ASD, 15 DD, 15 TD) between the ages of 15 and 26 months (M = 20 months) were administered three fear-eliciting tasks from the Laboratory Temperament Assessment Battery, Locomotor Version (LabTAB; Goldsmith & Rothbart, 1999): (1) Spider: a remote-controlled spider crawled toward participants, (2) Masks: an experimenter entered a room wearing masks, and (3) Dinosaur: a mechanical dinosaur emerged from a box. Each task consisted of three to four trials lasting 10 seconds each. Videotaped sessions were coded offline by blind coders for intensity of emotional responses during each trial using four-to-six-point Likert scales. Responses were averaged across trials, and composites were computed for Negative Affect (facial, bodily and vocal distress and escape behaviors) and Joy (facial, bodily and vocal joy). Emotions were then labeled as congruous with the task (e.g., Negative Affect) or incongruous (e.g., Joy). Proportions of congruent and incongruent emotions were computed by dividing each composite score by the sum of negative and joy composite scores during each task. All participants received the Autism Diagnostic Observation Schedule 2-Toddler Module (ADOS2-T: Lord et. al., 2012) to evaluate severity of autism symptoms.
Results: A linear mixed model revealed a significant Diagnostic Group*Task interaction (F(4,75.67) = 2.9, p = 0.027) for incongruous emotions. Pairwise comparisons revealed that the ASD group produced significantly more joy and less negative affect during Spider compared to the DD (p = .004) and TD groups (p = .02); however, there were no significant differences between groups for the Masks or Dinosaur tasks. While the majority of the TD (73%) and DD (80%) groups expressed fear during the Spider task, many toddlers with ASD (n = 11, 55%) expressed joy instead. For children with ASD, there was a significant positive correlation between the proportion of joy expressed during Spider and ADOS2-T total scores (r=.405, p=.006).
Conclusions: Preliminary findings suggest that toddlers with ASD are more likely to exhibit an incongruous emotion (joy) in response to a novel and potentially frightening stimulus compared to DD and TD peers. Their expression of joy did not generalize to other stimuli (Masks, Dinosaur). Incongruous emotion expression was associated with higher autism symptom severity in the ASD group. The presence of incongruous emotions in response to frightening stimuli in toddlers with ASD may have implications for later idiosyncratic fear expression, comorbidities, safety concerns, and challenging behaviors.

81 **180.081** Infant Neuroconnectivity Is a Predictor of Social Responsiveness Deficits at Age Four

A. Ross[1], *D. Swain*[2], *A. Scarpa*[1] *and M. A. Bell*[3], *(1)Psychology, Virginia Polytechnic Institute and State University, Blacksburg, VA, (2)Virginia Tech, Blacksburg, VA, (3)Psychology, Virignia Tech, Blacksburg, VA*

Background:
The ability to identify infants who are at increased risk of developing Autism Spectrum Disorder (ASD) would facilitate referral to early intervention, which has been shown to lead to improved outcomes. Biomarkers offer one method to attain that possibility. Hyperconnectivity between brain regions is seen in animal models of ASD and in human neuroimaging studies. A noninvasive way to assess neuroconnectivity in very young populations is via the electroencephalogram (EEG), a measure of neuroelectrical activity. EEG coherence is the squared cross-correlation between two electrodes and is conceptualized as a measure of functional connectivity between underlying neural networks.
Objectives:
The association between hyperconnectivity and social deficits in the literature led to our *a priori* hypothesis that early frontotemporal connectivity would predict later levels of poor social responsiveness and engagement (positive *beta* weights) in typically developing children.
Methods:
At five-months of age, 58 infant-parent dyads participated in a research study; baseline EEG was recorded while the infant watched multicolored balls spin in a toy. When the children were four years old, parents completed the Social Responsiveness Scale (SRS) about their child's social impairments. The SRS produces a total score, as well as five subscales: social awareness, social cognition, social communication, social motivation, and restricted and repetitive behaviors, with a higher score indicating increased impairment in each domain. All children were born full term with no complications, representing a typically developing sample.
Results:
Five-month EEG coherence at baseline between bilateral frontal and temporal scalp locations predicted SRS total score at four years (p=.03, F=3.64), with right hemisphere electrodes (F4-T8) providing unique variance (p=.012, b=.332). This measure of connectivity at five-months accounted for 12% of the variance in SRS total seen at four years. Based on this finding, we conducted *post hoc* analyses to determine which of the subscales may be driving the effect. Social communication (p=.028, F=3.835) and social motivation (p=.038, F=3.477) were the only two subscales predicted by five-month frontotemporal EEG coherence. Again, the right hemisphere electrodes (F4-T8) contributed unique variance for social communication (p=.011, b=.337) and social motivation (p=.039, b=.271)
Conclusions:
These findings suggest that right frontotemporal hyperconnectivity is associated with later social behaviors that may contribute to the social deficits seen in disorders like ASD. This hyperconnectivity seems to result in diminished social motivation and communication, but not in restricted and repetitive behaviors or social cognition and

awareness. Currently, there are no empirically supported methods to diagnose children with ASD as young as five-months of age; however, this measure of hyperconnectivity could serve as a predictor for reduced social responsiveness at age four. This could lead to early screening techniques and allow for targeted interventions for children who are at risk for developing ASD or other difficulties with social engagement.

82 **180.082** Initiating the 1-Year Well-Baby Check-up Approach in Early-Detection Challenged Areas: Survey Results and Initial Feasibility Findings

S. James[1], *E. C. Bacon*[2], *C. J. Smith*[1] *and K. Pierce*[3], *(1)Southwest Autism Research & Resource Center, Phoenix, AZ, (2)University of California San Diego, La Jolla, CA, (3)Neuroscience, UCSD Autism Center of Excellence, La Jolla, CA*

Background: A recent study in San Diego centered on creating a large-scale pediatrician network and utilization of the CSBS to screen all babies at the 1-year check-up as standard of care resulted in a mean age of 12 months for screening, 14 for evaluation, and 18 for treatment participation. These are far younger ages than is common in the U.S. It is unclear, however, if this model could be easily adopted in other cities. According to the CDC, Phoenix Arizona has one of the latest ages of diagnosis in the country at 4.7 years, and thus would be an ideal location to examine feasibility of implementing the 1-Year Well-Baby Check-Up Approach.
Objectives: The objective of this study was to first survey existing screening practices between San Diego, a long time 1-Year Well Baby Check-Up Approach city and Phoenix, a city without existing standardized screening programs. Next, the study sought to determine if following the steps of the 1-Year Well-Baby Check-Up Approach, which included building a pediatrician network and providing pediatricians with screening tools that contain clear cut-off scores and guidelines for referral, is an effective way to promote autism screenings at 12-month well-baby checkups and subsequent developmental evaluations.
Methods: First, 62 physicians in San Diego already engaged in active screening, and 85 physicians in Phoenix who were not part of an active screening program were surveyed to compare screening practices and beliefs. Second, the 1-Year Well-Baby Check-Up Approach was initiated in Phoenix, and initial indices of program development such as time required to create a pediatrician network and monthly rates of screening and referral was tracked.
Results: Survey responses indicated that the majority of pediatricians in Phoenix (64.29%) and San Diego (76.27%) agreed that autism can be detected at 12 months, but significantly fewer pediatricians in Phoenix (37.50%) than in San Diego (85.96%) reported that they frequently screen for autism at 12-month well-baby checkups, X^2 (1, N = 129) = 30.87, p < .001. Similarly, significantly more physicians in San Diego (77.59%) than in Phoenix (16.66%) reported using standardized screening tools as part of 12-month well-baby checkups, X^2 (1, N = 136) = 50.47, p < .001. A network of 108 pediatricians in Phoenix was created in 8 months and has resulted in a mean rate of 591 screens per month, and 84 referrals per month. Currently, 119 developmental evaluations have been completed as a result of the pediatrician network.
Conclusions: Results from this study suggest that rates of autism screenings conducted at 12-month well-baby checkups can be increased when pediatricians are provided simple tools that link screening and evaluation referrals. Indeed, results from this study found that the odds of screening for autism and using standardized screening tools at 12-month well-baby checkups is more than 10 times greater when pediatricians are provided simple screening tools with referral guidelines. Initial feasibility indices suggest that initiating the 1-Year Well-Baby Check-Up Approach to detect ASD around the 1st birthday may be a realistic option for many cities.

83 **180.083** Insights Gained from Electrophysiological Investigation of High-Risk Infants: Early Markers of ASD in Infants with Tuberous Sclerosis Complex

ABSTRACT WITHDRAWN

Background: Early identification and intervention research has traditionally relied on behavioral markers to predict outcomes and measure change across development. While valuable, this approach is limited by the restricted behavioral repertoire of infants and young children, particularly those with developmental delays. The integration of quantifiable brain-based measures in developmental research provides a means to capture subtle and covert processes, both within and across individuals, which may not be detected at the behavioral level. In this context, non-invasive brain-based measures that can be used from early in life, such as electroencephalography (EEG), hold promise as biomarkers of risk, prediction, stratification and treatment monitoring. Importantly, as EEG reflects the synchronous activation of large populations of neurons, it serves as a "bridge" between genes and behavior that holds considerable promise in mechanistic discovery in neurodevelopmental disorders.
Objectives: Here, we draw upon our prospective, longitudinal study of infants with TSC to demonstrate (1) how we have used EEG to explore whether impairments in higher-order visually mediated behaviors in TSC are grounded in alterations in low-level visual processing, (2) the ability of EEG to facilitate the deeper characterization of early development in this rare population, (3) the promise of EEG methods to guide the search for early, predictive biomarkers that uniquely sensitive to ASD and Intellectual Disability in this high-risk population.
Methods: High-density EEG recordings were conducted with infants with TSC and typically-developing control infants at 6, 12, 18, 24 and 36 months using 128-channel HydroCel Geodesic Sensor Nets (EGI Inc.). Based on evidence from animal models of TSC for alterations in the retinogeniculate pathway, we used a visual evoked potential (VEP) paradigm to determine whether alterations in low-level visual processing in TSC may be a potential mechanism for deficits in higher-order visually mediated behaviors (as indexed on behavioral measures). We also assayed more complex visual processing in TSC by recording event-related potentials (ERPs) to faces versus objects.
Results: To date, we have identified intact low-level visual processing in TSC (as demonstrated by remarkably intact VEPs; Varcin et al., in press) albeit with alterations in more complex visual processing emerging between 12 and 24 months. These findings suggest that atypical face processing does not appear to be a consequence of early visual processing alterations, and instead, point toward aberrations in circuits associated with the processing of more complex visual stimuli.
Conclusions: Impairments in the non-verbal, visually-mediated behaviors in TSC do not appear to be rooted in disturbances in low-level visual processing and, instead, may stem from higher-level alterations in information processing. Our EEG findings are also capturing changes in the processing of complex visual stimuli between 12 and 24 months, complementing our behavioral findings in highlighting this period as an important target for early intervention and guiding further investigation into potential mechanisms accounting for this change.

84 **180.084** Lateralization to Speech Stimuli and Handedness in Early Development of Autism Spectrum Disorder

K. H. Finch[1], *A. Seery*[2], *M. R. Talbott*[3], *H. Tager-Flusberg*[1] *and C. A. Nelson*[4], *(1)Boston University, Boston, MA, (2)New York University School of Medicine, New York, NY, (3)University of California, Davis, Sacramento, CA, (4)Boston Children's Hospital/Harvard Medical School, Boston, MA*

Background:
Numerous studies have investigated the patterns of asymmetry in individuals with autism spectrum disorder (ASD). Atypical lateralization of language has been found in individuals at risk for ASD as young as 12-months-old. Seery et al. (2013) found distinct patterns of lateralization in the late slow wave (LSW) in response to speech, and in follow-up studies, 12-month-olds later diagnosed with ASD showed reversed lateralization. Atypical behavioral asymmetry has been observed as left and mixed handedness occur more frequently in children with ASD (Dane & Balci, 2007). To date, no study has investigated the relationship between early patterns of cerebral lateralization and behavioral asymmetry in infants later diagnosed with ASD.
Objectives:
The current study aims to explore the relationship between neural responses to language stimuli at 12 months and handedness at 36 months.
Methods:
Participants
79 monolingual, English-speaking infants were divided into three groups: Low-risk controls (LRC; N=40), high-risk for ASD (HRA) infants (older sibling with ASD) without ASD (HRA-; N=31), and HRA infants with ASD (HRA+; N=8)
Language Lateralization
Event-related potentials to speech sounds were recorded at 12 months. A later sustained negativity (LSW; 300-700ms) was observed over the central regions. A laterality index was calculated by subtracting the mean amplitude of the LSW of the right hemisphere from the mean amplitude of LSW of the left hemisphere (LSW_{left}-LSW_{right}).
Handedness
Utilizing a novel observational approach, hand preference was measured on a variety of behavioral observations during the Autism Diagnostic Observation Schedule and the Mullen Scales of Early Learning at 36 months. Factor analysis with principle axis factoring extraction technique indicated a one-factor model with medium to high factor loadings (Table 1). Using these measures, a composite handedness score ([RH-LH]/[RH+LH]*100) was calculated for each individual.
Results:
At 12 months, LSW laterality index was significantly different across groups ($F(2,76)=3.86$, $p<.05$) with LRC and HRA+ infants showing opposite patterns ($p<.05$); handedness scores at 36 months did not differ across groups ($H(2)=3.934$, $p=.140$) (Table 2).
Across all participants, there was no significant relationship between LSW asymmetry at 12 months and handedness at 36 months (r_s=-0.09, p=0.43). Within each of the groups, 12 month LSW asymmetry did not significantly predict 36 month handedness in LRC infants (r_s=-0.22, p=0.17) or HRA- infants (r_s=-0.05, p=0.78). Conversely, for HRA+ infants, there was a significant relationship (r_s=0.78, $p<0.05$) such that infants with a laterality index more similar to the LRC group at 12 months were stronger right handers at 36 months.
Conclusions:
This study is the first to investigate the relationship between early asymmetry patterns in infants with and without ASD. We did not find a relationship between language lateralization at 12 months and handedness at 36 months in children without ASD. However, infants with ASD exhibit such a relationship in that HRA+ infants with a more typical response to speech at 12 months have more typical handedness at 36 months. This suggests that these individuals might have an underlying protective factor in the early development of cortical lateralization which later manifests into more typical language lateralization and handedness.

Table 1 Handedness measure factor analysis. *One-factor solution and item factor loadings for the handedness observational measures from the ADOS and MSEL*

Activities	Loading on Factor 1
Colors	0.86
Draws	0.79
Knife	0.58
Scissors	0.55
Fork	0.41
Toothbrush	0.41
Ball	0.33

Table 2 Descriptive statistics for laterality index and handedness score.

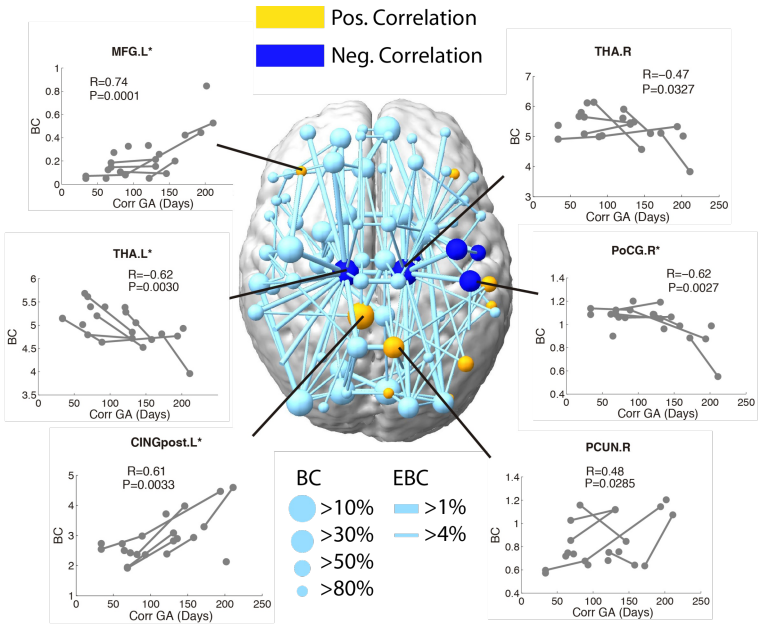
	Group			LRC vs. HRA- vs. HRA+ [b]
	LRC	HRA-	HRA+	
N	40	31	8	--
12 Month LSW Laterality Index	1.09 (2.5)	0.32 (2.8)	-1.67 (2.3)	*
Composite Handedness Score [a]	61.79 (47.0)	74.29 (53.1)	61.25 (43.6)	*n.s.*

[a] Composite handedness score ([RH-LH]/[RH+LH]*100) ranges from -100 to 100
[b] One-way ANOVA for comparisons of LSW laterality index; Kruskal-Wallis tests for comparisons of handedness scores, *<.05

85 **180.085** Longitudinal Charting of Infant Brain Connectomes in the First 6 Months of Life

L. Li[1], *S. Shultz*[2], *X. P. Hu*[3], *A. Klin*[2] *and W. Jones*[2], *(1)Department of Pediatrics, Marcus Autism Center, Children's Healthcare of Atlanta, Emory University, Atlanta, GA, (2)Department of Pediatrics, Emory University School of Medicine, Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, GA, (3)Department of Biomedical Engineering, Emory University, Atlanta, GA*

Background:
Recent advances in graph theory and its application in brain imaging science (i.e., brain connectomes) have shed tremendous light on organizational principles of brain structure and function[1]. However, Research utilizing the technique to longitudinally follow the development of brain networks in infants is still rare. Such work will reveal new information with regard to the architecture of brain structure and function in brain development and has direct translational significance in many neurodevelopmental disorders, including autism spectrum disorder (ASD).
Objectives: To chart spatial and temporal details of brain networks of infants in their first 6 month of life using diffusion MRI and graph theory
Methods:
14 typically developing infants (corrected gestational age: 34-211 days, 4 females) were imaged up to 3 times under natural sleep in the first 6 months of life, resulting in 21 scans in total. The diffusion data were collected on Siemens Trio TIM system with a 32-channel head coil and multiband technique. The imaging parameters include: MB factor of 2, TR/TE=6200/74ms, FOV=184×184, matrix size of 92×92, diffusion directions of 61 with 6 b=0 images and a b-value of 700. Streamline probabilistic tractography based on the outputs of FSL was implemented in Camino, achieving approximately 7 million streamlines per subject. We assume that patterns of macro-scale region-to-region connections (i.e., brain connectivity pattern) of the brain in infants with different ages will be largely constant. It is the brain connectivity efficacy (defined as the inverse of the mean radial diffusivity (RD)) along the pathway linking the two regions that alters over time[3]. Thus, we first derived connectional matrices of 90 brain regions in 14 typical infant brains and then thresholded the averaged connectivity matrix at the network density of 10%. The weights of brain networks were quantified by the mean of 1/RD in each pathway. We then examined the relationship between a graph-theoretic metric, betweenness centrality(BC), and the corrected gestational age for changes of brain network maturation over time.
Results:
The global efficiency of whole brain networks is positively correlated with age(R=0.94, P<1.8e-10). The topological roles of each brain region in structural brain networks of infants vary with time and have divergent trends: quantified by BC, bilateral thalamus and right pre- and post- central gyri have decreasing centrality over time (Fig.1), even though the averaged connectivity efficacy (as measured by 1/RD) in these regions increases over time (THA.L: R=0.88, P<1.99e-7; PoCG.R: R=0.91, P<8.1e-9). In contrast, several cortical regions, such as left posterior cingulate gyrus (CINGpost), left middle frontal gyrus (MFG), right angular gyrus (ANGU) and right inferior occipital lobe (IOC) have increased BC over time, indicating their increasingly important roles in infant brain networks (Fig.1).
Conclusions:
Our study also seems to fit the two-process theory of early brain development[4], which proposes that early reflexive behaviors in young infants are mainly mediated by subcortical structures. Such experience-expectant subcortical control will gradually decline and be replaced by experience-dependent, cortical control. Recent work by our group suggests disruptions in this neurodevelopmental transition in infants subsequently diagnosed with ASD[5].



86 **180.086** Neural Precursors of Language in Infants at High Risk for Autism Spectrum Disorder

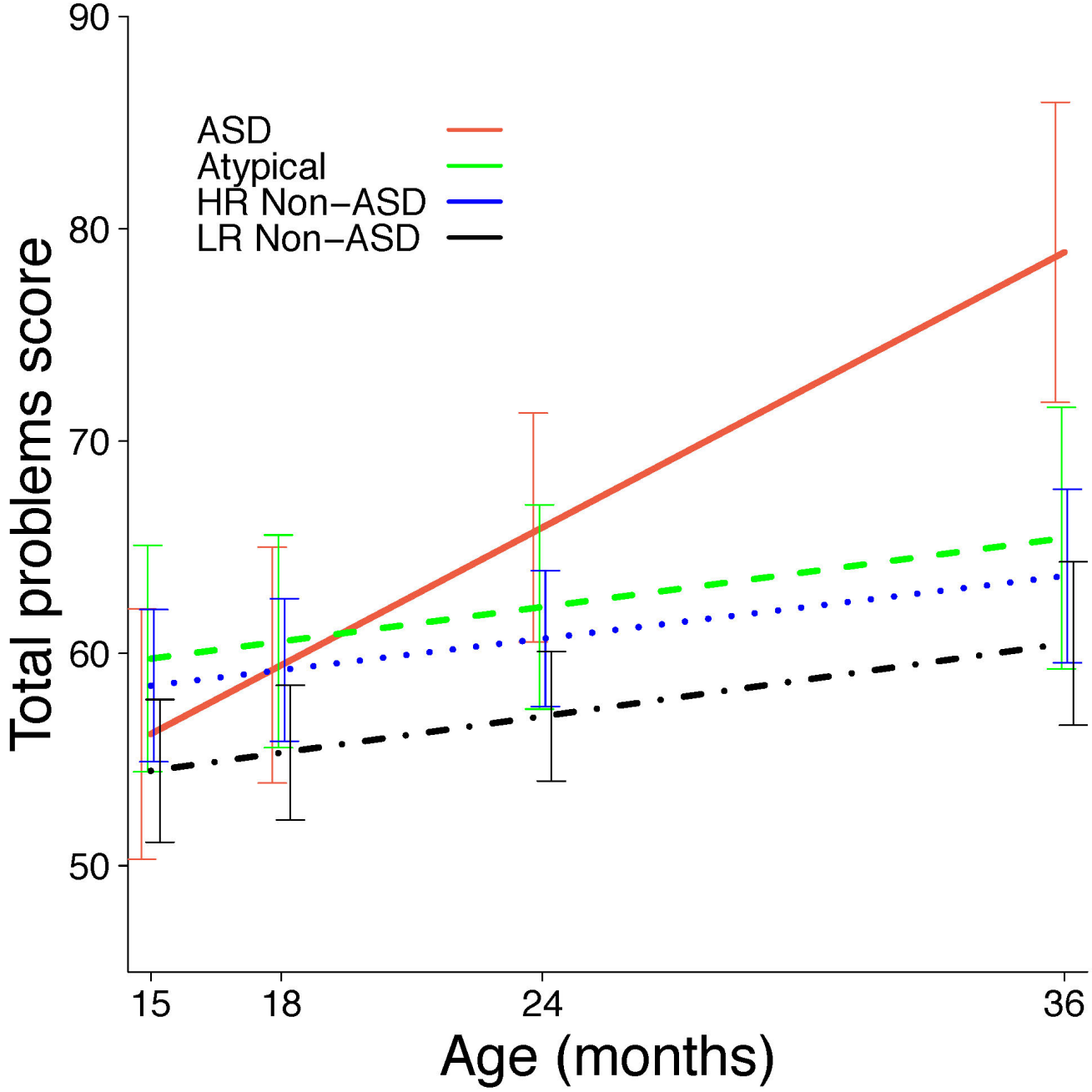
L. A. Edwards[1], *H. Tager-Flusberg*[2] *and C. A. Nelson*[3], *(1)Boston Children's Hospital, Boston, MA, (2)Boston University, Boston, MA, (3)Boston Children's Hospital/Harvard Medical School, Boston, MA*

Background: Autism spectrum disorder (ASD) is a developmental disorder characterized by difficulties in social interaction and communication. One in 5 infants with an older sibling with ASD will develop this disorder, compared to the rate of 1 in 68 in the general population. However, a subset of siblings who do not develop ASD may also exhibit a variety of developmental delays/problems, including language impairments. Research on children with ASD and their siblings has repeatedly shown that those who develop stronger language abilities have more positive outcomes. One strategy for improving language is to get children at risk for ASD into effective and appropriately targeted educational interventions in the very earliest stages of life, when precursors of language and other social behaviors are developing. However, ASD is currently not diagnosed until children have reached 2 or 3 years of age.
Objectives: In this study, we first investigate neural precursors of language acquisition as potential biomarkers of atypical development in 3-month-old infants at high risk for ASD. We then examine whether these biomarkers predict children's language and communicative outcomes at 18 months of age.
Methods: Participants were drawn from a larger sample of infants enrolled in an ongoing, longitudinal, prospective study of early development in siblings of children with ASD. Three month olds with high (HRA; *n*=21) and low (LRC; *n*=17) familial ASD risk were imaged using functional near-infrared spectroscopy while they listened to speech-like stimuli containing syllable repetitions or control syllable sequences (see Gervain et al., 2008). We analyzed their neural responses to these stimuli over left and right temporal regions to determine whether biomarkers of atypical language development are present the first few months of life. We then used multiple and ordinal linear regression techniques to investigate whether 3-month-old neural activity predicts children's 18-month expressive and receptive language (measured by the Mullen Scales of Early Learning [MSEL] and the MacArthur-Bates Communicative Development Inventory: Words and Sentences Module [MCDI]), and autism symptomatology (measured by Autism Diagnostic Observation Schedule severity scores) outcomes.
Results: While LRC infants showed initial neural activation that decreased over exposure to repetition-based language stimuli, potentially indicating a habituation response to repetition in speech, HRA infants showed no changes in their neural activity to these stimuli over exposure ($F(1,33) = 6.77$, p[*sequence*exposure*risk*gender*]=0.014). This 3-month-old neural activity predicted 18-month MSEL expressive language ($0.001<p<0.045$) and MCDI early gesture scores ($0.004<p<0.041$) in both LRC and HRA groups; in some cases, these associations also differed for males and females.
Conclusions: Putative precursors of language acquisition are disrupted in children at high risk for ASD from as young as 3 months of age. The current research thus identifies neural biomarkers that may be specific to language development, and which, with future research and educational application, may aid in determining which children are most likely to benefit from placement into language-based educational intervention programs from the very first months of life.

87 **180.087** Onset, Trajectory and Pattern of Feeding Difficulties in Infants Later Diagnosed with ASD

M. B. Steinfeld[1], *G. S. Young*[2] *and S. Ozonoff*[1], *(1)UC Davis MIND Institute, Sacramento, CA, (2)Psychiatry & Behavioral Sciences, UC Davis MIND Institute, Sacramento, CA*

Background:
Restrictive, rigid and extremely narrow food preferences, difficulties managing advanced or mixed textures, and negative mealtime behaviors are commonly described in children with Autism Spectrum Disorder (ASD).
Objectives:
To identify the onset, trajectory and pattern of feeding difficulties in infants later diagnosed with ASD.
Methods:
A new autism-specific factor structure (Allen et al 2015) for the Behavioral Pediatrics Feeding Assessment Scale (BPFAS), a validated and commonly used parent report measure of feeding problems (Crist & Napier-Phillips 2001), was applied to prospectively collected BPFAS's in a sample of 93 infants with an older sibling with ASD -- the high-risk (HR) group -- and 62 infants with no known familial ASD -- the low-risk (LR) group, as part of a larger funded infant sibling study. Infants enrolled at 6 or 9 months and were assessed prospectively at 6, 9, 12, 15, 18, 24 months. At 36 months comprehensive diagnostic assessments were conducted using ADOS, Mullen and observational data. The BPFAS was completed by parents at 15, 18, 24, and 36 months.
4 outcome groups were formed based on the 36 month clinical assessments: ASD, Atypical (defined as mild-moderate cognitive, language, or social impairment), high-risk typically developing (HR-TD) and low-risk typically developing (LR-TD).
Results:
As can be seen in Fig 1, longitudinal trajectories across groups revealed that the ASD group exhibited a significantly increasing number of feeding problems between 15-36 months compared to all other groups. By 36 months, the ASD group exhibited significantly more problems than all other groups. No differences were found between any of the other groups in change over time or at any age point.
The analysis of the 3 factor score described by Allen et al (2015) revealed a similar pattern for the food acceptance and mealtime behavior domains, with significant age by group interaction effects. The ASD group exhibited greater problems in terms of food acceptance and mealtime behavior domains over time compared to the other groups.
The medical/oral-motor domain did not show main effects for either age or group and no significant interaction between age and group.
Conclusions:
Children developing ASD showed a rapid increase in parent-identified feeding problems starting between 15-18 months of age, with significantly more feeding problems by 36 months of age compared to the other 3 groups. Food acceptance problems and mealtime behavior problems were significantly more common whereas medical/oral motor problems were not more frequent than in the other groups.



88 **180.088** Orienting Response to Social Versus Physical Audiovisual Synchrony Does Not Differ in Toddlers with ASD

R. D. Sifre, *W. Jones, A. Klin and S. Shultz, Department of Pediatrics, Emory University School of Medicine, Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, GA*

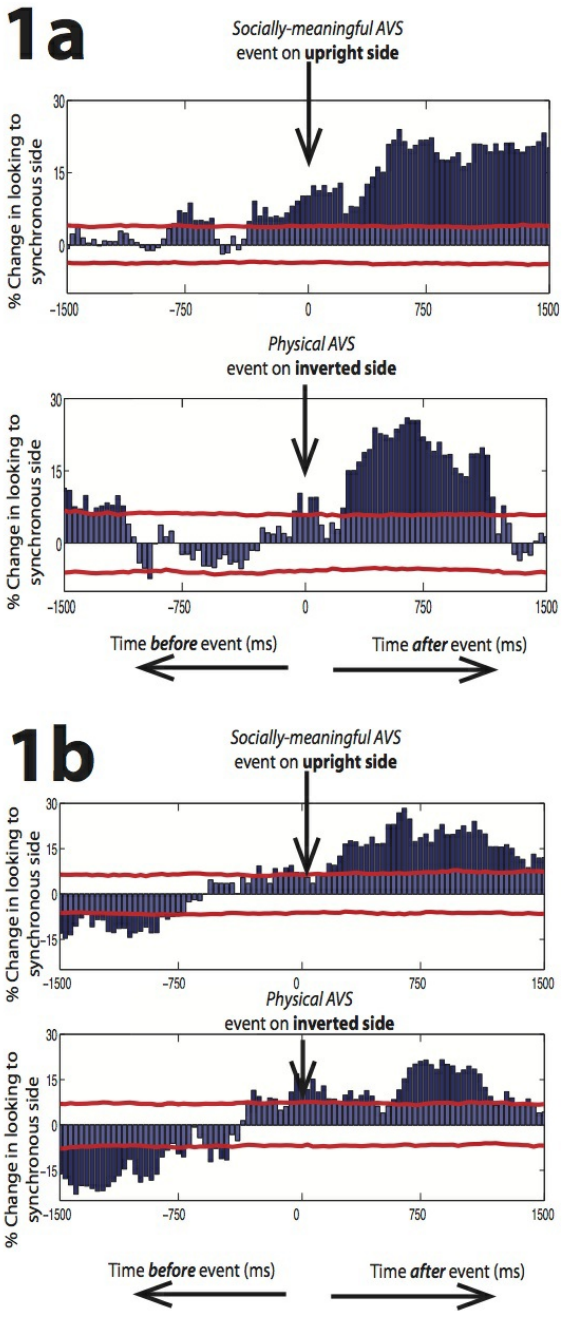
Background: Preferential orienting to biological motion, a skill thought to be critical for early social development, is disrupted in 24-month-old toddlers with autism (Klin et al., 2009). Instead of orienting to biological motion, toddlers with ASD attend to audio-visual synchrony (AVS), suggesting that their attention is guided by physical rather than social contingencies. Despite this apparent dichotomy, it should be noted that while AVS is indeed characterized by physical contingencies (the simultaneous presentation of light and sound), high AVS signals can also contain critical social information, as in the case of speech or co-speech gestures. This raises important questions about the adaptive value of orienting to AVS in typical development, and whether attention to AVS observed in ASD is driven primarily by preferences for physical or socially-meaningful contingencies.

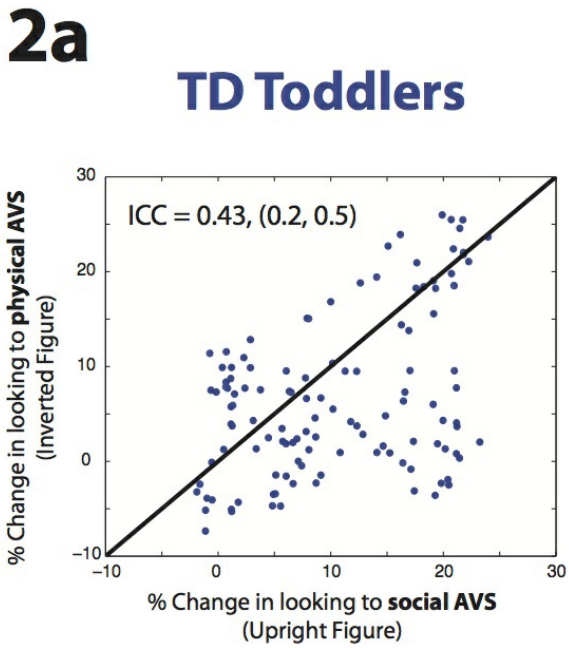
Objectives: Investigate whether toddlers with and without ASD attend differently to high-AVS signals generated by *socially-meaningful* versus *physical* contingencies.

Methods: 58 toddlers (21 ASD, 37 TD) were shown point-light biological motion animations. An upright animation was presented on one half of the screen with the soundtrack of the actor's vocalizations. On the other screen half, the inverted version of the same animation played in *reverse order.* Levels of AVS were quantified for the upright and inverted figure by measuring synchronous change in motion and sound at each frame. High-AVS moments were defined *a priori* as frames with AVS values exceeding the 90th percentile threshold. High-AVS moments generated by the *upright figure* were classified as *socially-meaningful AVS* in that they were generated by the movements and vocalizations of a biological figure. Conversely, high-AVS moments generated by the *inverted figure* were classified as *physical AVS* in that they were generated by the coincident alignment of two disparate signals of light and sound. Peristimulus time histograms were created to assess the probability of looking at the upright/inverted figure, 1500ms before and after a high-AVS event. If toddlers orient to both socially-meaningful and physical AVS, then they should show similar orienting towards high-AVS moments generated by the upright and inverted figure. If toddlers distinguish between socially meaningful and physical AVS, then they should orient differently to AVS generated by the upright versus inverted figure.

Results: Intra-class correlations revealed that while ASD toddlers showed remarkably similar orienting to AVS on the upright and inverted side at all time-points ($r=0.89$, $p<10^{-13}$), this relationship was weaker for TD toddlers ($r=0.14$, $p<10^{-6}$) (Figure 2a). TD toddlers' orienting to AVS on the upright and inverted side differed in two ways: They showed anticipatory looking towards the upright figure *before* socially meaningful high-AVS events, and demonstrated sustained looking *after* socially meaningful high-AVS events. Anticipatory and sustained looking were not observed for physical high-AVS events (Figure 2b).

Conclusions: While TD toddlers differentially orient to socially-meaningful and physical AVS, ASD toddlers' attention is indiscriminately biased by these two synchrony types. These findings support and expand on findings that ASD toddlers' preferentially attend to physical rather than social contingencies, while highlighting the important role that orienting to socially-meaningful AVS may play in typical development.





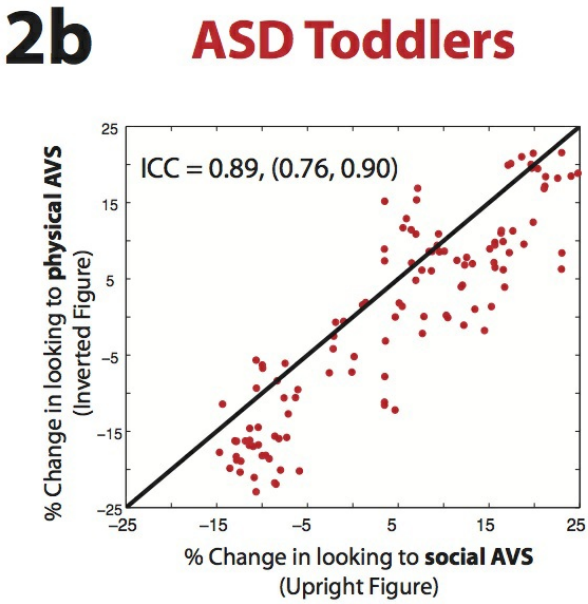


Figure 1. Peristimulus time histograms demonstrating % change in fixation 1500 ms before and after the onset of high-AVS events. Red lines indicate significance thresholds obtained via permutation testing (1000 permuted resamplings); shading indicates when the change in fixation reaches statistical significance ($p<0.05$). **a)** TD results. *Upright figure.* TD viewers show a prolonged increase in fixation beginning 333 ms *before* onset of a high-AVS event and sustained looking *after* event onset for 1500 ms. *Inverted figure.* There is a significant increase in fixation after the event onset that peaks at 25.9% and lasts for 1000 ms. **b)** ASD results. *Upright figure.* ASD viewers increase looking *after* the high-AVS event, peaking at ~700ms, but reducing to chance levels by 1500ms. *Inverted figure.* A similar profile is observed for the inverted figure, with increased looking peaking at ~750ms and reducing to chance levels by 1250ms.

Figure 2. To quantify similarity in response when looking at either socially-meaningful or non-social physical contingencies, we created scatterplots of change in looking to AVS events on the upright versus the inverted side. Intra-class correlation values quantify the relationship for **a)** TD and **b)** ASD results. ICC values reveals a significantly stronger degree of similarity in response patterns for the ASD (r=0.89, 95% CI: 0.76 – 0.90) than for TD toddlers (ICC = 0.43, 95% CI: 0.2–0.5).

89 **180.089** Otitis Media and Expressive Language Outcomes Across Toddlers with ASDs, Language Delays, and Typical Development

E. L. Fisher[1] *and D. L. Robins*[2]*, (1)Georgia State University, Atlanta, GA, (2)AJ Drexel Autism Institute, Drexel University, Philadelphia, PA*

Background: Research indicates that children with autism spectrum disorders (ASDs) experience otitis media at higher rates than typically developing children (Niehus &

Lord, 2006). This is particularly concerning given that children with ASDs are already at heightened risk for long-term language impairments, and recurrent otitis media is associated with poorer speech and language outcomes among typically developing children (Teele et al., 1984). Additionally, the presence of temporary hearing impairment due to fluid obstruction in the middle ear may complicate the diagnostic evaluations by negatively impacting a child's social engagement. A deeper understanding of the incidence of recurrent otitis media (ROM) across different populations and correlates ROM within those populations would be informative for both physicians selecting medical treatments and early intervention specialists attempting to evaluate children and recommend interventions.
Objectives: 1. To compare the incidence of ROM across children with ASDs, language delays, and typical development 2. To examine the relationship between ROM and expressive language outcomes within each group.
Methods: Toddlers (n=197) screened positive on the Modified Checklist for Autism in Toddlers (-Revised) (M-CHAT(-R); Robins et al., 1999, 2009) or were flagged by their pediatrician for possible ASD. Evaluations included ADOS, Vineland Adaptive Behavior Scales-II (VABS-II), and Mullen Scales of Early Learning (MSEL) and a developmental history. Children were classified as having ROM if parents reported ≥ 3 ear infections OR if children received myringotomy tubes.
Results: Fifty-six (20%) children were determined to have ROM. A chi-square test of independence was performed to examine the relationship between child diagnosis following a developmental evaluation and history of ROM. The results indicated no differences in rates of ROM among children with ASD, language delays and typical development, X^2 (2, N = 197) = .35, *Cramer's V* =.02, p = .84. Independent samples t-tests were performed to compare the expressive language development of children with ASD with and without a history of otitis media. The results indicated no significant differences on either the MSEL Expressive Language subscale or the VABS Expressive Communication subdomain, t = -.52, eta^2 = .002, $p > .05$. Higher socio-economic status (SES) was associated with presence of ROM, r = .27, $p < .01$.
Conclusions: Our sample did not show significant differences in the rate of ROM by diagnosis. Additionally, our finding that ROM did not relate to language differs from the current literature on typically developing children. It suggests that the influence of otitis media on language development may be reduced in children with ASD, perhaps due to the relatively larger contribution of social development. Our findings could also indicate the close monitoring of middle ear health leading to prompt treatments for infections may reduce the overall impact of ROM. This monitoring may relate to access to healthcare and information, which is affected by SES. Limitations of this study include the parent report of ROM design rather than standardized monitoring in a healthcare setting, which introduces the possible confound of parent ability to detect otitis media.

90 **180.090** Parent Concerns and Early Detection of Autism Spectrum Disorder

S. Saleem[1], *B. G. Davidson*[2], *A. C. Dowd*[2], *M. A. Lecheler*[3] *and A. R. Neal-Beevers*[2], *(1)The University of Texas Health Science Center at Houston, Houston, TX, (2)Psychology, University of Texas at Austin, Austin, TX, (3)School Psychology, Texas State University, Austin, TX*

Background: Early intervention significantly improves later outcomes of children with autism spectrum disorder (ASD) (Green et al., 2013). Parent-reported concerns about children prompt pediatricians to screen for ASD (Dosreis, Weiner, Johnson, & Newschaffer, 2006). However, oftentimes, clinicians respond to parent concerns with a watch-and-see stance (Landa, 2007). This may be particularly true of parents of high-risk siblings, for whom there is a concern that they will overreport symptoms due to overestimating the recurrence risk of ASD (Whitelaw, Flett, & Amor, 2007).
Objectives: This study compared parent concerns of high (HR) versus low-risk (LR) siblings and examined the association between parent concerns and standardized clinician ratings of ASD symptoms and language development.
Methods: Participants were enrolled in a longitudinal study tracking the emergence of ASD symptoms in HR siblings. The final sample consisted of 21 LR infants, 18 HR infants, and their mothers. The presence or absence of ASD in older siblings was determined via the ADOS-2 (Lord et. al, 2012) for HR older siblings and the Social Communication Questionnaire (Rutter, Bailey, & Lord, 2003) for LR older siblings. Infants were assessed at 12-, 15-, 18-, and 24-months-of-age. The Parent Concerns Questionnaire (PCQ; Ozonoff et al., 2010) was used to classify concerns into two categories: PCQ-Total (speech/language/communication, social, stereotyped behaviors, motor, medical/regulatory, behavior/temperament, general developmental, and unspecified ASD) and PCQ-ASD (speech/language/communication, social, stereotyped behaviors, and unspecified ASD; Ozonoff et al., 2010). Infant ASD symptoms were directly assessed at 12-, 15-, 18-, and 24-months using the Autism Observation Scale for Infants (AOSI; Bryson, Zwaigenbaum, McDermott, Rombough, & Brian, 2008). Language development was directly assessed using the Bayley Scales of Infant Development, Third Edition at 12-, 15-, and 24-months (Bayley-III; Bayley, 2006).

Results: Separate one-way ANOVAs revealed that, compared to LR parents, HR parents (1) reported significantly more PCQ-Total concerns at 12, 15, 18, and 24 months and (2) reported significantly more PCQ-ASD concerns at 12, 15, and 24 months (see Table 1). To examine potential associations between parent (PCQ-ASD) and clinician reports (AOSI), a pairwise correlation was conducted at each age. The findings revealed that parents and clinicians observed similar ASD-related symptoms at 12 ($r(26)=0.64$, $p<.05$) and 15 months ($r(33)=0.560$, $p<.01$). Lastly, we analyzed language concerns by conducting a one-way ANOVA between PCQ-Language and Bayley-III language scores at each age. Parents who reported a language concern had infants with significantly lower Bayley-III language scores at 12, 15, and 24 months (see Table 2).
Conclusions: The findings in this study highlight that HR parents report increased concern about their infant's development beginning at 12 months, especially with regard to symptoms relevant to ASD. It should be noted, however, that greater parent ASD concerns were associated with higher scores on the AOSI. Furthermore, parents who report concerns about delayed language development, have infants who score lower on a standardized measure of language development beginning at 12 months of age. Thus, these findings indicate convergent validity, suggesting that parent concerns regarding ASD symptoms and language development are credible and warrant referral for further developmental evaluation.

Table 1

Descriptive Statistics and One-Way ANOVAs for PCQ-Total and PCQ-ASD between HR and LR Younger Siblings

			PCQ-Total	PCQ-Total ANOVA		PCQ-ASD	PCQ-ASD ANOVA	
Age	Group	n	M (SD)	*F*	*p*	M (SD)	*F*	*p*
12 mo.	LR	15	.330 (0.72)	11.570	.002**	.067 (0.26)	10.259	.004*
	HR	11	2.273 (2.06)			1.00 (1.10)		
15 mo.	LR	16	.938 (1.00)	5.500	.026*	.190 (0.40)	11.950	.002**
	HR	17	2.118 (1.77)			1.118 (1.07)		
18 mo.	LR	16	.500 (1.10)	4.962	.033*	0.250 (0.58)	3.617	.066
	HR	17	1.720 (1.93)			0.830 (1.10)		
24 mo.	LR	15	.600 (0.74)	8.048	.008**	0.130 (0.35)	9.897	.004**
	HR	15	1.880 (1.59)			0.940 (0.96)		

*= p <.05, **=p <.01

Table 2

Descriptive Statistics and One-Way ANOVA Bayley-III Language Composite Score between the Presence and Absence of Language Concerns in All Younger Siblings

	No Language Concern		Language Concern		ANOVA	
	n	M (SD)	n	M (SD)	*F*	*p*
12 months	17	91.65 (10.95)	6	78.50 (11.50)	6.14	.02*
15 months	22	91.32 (15.29)	10	73.00 (8.17)	12.56	.00**
24 months	17	104.18 (17.51)	4	71.75 (14.77)	11.64	.00**

*= p <.05, **= p <.01

91 **180.091** Parent-Reported Social Interaction and Race, but Not Observed Social Impairments, Predict Intervention Enrollment in Toddlers Diagnosed with ASD

D. N. Abrams[1], *L. B. Adamson*[1], *D. A. Fein*[2] *and D. L. Robins*[3], *(1)Psychology, Georgia State University, Atlanta, GA, (2)Psychology, University of Connecticut, Storrs, CT, (3)Drexel University, Philadelphia, PA*

Background: It is widely accepted that early intervention following early diagnosis leads to the best prognosis for children with autism spectrum disorder (ASD; MacDonald, Parry-Cruwys, Dupere, & Ahearn, 2014; Orinstein et al., 2014). However, some children who are diagnosed as early as age 2 do not enroll in intervention targeting their ASD symptoms, despite this recommendation from clinicians. It is unclear what factors may contribute to a parent's ability or decision to enroll their child in intervention. It is possible that race, socioeconomic status, severity of their child's symptoms, the parent's perception of the child's difficulties, or other factors may contribute to enrollment (Thomas et al., 2007). It is important to identify factors contributing to intervention access in order to increase participation in relevant services.
Objectives: To identify predictors of enrollment in ASD-specific intervention following initial ASD diagnosis at age 2.
Methods: Toddlers (n=110) were diagnosed with ASD at around age 2 after screening positive on the Modified Checklist for Autism in Toddlers (-Revised) (M-CHAT(-R); Robins et al., 1999, 2009) and Follow-Up, or being flagged by their pediatrician for possible ASD. Evaluations included ADOS, Vineland Adaptive Behavior Scales (-II; VABS), Mullen Scales of Early Learning (MSEL), and a developmental history. Information regarding enrollment in intervention was collected at a follow-up evaluation at age 4.
Results: Of the 110 toddlers diagnosed with ASD at age 2, 71 (64.5%) enrolled in ASD-specific intervention whereas 39 (35.5%) did not; all but 8 toddlers participated in some type of early intervention (e.g., speech therapy). Logistic regression revealed that VABS(-II) Social Domain was predictive of enrollment, *OR*=.91, *p*<.001, whereas the ADOS Social Affect Calibrated Severity Score (ADOS SA CSS) was not predictive, *OR*=1.05, *p*=.68. Race was also predictive, as Black families (n=18) had 91% lower odds of enrolling in ASD-specific intervention than White families, *OR*=.09, *p*<.001, and other races (Hispanic n=8, Asian n=5, Multiracial n=8) had 82% lower odds of enrolling compared to White families, *OR*=.18, *p*=.001. Furthermore, in a multivariable model, VABS(-II) Social Domain scores, *OR*=.92, *p*=.001, and race (Black *OR*=.13, *p*=.001, other *OR*=.20, *p*=.004), independently predicted seeking intervention. Maternal education and child sex, age, cognitive, language, and symptom domain variables were not predictive, *p*s>.05.
Conclusions: Although all children received an ASD diagnosis at age 2, 35.5% did not enroll in ASD-specific intervention as recommended. Parent-reported social interaction (VABS Social Domain) was predictive of enrollment, but directly-observed social symptom severity (ADOS SA CSS) was not predictive. Therefore, parents who were more aware of, and possibly more concerned about, their children's social functioning were more likely to seek ASD-specific intervention regardless of actual symptom severity. Furthermore, racial minority families were much less likely to enroll in intervention than White families. This has clinical implications for working with parents to address barriers to enrollment in intervention. Future research should examine barriers, such as cultural beliefs, mismatch of race between the family and intervention provider, and stressors on the family related to socioeconomic or racial status. Research should also work to identify strategies to overcome these barriers.

92 **180.092** Parental Stress and Proband Mental Health As Predictors of Mental Health in Toddlers at High-Risk for Autism Spectrum Disorders

K. Hudry[1], *K. Crea*[2] *and C. Dissanayake*[3], *(1)Olga Tennison Autism Research Centre, Melbourne, Australia, (2)Olga Tennison Autism Research Centre, Bundoora, VIC, Australia, (3)Olga Tennison Autism Research Centre, La Trobe University, Melbourne, Australia*

Background:
Autism Spectrum Disorders (ASD) are diagnosable from toddlerhood and have a significant and pervasive impact on development and wellbeing across the lifespan. Furthermore, where a family includes one child with an ASD diagnosis, various risk factors present for adverse outcomes among later-born children, including both the genetic susceptibility for also developing ASD. However, temperamental characteristics are also heritable and unique environmental influences may present as a result of the ASD diagnosis in the older child (*proband*). While most 'high-risk' sibling research to date has focused on development of core ASD symptoms, there has been little consideration of broader factors such as emotional wellbeing and early indicators of mental health.
Objectives:
Using a variant on a high-risk sibling design, we investigated early emotional wellbeing and mental health indicators among the toddler-aged siblings of children with ASD, including a comparison group of low-risk controls with no family history of ASD. Specifically, we sought to identify the relative predictive value of environmental factors – parent stress and proband mental health difficulties – for toddler mental health, across the period of 2- to 3-years of age, beyond other factors such as risk status, temperament and core symptom presentation.
Methods:
A sample of 30 high-risk and 28 low-risk control toddlers was followed from 2- to 3-years of age. At the first visit, parents completed the self-report Depression Anxiety Stress Scales and the Behaviour Assessment System for Children (BASC) regarding their older child, and they also completed the BASC and the Short Temperament Scale for Toddlers (STST) for their younger child at each of the 2- and 3-year visits. A comprehensive assessment was conducted with high-risk toddlers at the 3-year visit to identify subgroups with and without ASD outcome.
Results:
As anticipated, the probands of high-risk toddlers (i.e., older children with ASD) had greater parent-reported mental health difficulties – internalising and externalising

problems, and broad behaviour symptoms – than did the older siblings of low-risk toddlers (i.e., those with no family history of ASD). Further, parents of high-risk toddlers had greater self-reported depression and stress than parents of low-risk controls. Across the sample as a whole, parent stress and proband mental health difficulties were significant predictors of concurrent mental health difficulties among toddlers (i.e., at the 2-year visit), and substantial continuity in these was then observed one year later (i.e., to the 3-year visit). Risk status (i.e., high- vs. low-risk group) and diagnostic outcome (i.e., ASD vs. no-ASD outcome, among the high-risk group) were not observed to confer additional risk for toddler mental health difficulties, beyond these parent and proband factors.
Conclusions:
Environmental risk factors may play an important role in determining mental health outcomes for young children – with effects apparent already by 2 years of age and showing continuity to 3 years – in the context of family history of ASD. It seems important therefore to monitor early social-emotional development and intervene early to support emotional wellbeing among toddlers at high-risk of ASD to support optimal developmental outcomes.

93 **180.093** Pupillary Light Responses in Infants at Low and High Risk for ASD

J. B. Wagner[1], *S. R. Scarano*[1], *H. Tager-Flusberg*[2] *and C. A. Nelson*[3], *(1)Department of Psychology, College of Staten Island, CUNY, Staten Island, NY, (2)Boston University, Boston, MA, (3)Boston Children's Hospital/Harvard Medical School, Boston, MA*

Background: Research has identified atypical physiological responses in individuals with ASD (e.g., Bal et al., 2008; Joseph et al., 2008), including an abnormal pupillary light reflex (PLR) that discriminated children with ASD from controls with 92.5% accuracy (Fan et al., 2009). The PLR is a well-studied index of the cholinergic system (for discussion, see Fotiou et al., 2009), and recently, Nyström et al. (2015) examined the PLR in infant siblings of children with ASD, a group with as high as a 1 in 5 chance of developing the disorder (Ozonoff et al., 2011). This work found increased sensitivity in the PLR in 10-month-old infants at high risk for ASD (HRA), marked by stronger and faster responses in comparison to low-risk controls (LRC; Nyström et al., 2015).
Objectives: The present study extends the findings of Nyström et al. (2015) to examine sensitivity in the PLR in HRA and LRC infants at 6 and 12 months, in hopes of gaining a richer picture of the trajectory of this response across the first year of life.
Methods: Participants included 32 infants, 12 6-month-olds (HRA: n=5; LRC: n=7) and 20 12-month-olds (HRA: n=5; LRC: n=15). As part of a paradigm examining attention to faces, a Tobii x120 eye-tracker was used to present infants with up to 14 trials of a black fixation screen followed by 32-s videos with white backgrounds showing familiar and unfamiliar faces. On trials where infants were attending to the screen during the shift from dark to light, the maximum absolute acceleration during the PLR and the relative pupil constriction were obtained. Pupil diameter was sampled at 60 Hz and Gaussian-smoothed with a standard deviation of 5 samples (83 ms). Velocity and acceleration were similarly smoothed prior to further processing. Relative pupil constriction was calculated from D_0 (baseline diameter) and D_m (minimum diameter) as $(D_0\text{-}D_m)^2/D_0{}^2$. Infants with at least three valid trials were included.
Results: Univariate ANOVAs were used to examine the influences of age (6, 12) and group (HRA, LRC) on constriction and acceleration during the PLR. For constriction, a marginal age*group interaction was found (p=.06), with LRC showing decreased constriction across age while HRA show increased constriction (Figure 1). For acceleration, a significant age*group interaction was found (p=.046), with HRA showing marginally increased acceleration in their PLR across age (p=.058) and LRC showing no change (p=.63; Figure 2).
Conclusions: Despite the modest sample size, this study extends the work of Nyström et al. (2015) to illustrate changes in the PLR between 6 and 12 months in HRA and LRC. Their work found stronger and faster responses in HRA as compared to LRC at 10 months, but the present findings suggest this is not yet the case at 6 months. Further analyses are underway with an extended sample, and future work will examine how individual differences in this physiological response might relate to developmental outcomes.

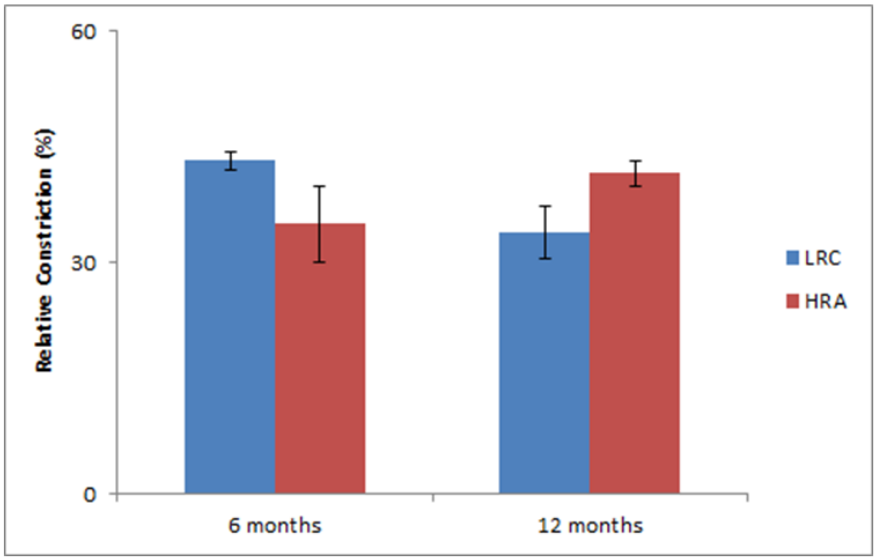


Figure 1: Relative pupil constriction in LRC and HRA at 6 and 12 months. A marginal interaction between age and group was found (p = .06). Error bars +/- SE.

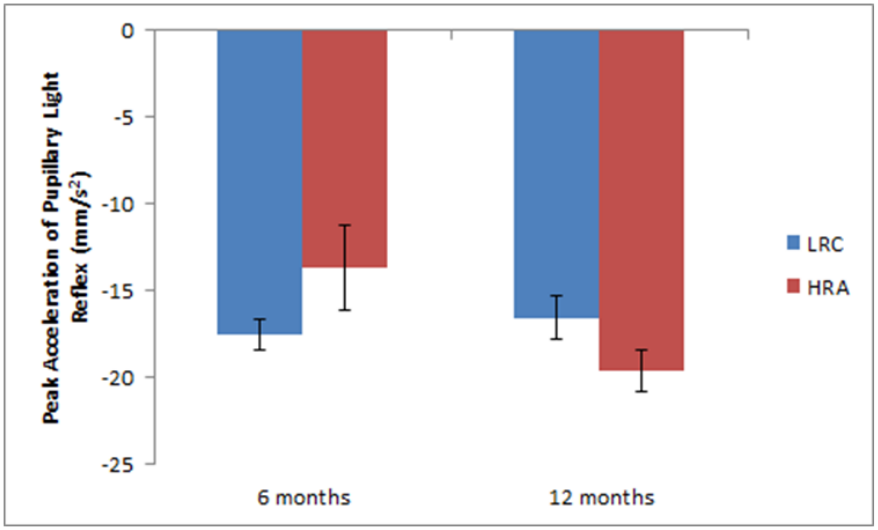


Figure 2: Peak acceleration of the pupillary light reflex in LRC and HRA at 6 and 12 months. A significant interaction between age and group was found (p = .046), with HRA showing marginally faster acceleration in the older age group and LRC showing no difference across age. Error bars +/- SE.

94 **180.094** Reliability of the Toddler Temperament Scale and Differences in Early Temperament Between High Risk Baby Siblings with and without Autism

***J. Chen**, M. Barton and D. A. Fein, Psychology, University of Connecticut, Storrs, CT*

Background: Research has shown that baby siblings of children diagnosed with autism who go on to receive an ASD diagnosis at 36 months demonstrate unique early temperament trajectories in the first two years (Garon et al., 2009). This study builds upon this literature by looking at early temperament differences between high risk baby siblings with and without a diagnosis of ASD at age 2, using the Toddler Temperament Scale (TTS).
Objectives: To assess the internal reliability of the TTS subscales, and test for group differences in parent-rated temperament between baby siblings with and without an ASD diagnosis at age 2.
Methods: Baby siblings were screened for autism using the M-CHAT or M-CHAT-R. Parents of children who screened positive completed the TTS when their child received a diagnostic evaluation including the ADOS, Mullen, Vineland, and parent interview (n=149, mean age of child = 22.6 months). Cronbach's alphas were calculated for each of the nine subscales of the TTS. Chi-square tests were used to compare demographics between children with an ASD diagnosis (n=80) and those with a non-ASD diagnosis (n=69; includes developmental delay, language disorder, and no diagnosis). Subscale scores (average score across items within a subscale), as well as parent responses to general impression items on the TTS were compared between groups using t-tests.
Results: Several subscales of the TTS were found to have acceptable to good internal reliability: Activity (α=.748), Rhythmicity (α=.758), Approach (α=.849), and Distractibility (α=.873). Other subscales were found to be less reliable: Mood (α=.693), Adaptability (α=.654), Persistence (α=.607), Intensity (α=.559), and Threshold (α=.573). ASD and non-ASD groups did not differ significantly in terms of gender or ethnicity. Parents of children in the ASD group tended to rate their child's behavioral style as significantly less distractible (p<.001, d= 1.00), less rhythmic (p=.004, d= .48), slower to adapt (p=.011, d= .43), more withdrawn (p=.009, d= .44), and having more negative mood (p=.004, d= .48), compared to parents with children in the non-ASD group. When asked directly for general impressions of their child's temperament, parents in the ASD group described their child as being more irregular in bodily functioning (p=.037, d= .35), slower to adapt to socially acceptable behavior (p<.001, d= .87), and less manageable (p=.002, d= .52).
Conclusions: Certain subscales of the TTS appear to be reliable when used with a sample of children at high risk for autism. Within this high risk group, baby siblings who receive an ASD diagnosis around age 2 may demonstrate different temperament profiles than their peers without autism. In particular, these children may be less able to remove themselves from ongoing behavior; less consistent in their eating, sleeping, and elimination routines; slower to change their behavior in response to novel people, events, and instructions; less likely to approach novel people or experiences; and present with more negative and less positive mood. Parents of these children may also describe their child as significantly harder to manage. Temperament assessments may provide important information about parents' experience of their child's behavioral tendencies in this high-risk group.

95 **180.095** Restricted and Repetitve Behaviors (RRBs) in Simplex and Multiplex ASD

***K. R. Bradbury**[1], M. Barton[2] and D. A. Fein[2], (1)University of Connecticut, Storrs, CT, (2)Psychology, University of Connecticut, Storrs, CT*

Background: Limited research has been conducted to explore the extent to which affected infant siblings of children with ASD are representative of the general population of children with ASD. Previous research from our lab suggests that affected infant siblings in multiplex families may be higher functioning than children with ASD in simplex families with respect to language and cognitive ability. While overall ASD severity did not differ, prior analyses suggested that children with ASD from multiplex families might

display more restricted and repetitive behaviors (RRBs) than those from simplex families. The current study proposes to further explore the profile of RRBs in simplex and multiplex ASD using a four-factor model.
Objectives: To examine differences in RRBs in toddlers with ASD from simplex and multiplex families.
Methods: A sample of 39 younger siblings with ASD (M_{age} = 24.2 months) from multiplex families (M-ASD) was compared to a matched sample of 39 children with ASD (M_{age} = 24.4 months) from simplex families (S-ASD). Samples were matched pairwise on age, gender, maternal education, and ethnicity. Presence and type of RRBs was assessed using parent report (ADI/parent interview) and clinician-rated measures (CARS, ADOS, and DSM-IV-TR). Based on previous research on the ADI, RRBs were divided into three factors - Insistence on Sameness (IS), Restricted Motor Behaviors (RMBs), and Circumscribed Interests (CI). A fourth factor, Unusual Sensory Responses (SE), was added. All RRB items were coded as present or absent. RRB factor scores and an ADI RRB total score were calculated and compared between groups. Relevant CARS items, ADOS items, and DSM-IV-TR criteria were selected based on these factors and compared between groups.
Results: Samples were well matched on age, gender, maternal education, and ethnicity (*p's* > .5). Based on parent-report, the M-ASD group exhibited more RRBs than the S-ASD group (p = .01, d = .76). Significant differences between M-ASD and S-ASD groups were observed in the Insistence on Sameness (p =.045, r = .25) and Unusual Sensory Responses (p =.039, r = .28) factors. More parents of M-ASD children endorsed the ADI *Compulsions/Rituals* item (M-ASD 29% vs. S-ASD 11%) and ADI *Unusual Sensory Interests* item (M-ASD 69% vs. S-ASD 27%) than parents of S-ASD children. Similarly, more M-ASD children meet DSM-IV-TR diagnostic criteria for adherence to routines than S-ASD children (M-ASD 26% vs. S-ASD 11%). No significant differences were observed on clinician-rated measures of behavior (ADOS and CARS).
Conclusions: Based on parent report, M-ASD children display more RRBs than S-ASD children, specifically in the areas of Insistence on Sameness and Unusual Sensory Responses. Scores on clinician-rated measures failed to corroborate these findings, potentially due to the small window in which a child is observed during an evaluation. This study builds upon previous research suggesting the heterogeneity of RRB presentation within the ASD population. Further research is needed to determine whether the presence of an older sibling with ASD sensitizes parents to the presence of RRBs and leads to more accurate reporting or perhaps even an over-reporting of symptoms.

96 **180.096** Retrospective Video Analysis of Grasp Types and Functional Actions in Infants at Heightened Risk for Autism Spectrum Disorders

L. Sparaci[1], *J. B. Northrup*[2], *O. Capirci*[1] *and J. M. Iverson*[2], *(1)Institute of Cognitive Sciences and Technologies (ISTC), National Research Council of Italy (CNR), Rome, Italy, (2)University of Pittsburgh, Pittsburgh, PA*

Background: Research shows delays in fine motor skills and object exploration, with cascading effects on later communication in infants at heightened risk for Autism Spectrum Disorders (ASD; LeBarton & Iverson, 2013). Studies on typical development highlight that infants' ability to grasp and use tools in accordance to function, supports later non-verbal and verbal communication skills (Capirci, Contaldo, Caselli & Volterra, 2005; Caselli, Rinaldi, Stefanini & Volterra, 2012). However, only a few studies have analyzed grasping behavior in infants at heightened risk for ASD and they have considered presence/absence of grasping rather than grasp types and functional actions (Libertus, Sheperd, Ross & Landa, 2014).
Objectives: To analyze functional grasps and functional actions with a standard object in a group of infants at heightened risk for ASD.
Methods: Participants were 42 infants at heightened risk for ASD: 15 with typical development (TD), 15 with language delay (LD) and 12 with ASD (ASD). As part of a larger longitudinal study, infants were videotaped at home for 45 min sessions at 10, 12, 18 and 24 months of age and administered the Early Social Communication Scales (ESCS; Mundy et al., 2003). During the ESCS, infants sat at a table and were given the opportunity to grasp and use a spoon positioned in front of them together with a small bowl for 1 min. Spontaneous behavior was retrospectively video coded analyzing: (1) whether infants produced at least one spoon grasp (grasp production); (2) in all cases in which the spoon was grasped at least once, whether the first grasp produced was functional or non-fuctional (grasp types); (3) in all cases in which at least one spoon grasp was produced, the number of infants that produced a functional action. Grasps were classified as 'functional' if they allowed to easily perform an eating action and 'non-functional' if the grasp rendered eating actions difficult (Connolly & Dalgleish, 1989). Actions were classified as 'functional' if the spoon was either dipped in the bowl or placed in the bowl and brought to the mouth as in feeding. Analyses focused on group differences in grasp production, grasp types, and numbers of infants producing a functional action.
Results: Analyses indicated: (1) no differences in numbers of infants who grasped the spoon (all ps >.05); (2) a significant difference at 24 months in the number of functional vs. non-functional grasps between ASD and TD (p=.03), but not between TD and LD infants (p=.10); (3) a significant difference at 10 months in the numbers of infants producing a functional action between ASD and TD (p=.005), but not between TD and LD infants (p=.23). This difference was no longer present by 18 months.
Conclusions: Data indicate later onset of functional grasps and actions in infants subsequently diagnosed with ASD. None of the infants in the ASD group produced a functional action at 10 months. Late onset of functional grasps and actions may hinder their role in supporting infant-caregiver interactions, leading to cascading effects on later communication skills in ASD.

97 **180.097** Revisiting Fixation Toward Eye and Mouth Region in ASD Toddlers from the General Population: Cross Sectional and Longitudinal Analyses

M. K. Kwon[1], *A. Moore*[2] *and K. Pierce*[3], *(1)Neuroscience, University of California, San Diego, La Jolla, CA, (2)University of California San Diego, San Diego, CA, (3)Neuroscience, UCSD Autism Center of Excellence, La Jolla, CA*

Background: Atypical eye contact is a well-known characteristic of children with Autism Spectrum Disorder (ASD), (APA, DSM-5, 2013), and it is thus not surprising that eye tracking studies have reported reduced fixation towards the eye region in ASD (Jones, Carr, & Klin, 2008; Jones & Klin 2013) . However, several studies have not replicated this effect (e.g., Chawarska et al., 2013; Young et al., 2009). One possible explanation for these inconsistent findings is different ages of participants. In Jones and Klin's (2013) study, ASD children showed similar rates of fixation as TD children on eye regions at 2 months and ASD children's rates of fixation on eyes declined to half the rate of TD children's at 24 months. Therefore, comparing fixation times across multiple time points may influence differences detected between groups (Klin, Shultz, & Jones, 2015).
Objectives: The present study examined the developmental changes in fixation time toward the eye, mouth and body region in ASD and TD children between 1 to 3 years of age.
Methods: Participants were 125 ASD and 110 TD toddlers ranging in age from 1 and 3 years. All toddlers participated in standard psychometric testing and were followed longitudinally until a diagnosis was confirmed at age three. Toddlers watched a 44 second movie showing a close-up image of a female speaking short common phrases coupled with familiar hand gestures (e.g., peekaboo). Fixation duration within 3 AOIs (eyes, mouth, and body) was measured using a Tobii T120 eye-tracker and was subsequently compared between three age cohorts (ages 1, 2 & 3 years). Ninety seven children (47 ASD, 50 TD) also had eye-tracking data available for a subsequent evaluation, approximately one year later, and changes in looking times were examined (T1 vs T2).
Results: Three two-way ANOVAs with Age (3) and Group (2) as between-subjects factors and proportion of fixation time of each AOI as a dependent variable revealed that only fixation time on body differed between ASD and TD children (F(1,229)= 5.342, p=.022, η^2=.023), and the amount of this group difference did not differ across ages (p=.445, η^2 = .007). Change in fixation times across two visits also revealed that ASD children looked at body regions longer than TD children (F(1, 95) = 10.228, p=.002, η^2 = .097), and no differences were found in looking times at eye or mouth regions, *p's* >. 465. The amount of group differences in fixation times on each of the 3 AOIs did not differ across time, *p's*>. 129.
Conclusions: Neither fixation times nor change in fixation times on eyes were different between ASD and TD groups. The ASD group did show slightly longer fixation to the body region (3-4 % difference at Ages 1 and 2) when compared to TD children. This result was consistent across one and two year old samples, but was not evident in three year olds. Overall the fixation patterns between ASD and TD toddlers were strikingly similar.

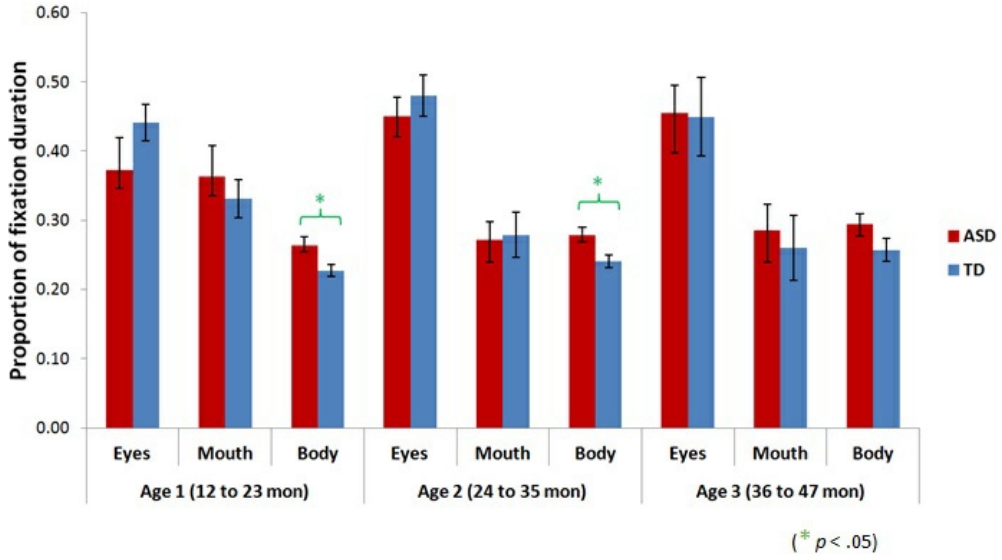


Figure 1. Mean proportions of total fixation durations from one-time visit samples (total *N*= 235). Error bars represent standard errors of the mean.

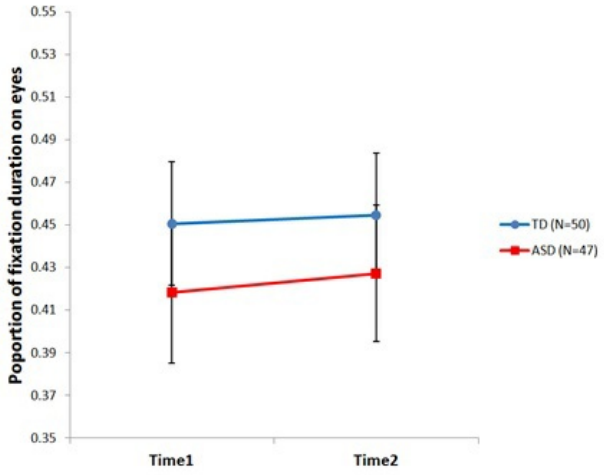


Figure2. Mean proportions of total fixation durations on eyes in ASD and TD groups. Error bars represent standard errors of the mean.

98 **180.098** Sex-Differences in 17-30 Months Old Toddlers: An Analysis of the M-CHAT

R. A. Oien[1,2], *L. Hart*[2], *S. Schjolberg*[3], *C. A. Wall*[2], *E. S. Kim*[2], *M. R. Eisemann*[1], *K. Chawarska*[2], *F. R. Volkmar*[2] *and F. Shic*[2], *(1)Psychology, UiT - The Arctic University of Norway, Tromsø, Norway, (2)Yale Child Study Center, Yale University School of Medicine, New Haven, CT, (3)Mental Health, Norwegian Institute of Public Health, Oslo, Norway*

Background: Research suggests that in general population males tend to be more prone to developmental delay (Boyle et al 2011) and have a higher activity level (Riddoch et al., 2007), while females have better social orientation (MacCoby et al., 1979), gaze responses (Conellan et al., 2003, Lutchmaya et al., 2002), as well as strengths in imitation (Hittelmann & Dickens 1979). Studies in ASD population also reveal marked sex differences in behavioral presentation. Females are four times less likely to be diagnosed with ASD than males (Baio, 2012) and, when diagnosed are more likely to exhibit co-occurring anxiety and other internalizing symptoms than males with ASD (Hartley & Sikora, 2009; Solomon et al., 2012). They also exhibit higher symptom severity than males (Dworozynski et al., 2012). These differences are apparent already in preschoolers with ASD (Hartley & Sikora, 2009; Zwaigenbaum et al., 2012).
Objectives: To evaluate sex differences in parent-reported autism-related behaviors in a large epidemiologic Norwegian sample of 17 to 30-months-old toddlers with and without ASD.
Methods: Data were drawn from the Norwegian Mother and Child Cohort Study (MoBa) and its sub-study the Autism Birth Cohort (ABC). The total sample comprised of 53,728 children, including 185 children later diagnosed with ASD. There were 153 (83%) of males and 32 (17%) of females in the ASD sample. Diagnoses were obtained from the ABC clinic or from the National Patient Register. Questionnaires were completed between 17 and 30 months. We conducted ANOVA to compare the proportion of failures on the M-CHAT between males and females in the non-ASD and in the ASD samples. Chi-square risk analyses were conducted to compare which items were most frequently failed by males and females in the non-ASD stratified samples matched on mean to ASD males and females. Logistic regression was used to analyze which items most frequently failed by males and females in the ASD sample, controlling for sex and total number of failed items.
Results: Non-ASD males (M=.85, SD=1.22) failed more (P<.001) than females (M=.74, SD=1.11). ASD males (M=2.68, SD=3.54) failed less (P<.001) than females (M=5.16, SD=5.34) on mean number of failed items. Risk analyses showed that non-ASD sample females presents strengths on *imitation* and *pretend play*. Males showed strengths on *enjoy climbing on things* and *functional play with objects*. Logistic regression revealed that ASD females were more likely to fail the *imitation* item, but less likely to fail the *follow to point* item compared to ASD males.
Conclusions: In this epidemiologically ascertained Norwegian sample, mothers reported a higher degree of symptom severity in female than male toddlers later diagnosed with ASD. Females in the non-ASD samples show strengths related to imitation compared to males, a strength that ASD females have lost compared to ASD males. They do however preserve the strength of response to joint attention over males. The study suggests that females later diagnosed, already during the very early stages, may show strengths in joint attention compared to ASD males, but show selective impairments in imitation.

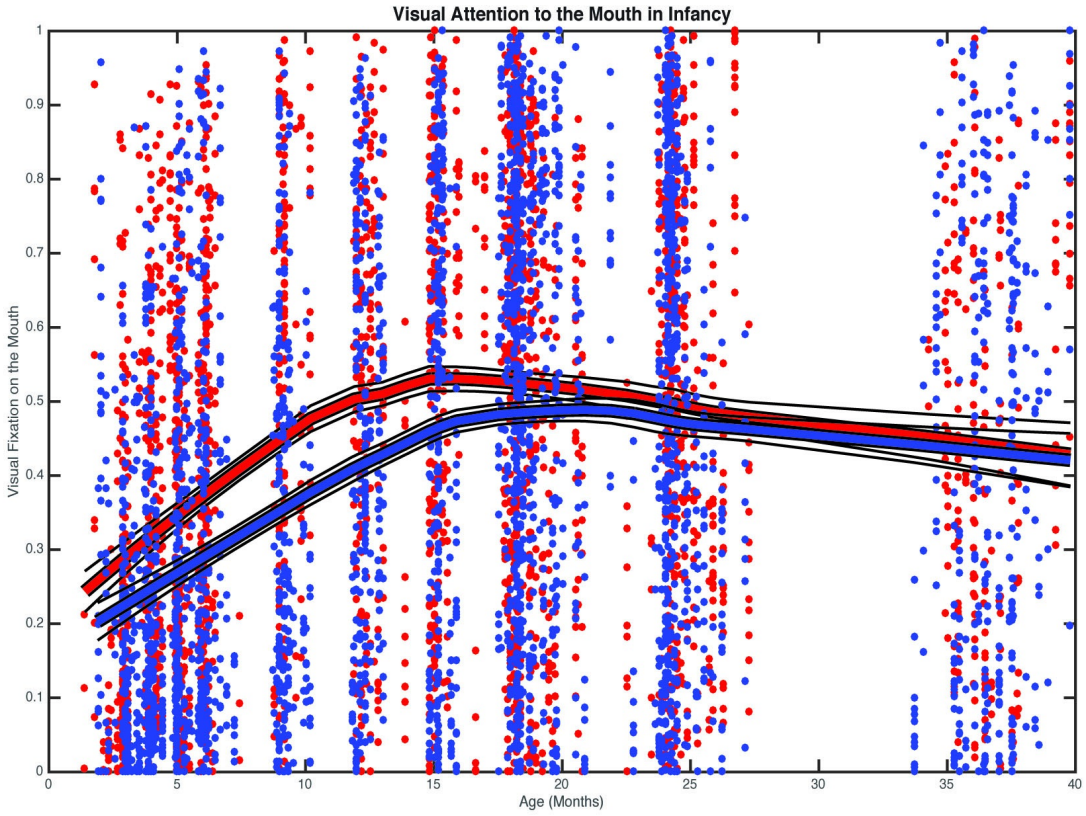
99 **180.099** Sex-Specific Differences in Infant Visual Attention and Early Word Production: Potential for Female Protective Factors

R. Burger-Caplan[1,2], *A. Klin*[3], *J. N. Constantino*[4] *and W. Jones*[3], *(1)Marcus Autism Center, Children's Healthcare of Atlanta & Emory University School of Medicine, Atlanta, GA, (2)Department of Psychology, Emory University, Atlanta, GA, (3)Department of Pediatrics, Emory University School of Medicine, Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, GA, (4)Washington University School of Medicine, Saint Louis, MO*

Background: Autism Spectrum Disorder (ASD) is among the most highly heritable of all psychiatric disorders, with a large body of research supporting a multifaceted genetic etiology. One well-documented but still poorly understood feature of that etiology is a highly skewed sex ratio, with only one affected female with ASD for approximately every 4 males (Werling & Geschwind, 2013). It has been suggested that there may exist some mechanism of “resilience” in females such that risk factors are less potent. We hypothesize that sex-specific differences in processes of typical development (TD)—i.e. female precociousness in acquisition of communicative milestones—could serve as such a protective factor and could support female resilience to ASD. Previous research from our laboratory suggested sex-specific differences in visual attention to the mouth in the first 18 months of life, temporally and developmentally aligned with language acquisition.

Objectives: We studied sex-specific differences in both visual attention to the mouth and in language acquisition, from 2 until 40 months of life, in order to better understand their potential role as protective factors for females at risk for ASD.
Methods: Eye-tracking data were collected in TD infants longitudinally from 2 until 40 months of life (146 male, 131 female). The MacArthur-Bates Communicative Development Inventory (CDI) was administered longitudinally at 9, 12, 18, and 36 months, assessing vocabulary acquisition. Z-scores were calculated from raw CDI scores.
Results: A marked sex difference exists in visual attention to the mouth (figure 1a) between 2 and 20 months of life, and is most pronounced in early infancy through the first year, with females demonstrating an increase in mouth-looking that is greater in magnitude and steeper in slope than the parallel phenomenon in males. Sex-differences in visual attention to the mouth disappear, however, by 36 months. A concurrent difference in vocabulary production between females (M=0.25, SD=1.05) and males (M= -0.22, SD=0.89) at 18 months (t=4.02, p<0.001) converges by 36 months, at which point females (M=0.12, SD=0.86) no longer differ from males (M= -0.09, SD=1.09; t=1.14, p=0.256; figure 1b).
Conclusions: Results indicate strong sex-specific differences in preferential visual attention beginning in very early infancy. When seen as an index of engagement with the social-communicative task of early language learning, female precociousness (increasing visual attention to the mouth more quickly than males in the first year) suggests an opportunity by which an existing sex difference of typical development might serve as a protective factor against developmental processes disrupted in ASD. Coupled together, the previously reported alignment of sex difference in mouth-fixation with sex difference in language acquisition, and the present study's report of the disappearance of sex difference in mouth-fixation concurrent with the disappearance of sex difference in language indicate a role for female precociousness in communicative development (particularly in its earliest stages) as protective against insults to the typical trajectory of normative social development.

a.



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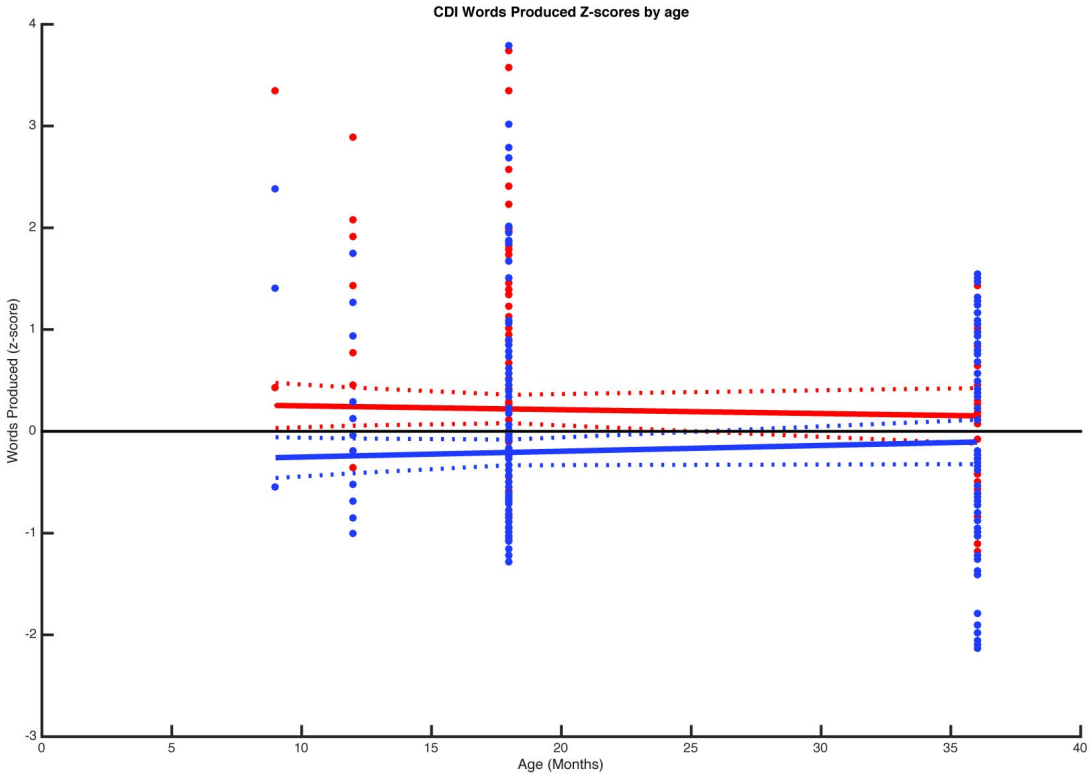


Figure 1: Females depicted in red; Males depicted in blue. Confidence Intervals represent 95% confidence. Longitudinal data presented for (a) visual attention to the mouth and for (b) vocabulary production as measured by the CDI. Sex differences in both measures converge by 36 months of age.

100 **180.100** Sleep and Developmental Progress in Infants at High-Risk for Autism

*A. J. Schwichtenberg[1], **E. Abel**[2], J. Amstutz[1], S. L. Christ[1], M. Miller[3], S. Ozonoff[3] and T. F. Anders[4], (1)Purdue University, West Lafayette, IN, (2)Purdue University, Lafayette, IN, IN, (3)UC Davis MIND Institute, Sacramento, CA, (4)UC Davis M.I.N.D. Institute, South Dartmouth, MA*

Background: Sleep dysregulation in families raising children with autism spectrum disorder (ASD) is common. Parents of children with ASD report more sleep problems in themselves, their children with ASD, and in younger siblings. Although several studies have documented elevated rates of sleep problems, few studies have assessed the

developmental correlates of these problems. The impact of sleep on development is a growing research area with studies of typically developing children noting deficits in language learning, memory, and social competence when sleep is restricted or dysregulated. Each of these developmental domains are also known areas of difficulty for children at elevated risk for ASD.
Objectives: This study aimed to assess the associations between sleep regulation and language, social, and visual reception skills within young children at elevated risk for ASD (i.e., infant siblings of children with ASD) across two independent samples.
Methods: In two samples child actigraph-derived sleep/activity patterns were classified as regulated or dysregulated. Infant/toddler developmental progress was indexed with the Mullen Scales of Early Learning (MSEL) and the Vineland Adaptive Behavior Scales. The first sample included 55 toddlers at 24 or 36 months of age (Sample C). Within this sample, 27 toddlers were younger siblings of children with ASD (high-risk group) and 28 had siblings with no known diagnosis (low-risk group). The second sample (Sample P) included 118 assessments between 6 and 30 months for 80 children (high-risk group = 41, low-risk group = 39).
Results: Using sleep time series and multivariate general linear models, children with regulated sleep had higher average MSEL visual reception (VR) and expressive language (EL) scores (β = 1.91, p < .05 and β = 2.03, p = .01, respectively) relative to children with dysregulated sleep (Sample P). Sleep explained 5% of the variance in VR and 6% of the variance in EL. In Sample C, there was a statistically significant interaction for sleep with ASD risk status for the MSEL VR scale. This interaction showed a modest but positive effect of regulated sleep for children in the low risk group (β = 4.38, p = .07) and no significant effect of sleep regulation for children in high risk (β = -1.78, p =.40). Sleep also interacted with both ASD risk status and child gender for MSEL receptive language (RL) scale. Sleep was associated with receptive language for children in the low-risk group but not the high-risk group. Additionally, boys with dysregulated sleep performed on average 7 months lower than their chronological age on the MSEL RL scale (β = 6.88, p < .01).
Conclusions: In the first three years of life, the present study demonstrated a modest but significant association between sleep regulation and concurrent language and visual reception development. However, this influence was not robust for infants developing at high risk for ASD. This may reflect the relative magnitude of the influence sleep has on development. Infants at elevated risk for ASD face both genetic and environmental risk factors which may have a stronger developmental impact when compared to sleep regulation.

101 **180.101** Social Emotion Regulation Strategies in Toddlers with ASD

A. Milgramm, *S. Macari, L. DiNicola, P. Heymann, E. Hilton, K. K. Powell, S. F. Fontenelle and K. Chawarska, Yale Child Study Center, Yale University School of Medicine, New Haven, CT*

Background: Emotion regulation (ER) encompasses the processes involved in initiating, maintaining, and modulating emotional responsiveness (Bridges & Grolnick, 1995). Toddlers often use social interaction to assist in the regulation of their emotions. Children with Autism Spectrum Disorder (ASD) often exhibit atypical emotional responses and also experience difficulties in social interactions. It is not clear if children with ASD differ from their non-ASD peers in their use of proximal (ProxER; i.e., physical contact with an adult) and distal (DistER; e.g., looking, vocalizing, smiling) social ER strategies.
Objectives: (1) To compare frequency of ProxER and DistER strategy use in toddlers with and without ASD. (2) To investigate whether the use of these strategies is modulated by the emotional context of the situation. We hypothesized that toddlers with ASD exhibit fewer proximal and distal social ER strategies compared to the Non-ASD group across all emotional probes.
Methods: Participants included 50 toddlers (ASD, n=20; Non-ASD, n=30) between 15 and 26 months of age (M=20 months) who completed the Laboratory Temperament Assessment Battery (LabTAB; Goldsmith & Rothbart, 1999). The Non-ASD group consisted of typically developing and developmentally delayed toddlers. Nine tasks were presented in order to elicit three emotions: Frustration, Joy, and Fear. Videotaped sessions were coded offline by blinded coders. DistER strategies included pointing, vocalizing, talking, and making eye contact with the examiner or parent. ProxER strategies consisted of physical comfort seeking behaviors such as touching the parent or moving into the parent's lap. Generalized linear mixed model (GLMM) analyses were used to examine the fixed effects of diagnostic group, emotion type, and their interactions on frequencies of DistER and ProxER.
Results: Preliminary analyses indicated that both groups used more DistER than ProxER overall. Analysis of DistER revealed a main effect of diagnosis (F(1,144)=6.19, p<.05; Non-ASD>ASD), no effect of emotion, (p=.357), and a marginally significant interaction effect (F(2,144)=2.37, p=.097). Planned contrasts revealed that the groups differed in frequency of DistER strategies only in the Joy condition, such that ASD<NonASD (p=.003). Analysis of ProxER revealed a significant main effect of diagnosis (F(1,144)=5.0, p<.05; ASD>Non-ASD) and emotion type (F(2,144)=24.8, p<.05, Fear>Frustration=Joy), and a significant group x emotion interaction (F(2,144)=3.26, p<.05). Planned comparisons indicated that the groups differed only in the Joy condition, such that ASD>NonASD (p=.049; see Figure 1a&b).
Conclusions: Overall, toddlers exhibited more distal than proximal social ER strategies, with toddlers seeking proximity to parents most frequently during Fear tasks. Both groups of toddlers used similar ER strategies in response to Fear and Frustration probes. However, while experiencing joy, toddlers with ASD were less likely to use ER strategies involving eye contact, pointing, or socially directed vocalizations and more likely to initiate physical contact. This increased use of proximal ER strategies may represent a lower level of social referencing by toddlers with ASD within contexts that encourage sharing emotions (e.g., joy) as opposed to seeking comfort (e.g., frustration, fear). Given that interventions for children with ASD often target social behaviors, these findings may help inform current approaches and lead to more effective outcomes.

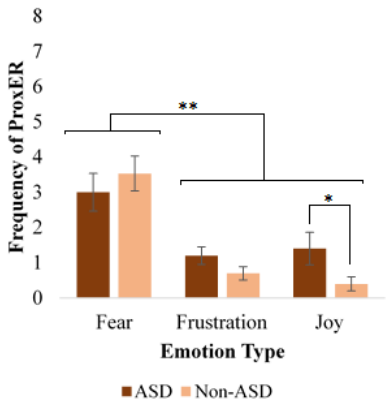


Figure 1a. ProxER across diagnoses and emotion types. *p < .05; **p < .01

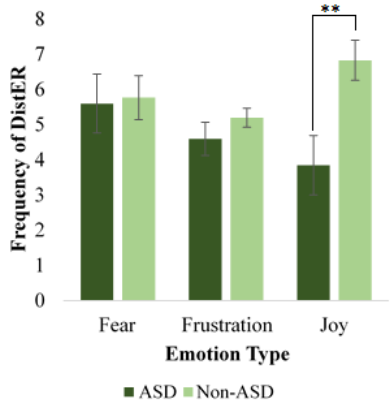


Figure 1b. DistER across diagnoses and emotion types.

102 **180.102** Social Orienting, Joint Attention, and Empathy: Impacts of Early Impairments on Subsequent Social Development

A. C. Dowd, *B. G. Davidson and A. R. Neal-Beevers, Psychology, University of Texas at Austin, Austin, TX*

Background:
Autism Spectrum Disorder (ASD) is characterized by deficits in social skills that develop early in infancy, including impairments in social orienting, joint attention, and empathy (Dawson et al., 2004). Early impairments in attending to social situations are posited to deprive children of social information that subsequently limits the development of other social skills (Mundy & Neal, 2001). Understanding how these early social skills build incrementally upon each other is crucial for building a developmental model of ASD, identifying target areas for intervention, and establishing a timeframe for beginning early interventions.
Objectives:
Identify the extent to which concurrent social orienting and joint attention skills predict infants' empathic responses at 12 and 15 months.

Methods:
Eighteen high-risk and 15 low-risk infant siblings were assessed longitudinally at 12- and 15-months-of-age for: 1) Attention and Affect responses to a standard empathy paradigm (Hutman et al., 2010); 2) Responding to and Initiating Joint Attention (RJA and IJA, respectively; Early Social Communication Scales; Mundy et al., 2003); 3) deficits in social orienting (FailToOrient) based on 'Orients to Name' (Autism Observation Scale for Infants; Bryson et al., 2008) and 'Responds to Name' (Bayley, 2006). Linear mixed-effects models were conducted separately for Attention and Affect as outcome variables, with RJA, IJA, FailToOrient, Age, and all possible two-way interactions as predictors. Models were optimized by removing non-significant interactions and main effects when their removal reduced the Akaike Information Criterion.
Results:
Attention: Significant RJA-by-Age and FailToOrient-by-Age interactions suggest that Attention at 12 months did not vary by RJA or FailToOrient. However, Attention at 15 months was lower for infants with low RJA scores or who failed to orient to their name. Furthermore, a significant RJA-by-FailToOrient interaction suggests that failing to orient to name did not affect Attention in infants with strong RJA skills; however, for infants with low RJA scores, Attention was even lower for infants who also failed to orient to name.
Affect: A significant RJA-by-Age interaction and marginally significant FailToOrient-by-Age interaction suggest that Affect at 12 months did not vary by RJA or FailToOrient. By 15 months, however, Affect was higher in infants with stronger RJA skills and marginally stronger for infants who oriented to their name.
Conclusions:
As empathy develops between 12 and 15 months, infants with deficits in RJA or social orienting also attend less and display less affect to another's distress. Attention was even lower when infants had deficits in both RJA and social orienting. However, infants attended more when they exhibited the more advanced skill (RJA) regardless of whether or not they failed the developmentally easier skill (social orienting). Together these findings help us understand how these social skills develop in relation to each other and may inform early intervention strategies.

Table 1.

Optimal Models for Attention and Affect Over Time

	Attention		Affect	
	Coefficient	*p*	Coefficient	*p*
Intercept	1.284	0.002	3.358	0.232
Age	-0.034	0.276	-0.115	0.572
RJA	-0.008	0.034	-0.059	0.032
IJA	NA	NA	-0.126	0.085
FailToOrient	0.727	0.009	2.383	0.150
RJA:Age	0.001	0.029	0.004	0.035
FailToOrient:Age	-0.070	0.029	-0.197	0.109
RJA:FailToOrient	0.001	0.019	NA	NA
RJA:IJA	NA	NA	0.001	0.058

103 **180.103** Social Scene Manipulation through Gaze-Contingent Interfaces: Towards Automated Gaze Strategy Instruction for Young Children with ASD

***Q. Wang**, E. S. Kim, C. A. Wall, E. C. Barney, Y. A. Ahn, C. Foster, M. Mademtzi, M. G. Perlmutter, S. Macari, K. Chawarska and F. Shic, Yale Child Study Center, Yale University School of Medicine, New Haven, CT*

Background: Eye tracking has been used to examine gaze patterns in studies of autism spectrum disorder (ASD). However most of these studies only recorded participants' eye movement during passive viewing, used static images, and manually defined boundaries of areas of interest (AOIs). In the present study, we investigate how typically developing (TD) children and children with ASD attend to dynamic social scenes in an interactive gaze paradigm.
Objectives: 1) To construct normative gaze models of dynamic social scene viewing by translating gaze patterns from TD controls into probability heatmaps and applying this model as an implicit AOI map for each video frame of dynamic stimuli. 2) To evaluate whether the looking behavior of children with ASD can be modified to resemble the normative gaze pattern.
Methods: Each toddler viewed four categories of dynamic video stimuli: Dyadic Speech (Motherese), Body Movements, Activity with Objects, and Singing Songs. These video stimuli were separated into 5 blocks with all categories of videos represented in each block. Participants included TD children (n = 31, Mage = 37.4 ± 14.29 months) and children with ASD (n = 9, Mage = 33.4 ± 7.07 months). All TDs were assigned to the regular, non-Gaze Contingent (non-GC) viewing condition, and their data was used for normative gaze pattern. Among ASD children, five were assigned to the Gaze Contingent (GC) condition and four were assigned to the non-GC condition. Subsequently dynamic heatmaps of the normative gaze pattern were applied to construct a corresponding set of attention-redirecting videos which darkened and blurred areas where the TD children were not looking. If the participants in the GC condition looked away from normative attention areas, the next video frame switched to the attention-redirecting video with bright and sharp regions corresponding to TD's heatmap distribution. This GC adaptive training method was designed to automatically attract the visual attention of children with ASD while they viewed the videos.
Results: In all four categories of videos children with ASD had significantly shorter looking times compared with TD children ($p < 0.001$). Furthermore, a linear mixed model analysis showed that children with ASD looked significantly less at Motherese dyadic speech videos compared to the other three categories of social scenes ($p < 0.001$); no significant difference was found in the TD group ($p > 0.4$). With GC adaptive training, children with ASD maintained their attention better than in the non-GC condition ($p < .05$). There were no significant contributions of Verbal ($p = .605$) or Nonverbal DQ ($p = .163$) to the model.
Conclusions: The preliminary data provide support for the application of GC training as a viable option for modifying gaze behaviors in children with ASD. Given that visual attention gates learning, this paradigm offers a highly promising avenue for developing new therapeutic interventions. By improving looking strategies of children with ASD, we hope to broaden their future access to social learning opportunities during this period of great neuroplasticity.

104 **180.104** Socio-Communicative Difficulties in Severely Visually Impaired (VI) Children WHO ARE at Risk of Autism As Measured By the Social Communication Schedule (SCS) and Parental Report

***N. J. Dale**[1], E. Sakkalou[2], M. O'Reilly[2], R. MacKechnie[3], C. Springall[3] and A. Salt[2], (1)UCL Institute of Child Health/ Great Ormond Street Hospital for Children, London, United Kingdom, (2)Clinical Neurosciences, UCL Institute of Child Health, London, United Kingdom, (3)Great Ormond Street Hospital for Children, London, United Kingdom*

Background:
Young children with congenital profound or severe visual impairment (VI) have a high risk of developing difficulties in social communication and interaction and behaviour problems. Children with profound VI (PVI) children, with light perception at best, are at greater risk for autism than children with basic 'form' vision (SVI) with difficulties becoming evident around the 2nd year of life (Dale & Sonksen, 2002). Existing tools used to measure early social communicative development are highly vision-dependent and not valid for children with VI. The Visual Impairment and Social Communication Schedule (VISS - Absoud et al., 2010) has had preliminary validation with children with VI and was highly reliable in predicting a later diagnosis of ASD; we are now developing this further to include standard behavioural items and social 'presses' (Social Communication Schedule -SCS).
Objectives:
To examine socio-communicative skills and difficulties in a sample of 2-year-old children with PVI and SVI using the SCS and Negative Behaviour Screener (NBS), and further examine relations with parent report of infant socio-communicative skills and pervasive developmental problems.
Methods:
Preliminary data from 51 children (M=26 months; 11 PVI, 40 SVI), with 'simple' congenital disorders of the peripheral visual system were rated using the SCS (high scores indicated better social communicative abilities) and the NBS (higher scores indicated more negative behaviours), whilst engaging in social and independent play tasks. Functional vision was assessed with the Near Detection Scale (Sonksen et al., 1983) to establish lower PVI and higher SVI. Parents rated the Vineland Adaptive Behaviour Scales (VABS) and the Child Behavior Checklist (CBCL). The subscales Communication and Social Skills from the VABS and the subscale Pervasive Developmental

Problems (PDP) from the CBCL were utilised. These subscales have shown predictive relations with ASD in previous studies (Volker et al, 1987; Sikora et al, 2007).
Results:
Strong negative relations found between SCS scores and NBS scores (r= -.74, *p*<.001) showed that children who scored higher on socio-communicative abilities on SCS had lower negative behaviour scores on NBS. A correlational analysis of the effect of vision level showed higher SCS scores and lower negative behaviours with higher level of functional vision (r= .48, *p*<.001; r= -.35, *p*<.01). Positive correlations were found between the SCS and VABS Communication (r=.53, *p*<.001) and Social Skills (r= .60, *p*<.001) and negative correlations between the NBS and VABS Communication, r= -.36, *p*<.01 and Social Skills, r= -.50, *p*<.001. Children with lower SCS scores and higher NBS scores were rated higher on the PDP by parents (r= -.37, *p*<.01, r= .33, *p*<.05 respectively).
Conclusions:
Children with VI with higher social communicative abilities at 2 years showed lower negative behaviours. Lack of functional vision was a risk factor with children with lowest functional vision (PVI) demonstrating weaker socio-communicative behaviours and higher negative behaviours. Together with promising validation with the parent report measures, the findings suggest that this 'early stage' tool may provide a useful means of differentiating behaviours which may be early signs of autism in this at risk population.

105 **180.105** Temperament Differences Across the First Three Years in High-Risk Younger Siblings of Children with ASD Compared to Low-Risk Controls

C. R. Hess[1] *and R. Landa*[2]*, (1)Center for Autism and Related Disorders, Kennedy Krieger Institute, Baltimore, MD, (2)The Kennedy Krieger Institute, Baltimore, MD*

Background:
Temperament differences between high-risk children who do and do not develop ASD have been noted during the first few years of life (Clifford et al., 2013; del Rosario et al., 2014).
Objectives:
To examine differences in child temperament characteristics in the first three years in a high-risk group of children who have an older sibling with ASD compared to a low-risk control group using a prospective, longitudinal design.
Methods:
Parents rated child temperament characteristics on the *Carey Temperament Scales (*Carey & McDevitt, 1995*)* for younger siblings of a child with ASD (N=157, 90 males) and low risk control children (N=23, 12 males) with no family history of ASD at 6-, 14-, 24-, and 36-months. The *Autism Diagnostic Observation Schedule* (*ADOS*; Lord et al., 2002; 2012) and *Mullen Scales of Early Learning* (*MSEL*; Mullen, 1995) were administered at each visit. At 36-months, children were categorized as high risk ASD (HR-ASD, n=32), high risk non-ASD (HR non-ASD, n=125) or low risk typically developing (LR, n=23) based on results of the *ADOS* and clinical best estimate.
Results:
Nonparametric Kruskal-Wallis tests, followed by Mann-Whitney U tests for comparisons, were used to analyze temperament differences between the three diagnostic groups from 6-36 months. Results were considered significant with p-values<.01 or lower. At 6 months, there was a trend for group differences for Intensity (*p*=.037). After removing an outlier, group differences were significant (*p*=.01). HR-ASD group was rated as lower in Intensity (i.e., more passive) than the HR non-ASD and LR groups (*p*s<.01), but the latter two groups did not differ. At 14 months, there were differences between groups for Distractability, Rhythmicity, and Threshold for Noticing New Stimuli (*p*s<.01). HR-ASD group was harder to distract from what they were interested in compared to the HR non-ASD and LR groups, and more arrhythmic than the LR group (*p*s<.01). The HR non-ASD group needed a higher threshold before noticing new stimuli compared to the LR group but not the HR-ASD group; the latter two groups did not differ. At 24 months, there were group differences for Adaptability, Rhythmicity, and Distractability (*p*s<.01). The HR-ASD group had greater difficulties with Adaptability and Rhythmicity than LR group, and were harder to distract from what they were interested in and more arrhythmic compared to the HR non-ASD group (*p*s<.01). At 36 months, there were group differences for Adaptability, Distractability, Mood, Persistence, and Threshold for Noticing New Stimuli. HR-ASD group had greater difficulties with Adaptability and more Negative Mood compared to LR group, and had greater difficulty with Adaptability, Distractability, Persistence, and Threshold for Noticing New Stimuli compared to HR non-ASD group (*p*s<.01).
Conclusions: In this prospective, longitudinal study, temperament differences between high-risk children who developed ASD and typically developing controls were noted as early as 6 months of age and continued through 36 months. This is consistent with findings that children with ASD tend to be more passive in infancy compared to infants without ASD, with notable difficulties in self-regulation of temperament in the second and third years.

106 **180.106** Temperament and Adaptive Functioning in a High-Risk Infant Sib Cohort

N. Garon[1]*, L. Zwaigenbaum*[2]*, S. E. Bryson*[3]*, I. M. Smith*[4]*, J. A. Brian*[5]*, C. Roncadin*[6]*, T. Vaillancourt*[7]*, V. L. Armstrong*[8]*, L. A. Sacrey*[9] *and W. Roberts*[10]*, (1)Mount Allison University, Sackville, NB, Canada, (2)University of Alberta, Edmonton, AB, Canada, (3)Dalhousie University, Halifax, NS, Canada, (4)Dalhousie University / IWK Health Centre, Halifax, NS, Canada, (5)Bloorview Research Institute, Toronto, ON, Canada, (6)Kinark Child & Family Services, Markham, ON, Canada, (7)University of Ottawa, Ottawa, ON, Canada, (8)IWK Health Centre / Dalhousie University, Halifax, NS, Canada, (9)Department of Pediatrics, University of Alberta, Edmonton, Alberta, Canada, Edmonton, AB, Canada, (10)University of Toronto, toronto, ON, Canada*

Background:
Siblings of children with Autistic Spectrum Disorder (ASD) have been found to be at higher risk of developing the disorder. As such this population provides a unique opportunity to investigate early mechanisms that influence the trajectory of individuals who develop ASD. Recent findings indicate that temperament may provide insight into the heterogeneous nature of ASD. Research supports a pattern of low positive affect, high negative affect and low regulation in prospective studies of high-risk infants subsequently diagnosed with ASD (Bryson et al., 2007; Garon et al., 2009). Notably, two studies have indicated that infants who are subsequently diagnosed with ASD show distinctive temperament trajectories in the first year of life (Clifford et al., 2013; del Rosario et al., 2014). Of interest for the current study, Evans and Rothbart (2009) have found evidence for two higher order temperament factors, which involve an integration of regulation and reactivity. Recently, Garon et al. (2015) have found differences in how these two main aspects of temperament were structured in a high risk population. In particular, Positive and Negative Affect factors at 24 months were positively associated with one another in the high risk population while the association was non-significant for the low risk population.
Objectives:
The current study had two main objectives. The first was to determine the higher order factor structure of temperament in a high risk population. The second was to determine whether these high order temperament factors at 12 and 24 months predicted adaptive functioning at 5 years.
Methods:
Infant siblings of children with ASD were assessed prospectively at 12 months on the Infant Behavior Questionnaire (IBQ) and at 24 months on the Toddler Behavior Assessment Questionnaire (TBAQ), both completed by parents. At 36 months, an independent 'gold-standard' diagnostic assessment for ASD was conducted including the Autism Diagnostic Observation Schedule (ADOS). At 5 years, parents completed the Vineland Adaptive Behavior Scale II (VABS-II). A confirmatory factor analysis (CFA) was used to derive two higher order temperament factors. A multivariate analysis of variance (MANOVA) was used to explore whether the temperament factors predicted different aspects of adaptive functioning. The dependent variables were VABS-II subscale scores while the independent variables were the two temperament factors and ASD symptoms as measured by the ADOS severity score at 36 months.
Results:
The hierarchical CFA resulted in two higher order temperament factors. The first factor labelled Regulation included significant loadings from the Positive Affect at 12 months, Positive Affect at 24 months, and Effortful Control at 24 months. The second factor, labelled Reactivity, included loadings from Negative Affect at 12 months, Negative Affect at 24 months and Positive Affect at 24 months. The MANOVA indicated that both Reactivity and Regulation made significant contributions to the prediction of adaptive function. Furthermore, these temperament factors remained significant predictors even when ASD symptoms at 36 months were included in the analysis.
Conclusions:
The present findings highlight the importance of early temperament. Further, these results suggest that temperament provides additional information beyond that provided by early ASD symptoms.

107 **180.107** The Clinical Utility of the Chinese Version Modified Checklist for Detecting Children with Autism Spectrum Disorders before Age 4 in Taiwan

Y. S. Wong*, C. C. Wu and C. C. Yang, Department of Psychology, Kaohsiung Medical University, Kaohsiung City, Taiwan*

Background: Autism spectrum disorders (ASDs) are characterized by impairment in social interaction, communication and restricted and repetitive patterns of behaviors (APA, 2000). However, the DSM-5 defined a single autism spectrum disorder (ASD), which changed the corresponding symptom structures from three to two dimensions, including deficits in social interaction/ communication, and repetitive interests/ stereotyped behaviors (APA, 2013).Children with ASDs will show symptoms before age 3 (APA, 2000) or early childhood (APA, 2013). Recently, the prevalence of ASDs increases significantly since 2007(CDC, 2014). However, the diagnosis of children with ASDs is usually delayed. Hence, the screening measures are very crucial to identify individual who has high risk for ASDs. Earlier detection usually promises a better prognosis. Among the numerous screening tools, the Modified Checklist for Autism in Toddlers (M-CHAT; Robins et al., 2001) is one of the most widely-used and well-researched, it consists of 23 yes/no items and can be finished in a short time by the caregivers.
Objectives: Therefore, this study aims to examine clinical utility of the M-CHAT for detecting children with ASDs before age 4 years in low-socioeconomic area of Southern Taiwan. Chia-Yi area was chosen because it belongs to one of the low-socioeconomic area in Taiwan and there are much indigenous people who is relatively disadvantage.

Methods: The Autism Diagnostic Observation Schedule (ADOS; Lord et al., 1999) was used to divide the children into ASDs and non-ASDs group, and M-CHAT was filled in by their caregiver. We would later see whether the classification of M-CHAT consistent with the result of ADOS. There were 236 children aged from 18 to 47 months old, including 113 children with ASDs and 123 children with developmental delay.
Results: The cutoff score of failing any 4 of the 23 M-CHAT items showed sensitivity of .77 and specificity of .72. Using cutoff score of failing any 3 of the 14 new critical items, which is called Brief 14 and was selected by using discriminant analysis, yielded the sensitivity of .71 and specificity of .82.
Conclusions: Inconsistence with previous studies, there is no item that children with ASDs showed failure rate beyond 50%.It might be due to the cultural issue in Chinese parents, they might underreported or deny their kids' symptoms as they want to save their face. Being unfamiliar with ASDs symptoms, they might normalize and misinterpret their kids' abnormal behavior. Even so, the validity of using the M-CHAT to screen clinical samples less than age of 4 years seemed acceptable in low-socioeconomic area of Southern Taiwan. This study also showed that there is cultural universality for children with ASDs in the domain of joint attention and imitation. Furthermore, this study replicated previous findings which children with ASDs showed impairments in social-communicative skill. Results suggest the need for increased education and detail information about childhood development. Furthermore, Brief 14 is suggested to use in the population in Taiwan to gain a better validity.

108 **180.108** The Development of Joint Attention and Vocalizations in Infants at Heightened Risk for Autism Spectrum Disorder

P. Heymann[1], *J. B. Northrup*[2], *M. V. Parladé*[3], *N. B. Leezenbaum*[2], *K. L. West*[2] *and J. M. Iverson*[2], *(1)Yale Child Study Center, Yale University School of Medicine, New Haven, CT, (2)University of Pittsburgh, Pittsburgh, PA, (3)University of Miami, Coral Gables, FL*

Background: Infants at heightened risk (HR) for Autism Spectrum Disorder (ASD) who later receive an ASD diagnosis exhibit delays in both joint attention (JA) and pre-linguistic vocalization development (Morales et. al., 2000; Paul et. al., 2011). In typically developing infants, vocalizations are used early on to establish JA between infants and caregivers (Wu & Gros-Louis, 2014), demonstrating an early-emerging link between these behaviors. Previous studies have focused on JA and vocalizations separately (Toth et. al., 2006), but the simultaneous development of these behaviors, as well as their collective impact on early skill acquisition, remains to be explored.
Objectives: This study was designed to examine the development of JA, vocalizations, and their co-occurrence in three groups of HR infants.
Methods: 50 HR infants (30 males) were observed during the Early Social Communication Scale (ESCS; Mundy et. al., 2003) at 14, 18 and 24 months as part of a larger longitudinal study. At 36 months, each infant was classified into one of three outcome groups: Autism Spectrum Disorder (ASD; n = 9); Language Delay (LD; n = 15), or No Diagnosis (ND; n = 25). Videotaped sessions were coded offline by blind coders. Initiating joint attention (IJA: e.g., eye contact between a toy and experimenter, showing) and initiating behavioral requests (IBR: e.g., reaching, giving, pointing) were coded according to the ESCS manual (Mundy et. al., 2003). Each vocalization was identified and coded as vowel only (VO), syllabic (i.e. containing a consonant), or word.
Results: Repeated measures ANOVAs were utilized for all analyses. For JA, a significant main effect of outcome was found only for higher level IJA behaviors (e.g., shows: $F(2,47)=14.43$, $p=.00$). For vocalizations, a 3 (age) x 3 (outcome group) x 3 (vocalization type) repeated measures ANOVA revealed a significant 3-way interaction ($F(8,188)=8.613$, $p=.000$; see Figure 1). Follow-up ANOVAs indicated an age by vocalization type interaction for the ND ($F(4,100)=71.71$, $p=.000$) and LD ($F(4,56)=10.611$, $p=.000$) groups, but not for the ASD group. The ASD group consistently produced fewer and lower quality vocalizations at all three ages, showing no increases in production of any vocalization type at any age. Examining the co-occurrence of JA behaviors and vocalizations, a main effect of outcome was revealed for both IJA + vocalization and IBR + vocalization (p's < .05). Infants later diagnosed with ASD paired vocalizations with JA behaviors significantly less frequently than their ND and LD peers.
Conclusions: Infants who later receive an ASD diagnosis produced fewer higher level IJA behaviors, vocalized less, and produced more vowel-only vocalizations then their ND and LD peers. They further demonstrated a specific difficulty coordinating these behaviors. Coordinating JA behaviors with a vocalization likely enhances communicative quality and engages partners in a way that a simple reach or shift in eye gaze may not. These findings highlight the importance of observing how these two types of communicative behaviors develop together in a HR population.

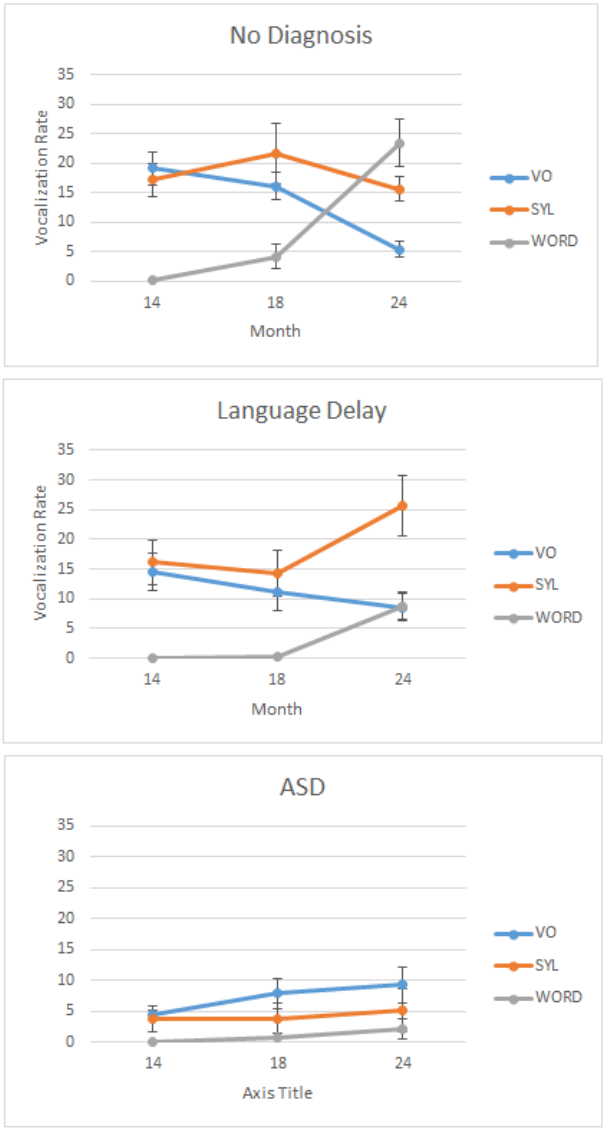


Figure 1: Rate per 10 Minutes of Vocalizations at 14, 18 and 24 months between the three outcome groups.

109 **180.109** The Effects of Others' Speech during Activity Monitoring on Attention Patterns in Toddlers with and without ASD

***Y. A. Ahn**, Q. Wang, C. A. Wall and F. Shic, Yale Child Study Center, Yale University School of Medicine, New Haven, CT*

Background: Previous research on activity monitoring eye-tracking tasks suggests that toddlers with Autism Spectrum Disorder (ASD) attend less to people and their activities than developmentally delayed and typically developing toddlers (Shic, Bradshaw, Klin, Scassellati, & Chawarska, 2011). Toddlers with ASD divert their attention more towards non-social stimuli (Shic et al., 2014). However, it is unclear whether the presence or absence of others' speech influences attention allocations in toddlers with ASD.

Objectives: To examine the impact of others' speech during activity monitoring in toddlers with and without ASD.

Methods: Thirty-two toddlers with ASD (M_{age} = 30 months, *SD* = 7 months) and 42 toddlers without ASD (M_{age} = 27 months, *SD*= 9 months) viewed 16 20s video clips of two female adults interacting and engaging in a shared activity. Participants without ASD consisted of toddlers with typical development and those with developmental delays not classified as ASD. The video clips varied by the actress pair, type of activity, background, gaze behavior of the actresses, and presence of distractors. Participants' gaze patterns were examined with eye-tracking method. Analyses were conducted to investigate between-group differences in the percentage of time participants spent looking at the scene (%Scene), the actresses' heads (%Head), bodies (%Body), both actresses' heads and bodies (%People), shared activity (%Activity), and background (%Background) during times when actresses were speaking vs. when actresses were silent.

Results: Compared to non-ASD toddlers, the ASD group demonstrated significantly less looking towards people ($p < .01$) and activity ($p < .001$), and significantly more looking at the background ($p < .001$) throughout the experiment. For both diagnostic groups, %People increased with the presence of speech ($p < .05$). There was a trend towards decreased looking at activities when speech was present ($p = .08$). Non-ASD toddlers looked more at heads than bodies when speech was present ($p < .05$). ASD participants looked more at people when actresses were speaking than when they were not speaking ($p < .05$), but %Head and %Body within the ASD group did not differ. Univariate ANOVA analysis did not yield any significant interaction between speech and diagnostic groups for any outcome measure ($p > .05$).

Conclusions: These results support previous findings that toddlers with ASD demonstrate decreased attention towards people and activities and increased attention towards the background as compared to their peers without ASD. The current analyses further highlight that the presence of speech may play a role in directing toddlers' attention to social components of the scene. Non-ASD toddlers attended significantly more to heads, whereas toddlers with ASD attended to heads and bodies equally, even in the presence of speech. This may suggest that the speech is not salient enough to direct attention to heads for toddlers with ASD, which is generally the focus of typically developing and developmentally delayed toddlers. Future research should explore the effects of non-speech sounds or movement on the monitoring of social activities.

110 **180.110** The Onset of Restricted, Repetitive and Stereotyped Patterns of Behavior in 18 Month Olds with Suspected Language Delay

***A. Thurm**[1], S. S. Manwaring[2], L. B. Swineford[3], A. Stevens[2] and C. Farmer[4], (1)National Institutes of Health - National Institute of Mental Health, Bethesda, MD, (2)University of Utah, Salt Lake City, UT, (3)Pediatrics and Developmental Neuroscience Branch, National Institute of Mental Health, Bethesda, MD, (4)National Institutes of Health, Bethesda, MD*

Background: The study of the ontogeny of ASD symptom development has begun to include exploration of the early presence of Restricted, Repetitive and Stereotyped Patterns of Behavior (RRBs) in children at risk but not yet diagnosed with ASD (Elison et al. 2014). With significantly more studies devoted to the differentation of delay versus deviance in social-communicative skills, it is important to also explore the presence and timing of RRB's in children at risk for autism because they show specific delays (e..g language delay).

Objectives: The aim of the present study was to examine the frequency and timing of RRB onset in 18 month olds evaluated due to referral for language delays.

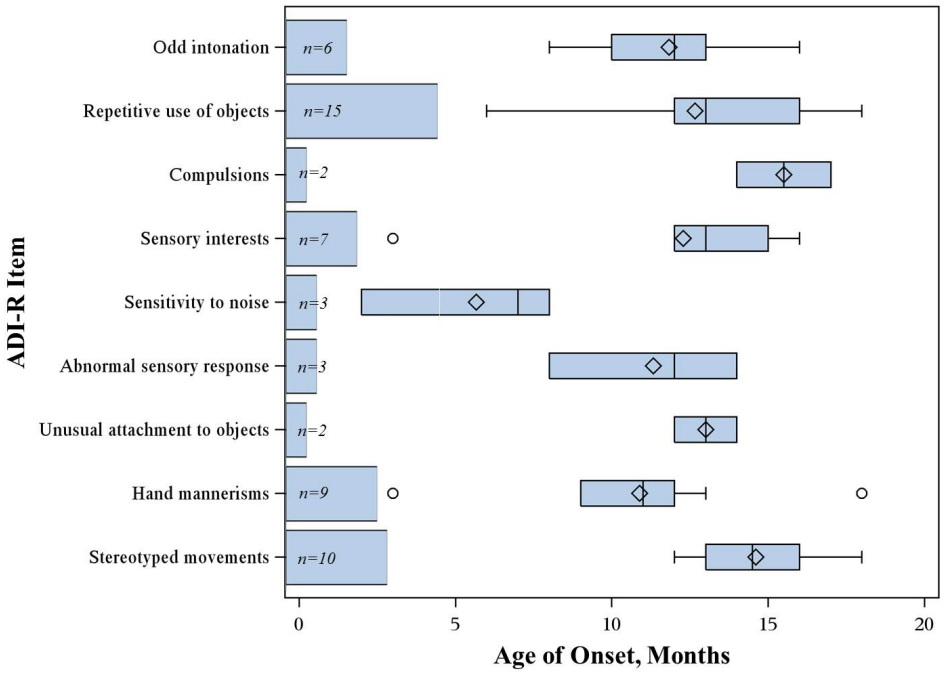
Methods: Participants (n=37) were recruited based on suspicion of language delay, with only one child diagnosed with ASD before study participation. Data were collected during an initial screening at approximately 18 months of age (mean = 18.6, SD = 1.4, range 16-21 months). The assessment battery included the Mullen Scales of Early

Learning, the Autism Diagnostic Observation Schedule, 2nd Edition (ADOS-2) Toddler module and the Autism Diagnostic Interview-Revised (ADI-R) Toddler version- four restricted and repetitive behavior domain items (RRB), in which a score of 0 indicates absence of a symptom, 1 indicates mild presentation, and 2 indicates symptoms with interference. The Repetitive Behavior Questionnaire (RBQ) was also administered to a parent.

Results: The mean nonverbal ratio IQ in this sample was 94.2±17.1, with a mean verbal ratio IQ of 61.0±22.8. Of 33 participants with ADI-R administrations, 42% (n=14) had a score of zero on the RRB domain. Eleven toddlers (33%) had scores of 1 or 2, and the remainder (n=8, 24%) had scores of 3 to 8. All RRBs were reported to emerge by 18 months of age, with specific behaviors noted as early as 2 months of age (*Sensitivity to Noise*) (Figure 1). Two behaviors, *Difficulties with minor changes in routine and Resistance to trivial changes in environment* were not reported for any participant. The ADI-R RRB algorithm score was strongly correlated with the ADOS RRB severity score and the Social Affect severity score, and was more moderately correlated with the RBQ Total Score (Table 1). Both the ADI-R and ADOS RRB scores were negatively correlated with Mullen nonverbal and verbal ratio IQs. The RBQ Total Score was not correlated with the Mullen scores. The earliest reported age of onset for any repetitive behavior was calculated from the ADI-R, but this did not correlate with any other variable.

Conclusions: This study found significant rates of RRBs in 18 month olds referred for language delay, with sensory related symptoms starting earliest. Validating previous findings, insistence on sameness was minimal in this young sample, but the presence of motor movement abnormalities and repetitive use of objects was frequent. Repetitive behaviors, both reported and observed, were strongly related to each other and to both nonverbal and verbal development. Further studies with larger sample sizes and diagnostic outcome groupings should explore the stability of RRB's in children referred for language delays.

Figure 1. Rate of endorsement (left bar) and age of onset (boxplot) for repetitive behaviors in toddlers with language delays



Note: N=33. Two items were not endorsed for any participant (*Difficulties with minor changes in routine, Resistance to trivial changes in environment*).

Table 1. Spearman correlations among repetitive behavior measures in toddlers with language delays

	ADI RRB Score	Earliest age of onset for RRB	ADOS RRB CSS	RBQ Total Score
ADI-R RRB Algorithm Score	N=33			
ADI-R Earliest Age of Onset	-.06	N=22		
ADOS RRB Calibrated Severity Score	.71**	-.21	N=35	
RBQ Total Repetitive Behavior Score	.41*	-.40	.30	N=35
ADOS Social Affect Calibrated Severity Score	.84*	.27	.59**	.39*
Mullen Nonverbal Ratio IQ	-.49**	-.05	-.43**	-.20
Mullen Verbal Ratio IQ	-.69**	-.06	-.66**	-.30

Note: **p<.01, *p<.05. n=31 for correlations with ADI; n=33 for correlations between ADOS and RBQ.

D. Oosting *and A. S. Carter, Department of Psychology, University of Massachusetts Boston, Boston, MA*

Background: Joint attention (JA) skills, and particularly the ability to initiate joint attention (IJA), have been shown to predict receptive and expressive language development in young children with ASD (Charman et al., 2003; Mundy, Sigman, & Kasari, 1990). Fewer studies have focused specifically on JA indices as predictors of language and social interaction skill development in very young (<3 years) minimally verbal children with ASD.
Objectives: We explored whether one-year gains in language and social interaction skills were associated with the following baseline joint attention indices in toddlers with ASD who were minimally verbal: initiation of, and response to, joint attention, behavioral requests, and reciprocal social interactions.
Methods: Participants were 62 children with ASD assessed first at 18 to 33 months (Time 1, T1; M=28±4) and again approximately one year later (T2). All participants were minimally verbal at time 1, defined by Mullen Scales of Early Learning expressive language t-scores of 20. Social interaction skills were assessed with the ADOS Reciprocal Social Interaction scores and mother-reported Vineland Adaptive Behavior Scales (VABS-I) Socialization standard scores. Language abilities were assessed with the Mullen Scales of Early Learning Expressive and Receptive Language t-scores, and JA indices assessed with the Early Social Communication Scales. Regression analyses examined whether T1 JA indices independently predicted improvements in receptive and expressive language and social interaction skills, represented by T1-T2 difference scores. T1 Mullen nonverbal developmental quotient (NVDQ) and/or T1 age were covaried in regression models when correlated with the dependent variable.
Results: Prior to examining regression models, pairwise comparisons established significant improvements from T1 to T2 on all outcome measures (ts > |3.5|, ps < .001). Younger age at T1 and higher T1 NVDQ scores were associated with greater gains in receptive language. Children who were younger at time 1 showed greater improvement in ADOS Reciprocal Social Interaction score, whereas the reverse was true for the VABS-I Socialization scores. T1 IJA and response to JA (RJA) significantly predicted gains in receptive language skills (β = .29, p = .02; β = .47, p < .001). JA indices were unrelated to gains in expressive language. T1 response to social interaction significantly predicted greater social interaction symptom reduction on the ADOS and larger gains in VABS-I Socialization score (β = .26, p = .04; β = .33, p = .01).
Conclusions: Previous literature highlighted early initiation of, and response to, joint attention as predictors of both receptive and expressive language gains. Our results show that for these young minimally verbal children, early IJA and RJA skills were associated with gains in receptive language and were unrelated to gains in expressive language. Improvements in social interaction skills and reductions in social interaction symptoms were associated with responsiveness to other social situations (e.g., reciprocal social games).

112 **180.112** The Role of Temperament and Broader Autism Phenotype in the Prediction of Toddlerhood Externalising and Internalising Symptoms

M. Uljarevic[1]*, K. Crea*[2]*, C. Dissanayake*[3] *and K. Hudry*[4]*, (1)Olga Tennison Autism Research Centre, La Trobe University, Bundoora, Australia, (2)Olga Tennison Autism Research Centre, Bundoora, VIC, Australia, (3)Olga Tennison Autism Research Centre, La Trobe University, Melbourne, Australia, (4)Olga Tennison Autism Research Centre, Melbourne, Australia*

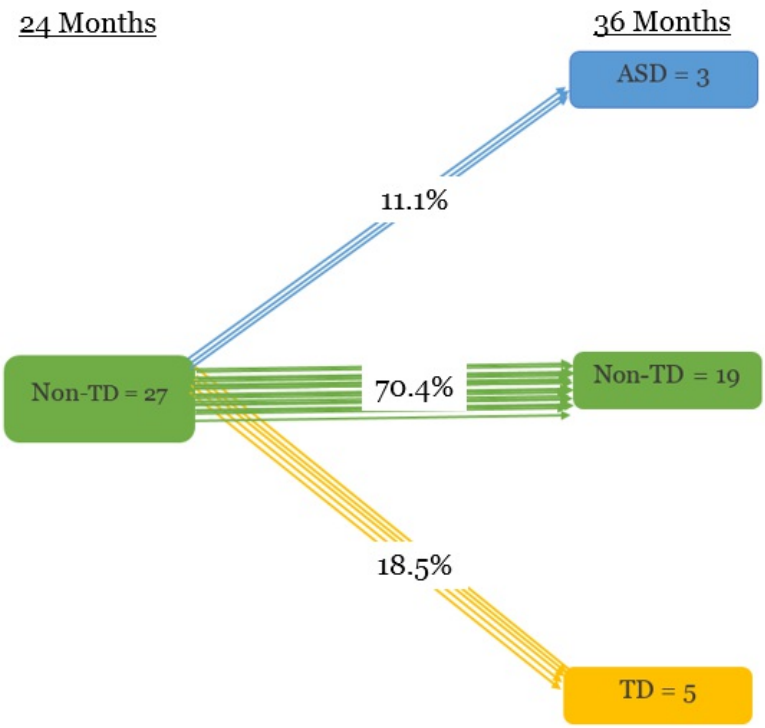
Background: Autism Spectrum Disorder (ASD) is the term used to describe a cluster of neuro-developmental conditions comprising social and communication impairments and the presence of restricted patterns of behaviours and interests. Co-morbid Internalising and Externalising symptoms are prevalent and often have greater negative impact on functioning than do the core ASD symptoms themselves. Significant heterogeneity is apparent across every facet of ASD, both in terms of core and co-morbid symptoms. However, factors that may account for such heterogeneity remain poorly understood. Given the substantial body of research showing both the positive and negative impacts of temperament on social, emotional, and behavioural outcomes outside the context of ASD, it seems clear that research on temperament in the context of ASD may hold significant potential for informing our understanding of the variability inherent in individuals' developmental trajectories and outcomes.
Objectives:
To explore the extent to which Internalising and Externalising symptoms may vary as a function of temperamental differences among young children between 2- and 3-years of age (when ASD is often diagnosed), and in conjunction with the Broader Autism Phenotype (BAP) and specific ASD symptom presentation.
Methods:
Mothers of 60 toddlers completed the Short Temperament Scale for Toddlers and the Behavior Assessment System for Children when toddlers were aged between 2 and 3 years. Thirty children had an older sibling diagnosed with ASD (BAP) and around half of them met criteria for an ASD diagnosis (BAP-ASD) by 3 years of age. The older sibling of 30 children did not have ASD. All children were assessed for cognitive level using the Mullen Scales of Early Learning and children in the BAP group were assessed for ASD symptoms using the Autism Diagnostic Observation Schedule (ADOS).
Results:
Toddlers in the BAP group had more Externalising, t(45)=2.98, p=.005 (*Cohen's d*=.89) and Internalising Problems, t(45)=2.54, p=.015, d=.76, than those without a sibling with ASD. There was also the suggestion of more Externalising Problems among the BAP-ASD compared to the BAP-non ASD subgroup, t(21)=1.32, p=.203, d=.58, but there was no evidence of subgroup differences on Internalising Problems, t(21)=.51, p=.619, d=22. While no differences on global Easy/Difficult Temperament were detected between the BAP and control group, t(35.8)=.12, p=.908, d=.04, there was a suggestion of more difficult temperament among the BAP-ASD subgroup, t(21)=1.67, p=.109, d=73. For the whole sample, however, more difficult temperament was significantly associated with both externalising (r=.41, p<.01) and internalising symptoms (r=.58, p<.01) and the associations remained significant after controlling for the effect of BAP and cognitive level.
Conclusions:
This study replicated previous findings suggesting higher rates of Internalising and Externalising symptoms in individuals with the BAP, extending to demonstrate that this is already the case by toddlerhood. Furthermore, our findings suggest that temperament predicted both internalising and externalising traits over and above the influence of cognitive level, BAP status and ASD traits. Further longitudinal research is necessary in order to explore the directionality of the effect and to capitalise on the possibilities afforded through study of the construct of temperament in infants and children with ASD.

113 **180.113** The Stability of Atypical Developmental Outcomes in Young Children at Risk for Developing ASD

K. K. Powell[1]*, S. Macari*[1]*, E. Hilton*[1]*, S. F. Fontenelle*[1]*, J. Koller*[2] *and K. Chawarska*[1]*, (1)Yale Child Study Center, Yale University School of Medicine, New Haven, CT, (2)School of Education, Hebrew University of Jerusalem, Jerusalem, Israel*

Background: Prospective studies of infants at risk for developing Autism Spectrum Disorder (HR-sibs) estimate that 18.7% of siblings develop ASD themselves (Ozonoff et al., 2011). Another approximately 19- 28% of siblings evidence other developmental atypicalities (Georgiades et al., 2013; Ozonoff et al., 2014). While the diagnosis of ASD made prior to age 3 is relatively stable in HR-sib cohorts (Ozonoff et al., 2015), the diagnostic stability and clinical presentation of the "atypical" group is less clear.
Objectives: To examine the stability of atypical developmental outcomes between 24 and 36 months in a high-risk sample.
Methods: Seventy-nine HR-sibs (68.5% males) were comprehensively assessed at the ages of 24 and 36 months utilizing the Mullen Scales of Early Learning, Vineland Adaptive Behavior Scales, and Autism Diagnostic Observation Schedule. For the Mullen and Vineland higher standard score indicates higher functioning, while a higher score on the ADOS indicates poorer functioning. Each participant was assigned a Clinician Best Estimate (CBE) diagnosis at each time point. The following CBEs were utilized: ASD (*Autistic Disorder* or *PDD-NOS*), non-TD (*Broader Autism Phenotype (BAP):* sub-threshold ASD-related symptoms that supersede other developmental delays, and *Developmental Delays*: language, cognitive, and/or behavioral problems), and TD (*no clinical diagnosis* or *mild symptom* presentation that did not warrant a diagnosis). Stability of diagnostic presentation and clinical features were subsequently evaluated in the non-TD group. Pearson correlations were conducted to examine the relationship between developmental skills, adaptive communication and socialization, and autism severity between 24 and 36 months.
Results: Of the 79 HR-sibs, 27 (34%) were identified as having BAP or other developmental issues (non-TD) at 24 months. At the age of 36 months, 19 (70.4%) maintained a non-TD classification, 5 (18.5%) were considered TD, and 3 (11.1%) met criteria for ASD. Verbal DQ (r(23)=.643, p<.01), Vineland Communication (r(22)=.757, p<.001), and Vineland Socialization (r(22)=.504, p<.05) were significantly correlated between 24 and 36 months, while Nonverbal DQ and ADOS severity were not (ps>.1).
Conclusions: Out of the 34% of HR-sibs identified as non-TD at 24 months, the majority (70.4%) continues to demonstrate difficulties consistent with non-TD presentations at 36 months. Approximately 20% of them appear to catch up to their TD peers, but in approximately 10%, symptoms worsen and are consistent with ASD. While verbal abilities and adaptive communication and socialization were significantly correlated across time points for the non-TD group, nonverbal abilities and autism symptom severity were not. Diagnostic stability and clinical presentation can be variable for many HR-sibs, particularly those demonstrating atypical developmental patterns early in life. The results of this study highlight the need for continued monitoring and later follow-up of HR-sibs to confirm later (and potentially more stable) diagnostic outcomes.

Figure 1. Diagnostic Stability of non-TD CBEs



114 **180.114** Using Child Behavior Checklist for Assessing and Detecting Peschool Children with Autism Spectrum Disorders

Y. T. Chiu, *W. H. Yu and C. C. Wu, Department of Psychology, Kaohsiung Medical University, Kaohsiung City, Taiwan*

Background: **C**hildren with autism spectrum disorders (ASDs) usually accompanied emotional and behavioral problems. Children with emotional and behavioral problems could resulte in more impartments on their social and communication distress, thus make stress on their caregiver.
Objectives: Child Behavior Check List 1.5-5 (CBCL/1.5-5) is a tool for evaluating emotional and behavioral problems of preschool children. Precious researches used CBCL/1.5-5 to screen ASDs children. However, there is no research in Taiwan. In this study, the CBCL/1.5-5 was used to assess and detect peschool children with ASDs.
Methods: 249 children aged less than 48 months old, including 99 children with ASDs, 114 children with developed delay (DD), and 36 children with typical development. The CBCL/1.5-5 was completed by the caregivers for measuring emotional and behavioral problems of all children.
Results: These three groups showed significantly different on the internalizing problems, total problems, withdrawn, attention problems, and pervasive developmental problems subscales. All of withdrawn, pervasive developmental problem and internalizing problems are better index for distihduishing children with ASDs from children with DD. Using signal detection procedure, T-score of 66 on the withdrawn subscale as the cut-off to distinguish children with ASDs from those with DD, the sensitivity and specificity were 72% and 70%, respectively; the pervasive developmental problems subscale use T-score of 70 as the cut-off to distinguish children with ASDs from those with DD, the sensitivity and specificity were 71% and 63%, respectively; the Internalizing problems scale use T-score of 63 as the cut-off to distinguish children with ASDs from those with DD, the sensitivity and specificity were 71% and 63%, respectively. The results revealed that using the withdrawn and pervasive developmental problems subscale as a screening index for fdeteding children with ASDs, it showed accepted validity.
Conclusions: Used the CBCL/1.5-5 as a screening tool for children with ASDs, the withdrawn and pervasive developmental problem subscale have moderate validity, suggest the two subscales can be screening tool in the clinical setting.

115 **180.115** Video-Referenced Ratings Assessing Social Behavior in Hispanic Toddlers

B. Benedict[1], *B. Harris-Olenak*[2], *T. Jacob*[2] *and J. N. Constantino*[3], *(1)VA Palo Alto Health Care System, Menlo Park, CA, (2)Family Research Center, VA Palo Alto Health Care System, Menlo Park, CA, (3)Washington University School of Medicine, Saint Louis, MO*

Background:
Childhood development involves a complex interplay of cognitive, communicative, and social skills; deficits in any of these areas comprise key characteristics of Autism Spectrum Disorders (ASD). Most important to this study is early detection of impairments in reciprocal social behavior (RSB) (i.e., the drive to engage others and ability to interpret and respond to interpersonal cues). Although psychometrically-sound diagnostic tools measuring RSB exist, instruments for assessing RSB in toddlers under age 2, a critical and rapid developmental period, have been only minimally validated (Marrus et al., 2015) and only within a Caucasian sample.
Objectives:
This study aimed to replicate previous findings by Marrus and colleagues (2015) in order to test the utility and external validity of the Video-referenced RSB (vrRSB) measure. Due to the largely biological, developmental nature of RSB, we predicted that results would replicate across samples.
Methods:
Hispanic families with twins were recruited from California birth records (large majority were bilingual). Of the 2874 families targeted for the CA-ERSB study, 335 families responded to the recruitment mailing, 41 families opted out, 143 families were ineligible, and 151 families enrolled in the study. As a part of a larger battery, enrolled families were administered vrRSB across two waves of data collection and the Modified Checklist for Autism in Toddlers (M-CHAT) and the MacArthur-Bates Communitive Disorders Inventory (CDI) across one wave of data collection. Descriptive statistics were conducted to examine vrRSB score distributions and sample characteristics. Chronbach's alpha and intraclass correlations examined test-retest reliability, Pearson correlations and independent samples t-test examined concurrent validity, and a repeated measures t-test examined developmental progression of RSB over a 6 month period.
Results:
Analyses indicted that scores on the vrRSB were continuously distributed. Six-month reliability (a = 0.814; ICC=0.687, p=0.000) and validity were established. Video-referenced RSB total scores were inversely correlated with receptive (r=-0.235, p=0.000) and expressive (r=-0.373, p=0.000) language scores on CDI and vrRSB total score means were significantly different for those who failed (n=46; m=34.09, SD=11.68) versus passed (n=254; m=20.84, SD=7.59) the M-CHAT (t=-7.42, df=52, p=0.000)]. In order to examine developmental progression of RSB, mean changes in vrRSB scores across wave 1 (m=22.83, SD=9.59) and wave 2 (m=20.07, SD=10.22) were examined. Results indicated improved social competency over time; change scores were in the expected direction and were significantly different across two time points (t=6.114, df=301, p=0.000).
Conclusions:
Results from Marrus et al. (2015) were replicated providing support for the external validity of the vrRSB across ethnicities and geographic regions. Like autistic trait ratings in school-aged children, toddlers' scores on the vrRSB demonstrated high inter-individual stability, moderate concurrent validity, and significant developmental progression over a six month. These findings supported "downward extension" of early detection of ASD and provided evidence for the vrRSB's ability to monitor changes over time. Thus, the vrRSB is a promising assessment option for early identification and intervention of ASD in diverse populations.

116 **180.116** Visual Search Cancellation at 36 Months in Autism: Search Strategies and Infant Predictors

ABSTRACT WITHDRAWN

Background: Enhanced visual search is one of the most replicated findings in the autism spectrum disorders (ASD) literature and has been documented as young as in infancy and toddlerhood. Visual search in this context often refers to locating one target amongst distracters—less research has investigated search strategies when there are multiple targets amongst distracters, and no studies to our knowledge have manipulated targets and distracters to investigate varying search strategies based on task requirements. It is possible that in ASD performance will be poorer in a multiple target cancellation task, in particular when targets represent a conceptual category as opposed to an exemplar and thus require conceptual knowledge. In contrast, it is possible that performance will be enhanced when exemplar targets are perceptually similar to distracters, thus requiring perceptual abilities known to be enhanced in ASD.
Objectives: This study sought to investigate cancellation performance in 36-month-olds at high and low risk for autism. Additionally, visual search performance for single targets earlier in childhood were used to predict cancellation performance at 36 months to determine if the abilities underlying single target visual search relate to cancellation performance.
Methods: Sixty-two 36-month-olds at high and low risk for ASD participated in the visual search cancellation task on a touchscreen monitor as a part of a battery of cognitive tasks. In this task, children were asked to search for and touch a) cats among inanimate objects (baseline, “exemplar search”), b) animals amongst inanimate objects (to test categorization, such that higher autistic symptoms were hypothesized to relate to worse performance, “conceptual search”), and c) dogs amongst furniture (to test for the ability to discriminate between perceptually similar objects, such that higher autistic symptoms were hypothesized to relate to better performance, “perceptual search”). The Autism Diagnostic Observation Scale (ADOS) was used to assess severity of autism symptoms.
Results: While controlling for motor and language abilities, ADOS social affect (SA) scores related to the difference between exemplar and conceptual search conditions in a combined measure of speed and accuracy, with poorer search related to high SA scores. To understand the origins of poor performance, we analyzed search strategies. Interestingly, ADOS repetitive and restrictive behavior (RRB) scores related to spatial search efficiency specifically in conceptual search, with more efficient search related to higher RRB scores. This may be due to children with low autistic symptoms using a conceptual strategy (all the camels are touched then all the bears, etc.), which is still strategic but not spatially efficient. There is some evidence for this hypothesis, with a negative relationship between measures of conceptual strategy and spatial strategy. Finally, there is a marginal negative relationship between single target visual search at 24 months and spatial search efficiency in conceptual search.
Conclusions: High autistic symptoms show counterintuitive continuous relationships with both poorer speed/accuracy as well as better spatial search efficiency. These relationships may be explained by poor conceptual knowledge resulting in less conceptually driven search.

117 **180.117** When Do the Developmental Trajectories of Siblings with ASD and BAP Diverge from Typically Developing Siblings?

E. Hilton, *K. K. Powell, S. Macari, A. Milgramm, P. Heymann, L. DiNicola, S. F. Fontenelle and K. Chawarska, Yale Child Study Center, Yale University School of Medicine, New Haven, CT*

Background: Younger siblings of children with ASD are at increased risk for developing ASD and Broader Autism Phenotype (BAP) (Ozonoff et al., 2011). BAP features include a wide range of subthreshold deficits and atypical behaviors in domains often affected in ASD. Extant evidence suggest that high-risk (HR) siblings with BAP already show developmental vulnerabilities and decreased social engagement by 12 months compared to typically developing (TD) infants without familial history of ASD (Ozonoff et al., 2014). More clinically informative would be to determine when the developmental trajectories of HR infants with typical and atypical development diverge.
Objectives: To examine when HR-sibs begin to diverge in regard to social and communication adaptive functioning and severity of autism symptoms.
Methods: All infants (n= 63, 66.7% males) underwent comprehensive evaluations at 12, 18, 24, and 36 months. Classification of ASD (n=15), BAP (n=15) and HR-TD (n=33) was based on a comprehensive assessment at 36 months. In order to examine divergence, the Vineland Adaptive Behavior Scales Communication and Socialization domains and the Autism Diagnostic Observation Schedule- Toddler (ADOS-T) were administered. A higher standard score on the Vineland Communication and Socialization domains indicates higher functioning, while on the ADOS-T a lower calibrated severity score indicates higher functioning.
Results: A repeated-measures age (3) x group (3) ANOVA indicated a significant main effect of group [$F(2, 62) = 10.49$, $p < .01$], a significant main effect of age [$F(2, 62) = 19.581$, $p < .01$], and a significant interaction of age by group [$F(2,62) = 1.99$, $p < .025$]. At 12 months, ASD displayed higher symptom severity on the ADOS than HR-TD ($p < .01$). At 18 and 24 months, ASD had higher ADOS-T severity ($ps<.01$) and lower Vineland Communication ($ps < .01$) and Socialization ($ps < .01$) scores. No significant group differences were found between BAP and HR-TD at 12 months ($ps > .1$). At 18 and 24 months, BAP demonstrated higher symptom severity on the ADOS ($p < .01$) and lower Vineland Communication scores ($p < .05$) than HR-TD. ASD had lower Vineland Socialization scores than BAP at 18 months ($p < .01$); all other comparisons between the two groups were non-significant.
Conclusions: Already at 12 months infants who later develop ASD show more severe autism symptoms than TD siblings. At 18 months, those with ASD continued to show higher ADOS scores and also demonstrated lower abilities on adaptive communication and socialization domains, with group differences remaining stable at 24 months. BAP and HR-TD were differentiated less often: only at 18 and 24 months on Vineland Communication and ADOS. Finally, BAP and ASD only differed at 18 months on adaptive socialization. By and large, BAP presented as intermediate to ASD and HR-TD, but more closely aligned with those with ASD. The distinctive findings on the adaptive socialization scale highlight the potential contribution of “social ability” in differentiating BAP from ASD. Future studies should further examine the role of social ability in the various atypical developmental trajectories of children at risk for developing ASD.

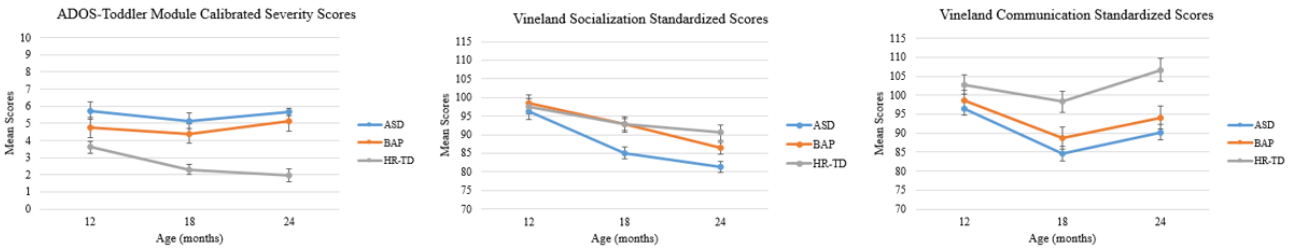


Figure 1. Mean scores of ASD, BAP, and HR-TD participants on the ADOS – Toddler, Vineland Socialization, and Communication domains at 18, 24, and 36 months.

118 **180.118** “Did Somebody Call My Name?” Neural Responses to Hearing Their Own Name in Infants at Low and High Risk for Autism Spectrum Disorder at 14 Months of Age

M. Arslan, *N. L. Dewaele, E. Demurie, P. Warreyn and H. Roeyers, Ghent University, Ghent, Belgium*

Background:
People attend to their own name even in noisy environments and use this as a signal to follow social conversations. Typically developing infants start to orient towards the sound of their own name already at 4-5 months of age, which was also observed by altered neural responses via event-related potentials (ERP). A reduced attention to this ostensive cue was however detected in infants who are at high risk for autism spectrum disorder (ASD) and it is considered to be an early sign of ASD.
Because enhanced attention to the own name may be important for language acquisition by functioning as a tool for speech segmentation, a reduction in this attention may result in weakened early social information processing, interfering with the development of social skills. Therefore, the own name as social cue may play a particularly significant role in the beginning of the second year of life, since at that age language acquisition progresses very fast.
Objectives:
The aim of this study was to investigate whether 14-month-old infants at high-risk for ASD show a different ERP pattern compared to infants at low-risk for ASD, in the way they process personal names and more specifically their own name. It was hypothesized that the infants at high-risk for ASD would show extenuated ERP responses to their own name compared to an unfamiliar name.
Methods:
Initially, data from 46 14-months-old infants at low-risk and high-risk for ASD were collected. After excluding data from 20 infants due to excessive movement and artifacts, data from 16 low-risk and 10 high-risk group infants were included in the analyses. ERPs were measured during an own name/unfamiliar name task with both balanced auditory and visual stimuli (Parise et al, 2010). The Mullen Scales of Early Learning (Mullen, 1995) were administered to assess cognitive abilities of the infants.
Results:
The stronger N200-600 component on the right parietal electrodes and significantly stronger positivity on the right frontal electrodes evidenced that the low-risk infants discriminated and paid more attention to their own name compared to the unfamiliar name. No such differences were detected within the high-risk group. Significant group differences were found during the own name presentations (right frontal ROI $p = .047$), yet both groups showed similar ERP patterns during the stranger’s name presentations. Despite the small initial subject size, differences were clear and in the expected direction.
Conclusions:

This study is the first study showing the different neural responses in 14-month-old infants that are at high-risk for ASD, to the unique and very important social cue which introduces periods of communication: “the own name”. The preliminary results of 26 subjects suggest that infants at risk for ASD have specifically diminished attention for their own name, rather than a general diminished attention for speech. The results of an extended sample will be presented at the conference.

Poster Session
181 - Family Issues and Stakeholder Experiences
11:30 AM - 1:30 PM - Hall A

119 **181.119** "You Never Stop Holding Your Breath": Narratives of Simplex and Multiplex Mothers with an Infant

C. Ponting[1], *E. Baker*[2], *S. S. Jeste*[1], *M. Dapretto*[3] *and T. Hutman*[4], *(1)Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA, (2)UCLA Center for Autism Research and Treatment, Los Angeles, CA, (3)University of California, Los Angeles, Los Angeles, CA, (4)University of California Los Angeles, Los Angeles, CA*

Background:
Understanding the holistic experience of parenting children with Autism Spectrum Disorder (ASD) is critical to support the family unit effectively. Many studies report an elevated caregiving burden among mothers of a child with ASD (e.g., Nealy et al., 2012). There is a need to better characterize the experience of mothers who have a younger child in addition to a child with ASD, as cognitions about parenting related to ASD likely affect other children in the household (Meirsschaut, Roeyers & Warreyn, 2010). Qualitative approaches have been recommended in the analysis of maternal caregiving experiences and coping with chronic stressors (Brannen & Petite, 2008; Folkman & Molzkowitz, 2004); yet narrative approaches are lacking in the study of simplex and multiplex families.
Objectives:
We used a qualitative approach to identify common themes among mothers parenting children with ASD and an infant. The objectives of the study were to understand meaningful experiences—both positive and challenging—related to caring for a child with ASD and an infant, and to compare these experiences between simplex and multiplex mothers.
Methods:
We conducted in-depth, semi-structured interviews with 20 mothers of a child with ASD and an infant enrolled in UCLA’s Infant Sibling Study (prior to conclusive diagnosis). At the time of the interview, infant siblings (IS) ranged in age from 9-35 months and affected siblings ranged from 3-10 years. In a quarter of the sample, the infant had at least two older siblings with ASD (multiplex). Interview questions addressed mothers’ perceptions of the relationship between the proband(s) and the IS, familial impacts of receiving the proband’s diagnosis, and formative experiences related to raising children with ASD while also raising an infant. Interviews (lasting 27-83 min) were transcribed and double coded for accuracy, and a codebook was established and validated using five pilot interviews, consistent with a thematic analysis approach (Braun & Clark, 2006).
Results:
We identified salient themes among mothers in three domains: 1) Benefits of parenting a child with ASD, 2) Challenges of parenting a child with ASD, and 3) Misconceptions about their child’s diagnosis. Preliminary sub-codes with the highest frequency in each domain, respectively, are: a) Increased Empathy b) Difficulty balancing time between siblings, and c) Heterogeneity in ASD presentation. We will report two additional sub-codes that reached saturation in each domain, and representative quotes have been selected for each. Forthcoming analyses compare the responses of simplex and multiplex mothers to pinpoint the unique challenges associated with caring for multiple affected children with varying, yet chronic needs.
Conclusions:
Utilizing a narrative approach provided access to a nuanced account of mothers’ experiences raising a child with ASD and a new baby—data that are inaccessible through the use of standardized measures. These findings are relevant for clinicians seeking to understand challenges faced by parents; affected children, who encounter a new sibling and a necessary reduction in the time devoted exclusively to their needs; and infants, who enter into an environment of elevated familial stress—which is implicated in suboptimal cognitive and language development in infancy (Keim et al., 2011).

120 **181.120** A Family Centered Perspective on Addressing Feeding Concerns of Parents of Children with ASD

A. Bonsall[1], *M. Thullen*[2] *and K. Sohl*[3], *(1)Occupational Therapy, University of Missuori, Columbia, MO, (2)Health Sciences, University of Missouri, Columbia, MO, (3)University of Missouri - Thompson Center, Columbia, MO*

Background:
Family-centered care for children with autism spectrum disorder (ASD) includes working in partnership with parents and providing supports and services that are responsive to parents’ needs. Children with ASD often display restrictive or rigid behavioral patterns related to eating such as only eating specific foods, only eating under specific circumstances, and general problem behaviors around mealtimes. Because behaviors related to feeding influence families, addressing parenting feeding concerns can be considered not only a child need, but also an aspect of family-centered care.
Objectives:

1. Identify the concerns of parents around feeding behaviors of their children with ASD.
2. Identify of the frequency that parents describe their children having received therapy in relation to parent feeding concerns.

Methods:
This paper draws from questions from an online survey sent to parents that had an ADOS on file at a local autism network treatment center. Respondents include 113 parents (90% female) of children with ASD (ages 5-13). Parents filled out surveys as well as open and close ended questions regarding feeding concerns. This paper focuses on three questions: 1) Has a therapist worked with your child on eating issues/behaviors? 2) Do you currently have or have you in the past had concerns about your child's eating behaviors? 3) Please describe the concerns you have or you had related to your child's eating behaviors? The results of the third question were coded thematically by researchers familiar with feeding issues. If a parent’s answer fit into more than one theme it was coded multiple times.
Results:
The results indicate that 41% of parents currently have or in the past have had feeding concerns but have not had a therapist work on feeding behaviors (see table 1). Table 2 lists the frequencies and percentage of parents that had each type of concern and if their child had worked with a therapist. Limited food variety was the most common concern (50 respondents) but was still infrequently addressed by a professional (34%). While there is a general lack of treatment for feeding concerns, the lack of treatment for overeating as a concern particularly stands out.
Conclusions:
This study found a gap between the feeding concerns of parents of children with ASD and professional services provided to treat those concerns. Although the causes for this gap were not clearly identified as part of this study, it is important for professionals and systems working with families of children with ASD to recognize that this is a gap. Minimizing that gap is an important aspect of providing family-centered care that addresses parents’ concerns.

Table 1

		Has a therapist worked with your child on eating issues/behaviors? Yes	No	
Do you currently have or have you in the past had concerns about your child's eating behaviors?	Yes	31 (27.4%)	46 (40.7%)	77 (68.1%)
	No	2 (1.8%)	34 (30.1%)	36 (31.9%)
		33 (29.2%)	80 (70.8%)	

Table 2

Parent mealtime concern	Examples	Frequency	% of parents that have had concerns addressed
Limited variety of food	"rarely tries new foods" "only eats same things"	50	34%
Poor nutrition/undereating	"concerned about nutrition" "not eating enough"	14	42%
Overeating	"obsessed with eating" "constantly hungry"	11	27%
Mealtime behaviors	"doesn't eat meals with us" "does not finish meals"	11	36%
Texture issues	"problems with textures" "only eats crunchy food"	11	45%
Mechanics of feeding	"pocketing food" "cramming" "not chewing food"	8	50%

121 **181.121** A Preliminary Investigation of the Perspectives of Young Men with ASD and/ or ADHD and Their Caregivers about Conscript Military Service (CMS)/ National Service (NS)

*P. Y. Chay[1], C. Cheok[2] and **I. Magiati**[1], (1)Department of Psychology, National University of Singapore, Singapore, Singapore, (2)Department of Addiction Medicine, Institute of Mental Health, Singapore, Singapore*

Background: Transition to adulthood can be challenging for many individuals with ASD and/or ADHD. In a number of countries, including Singapore, Conscript Military Service (CMS) or National Service (NS; hereafter referred to as NS) is compulsory for young adult men. For many men with or without ASD/ADHD, NS can be a rewarding, yet challenging experience. With approximately 1% of the population having ASD and more males than females being diagnosed, an increasing number of males with ASD and/or ADHD are likely to serve, but very little is known about their and their caregivers' perspectives.
Objectives: (i) to explore the men's and their caregivers' perceived opportunities and challenges in being enlisted for NS; (ii) to examine factors that may affect perceived NS-related distress in men with ASD/ADHD; and (iii) to explore perceived support needed from family, school, and Ministry of Defence (MINDEF) before NS in order to better support them in the transition to and during NS.
Methods: Participants included 42 caregivers and 17 15- to 19-year-old men with ASD/ADHD who were eligible for NS enlistment in Singapore. They were surveyed on their attitudes towards NS, perceived readiness, and perceived support needed for transition to NS. Measures of ASD and ADHD symptoms, emotional and behavioural issues, and perceived NS-related distress were administered in pen-and-paper or online format. Responses to open-ended questions were analysed thematically. Responses to close-ended questions and checklists were analysed quantitatively. Correlation and regression analyses examined factors that might explain reported NS-related distress.
Results: Most caregivers appreciated the benefits of serving NS, but did not wish their sons to face the potential challenges without the necessary support. 83% of the caregivers would want their sons to complete NS if their skills and strengths, as well as their needs, were carefully considered during placement– this figure was 53% when the young men themselves were asked.
A number of common themes relating to perceived opportunities and challenges were identified. NS was thought to potentially increase opportunities for social integration and to possibly enhance functional outcomes. However, there were many concerns about how others' limited understanding and unhelpful reactions towards their sons with ASD/ADHD might exacerbate the challenges. Common themes related to concerns centred on lack of appropriate support or management and limited awareness of ASD or ADHD in the community.
Men with ASD/ADHD who reported more emotional and behavioural issues were more concerned about NS, felt less prepared for it and reported more pre-enlistment distress than men with fewer emotional and behavioural difficulties. Participants perceived preparing men with ASD/ADHD for NS as an important collaborative effort and placed similar emphasis on the role that each of the stakeholders (family, school, MINDEF) could play.
Conclusions: Caregivers and men with ASD/ ADHD articulate their need for more information about the support currently available for young men with ASD/ ADHD before and during NS, and strongly advocate a more coordinated collaboration amongst families, schools and NS-related organizations to facilitate transition to NS for men with ASD/ADHD *before* actual enlistment takes place.

122 **181.122** A White Lie? Subjective Experience of Deception in Adults with ASD

*A. Duquette[1], M. Devaine[2], É. Petit[3], J. Daunizeau[4] and **B. Forgeot d'Arc**[5], (1)Psychology, Université de Montréal, Montréal, QC, Canada, (2)Brain and Spine Institute, Paris, France, (3)Hôpital Rivière-des-Prairies, Montréal, AK, Canada, (4)Brain and Spine Institute, INSERM, Paris, France, (5)Psychiatry, Université de Montréal, Montreal, QC, Canada*

Background: Masking or distorting information, like specific goals of an experiment or conditions, is common in psychology. Individuals in the autism spectrum are believed to particularly value truth and might therefore be negatively affected by deception. Because of the vulnerability of many participants, maintaining confidence in the hospital institution is essential. Besides, raising awareness on the subjective experience of participants in research using deception is a component of research/users partnership. Therefore, the ethical issue of using deception in individuals with ASD is major and conciliating scientific objectives with respect of integrity and rights of participants can be a challenge. However, the existing scientific literature shows little consideration for this issue and provides no consensual practice parameters.
Objectives: The goal of this study was to evaluate the impact of deception in individuals with ASD, under careful preparation and monitoring.
Methods: collaboration between researchers and local ethical board led to the development of a procedure for standardized debriefing and subjective experience assessment. First, an initial (deceived) belief assessment measures the efficiency of the deceptive manipulation. Then, the nature of the deception is disclosed to the participants, and a final belief assessment measures whether they understand that they had been previously deceived. Lastly, a Subjective Experience Self-Questionnaire, based on Lickert scales and free comments assesses satisfaction (specifically whether participants had fun, felt useful, welcome, well informed, respected and well paid) and

intention to participate in future studies. Adults with ASD and controls without ASD matched for age, IQ and gender took part to the study (n=48). Participants in the ASD group had been assessed with ADOS-G and met DSM-IV criteria for an ASD. All participants had FSIQ>85. Participants with self-reported depression (Beck depression Inventory score>20) were excluded. Following an experiment using active deception, initial and final belief assessment as well as subjective experience questionnaires were administrated to participants. Testing was monitored by the ethics board, using individual reports. Initial belief (affected by deception), final belief (corrected by debriefing) and subjective experience were compared between ASD and control groups.
Results: Initial belief attested that a large majority of participants of both groups were similarly deceived by the protocol, as intended. Final belief attested that all participants understood that they had been deceived. Global satisfaction was high in both groups but lower in ASD individuals (80% vs 89%, $F(1,46)=5.68$,$p<.05$). In both groups, fun was lower than satisfaction regarding reception, information, respect and pay. Intention to participate in the future was high (95% and 91%, *p*:ns). Participants less likely to participate again mentioned boredom and low pay.
Conclusions: Under careful preparation and monitoring, the use of deception in our experimental protocol did not reveal greater impact of deception in adults with ASD. Limits of the study include satisfaction data collection by the experimenter herself and lack of follow-up. Altogether, although risk-benefit balance and appropriate action should be individually considered for each study, the present work provides materials and guidelines for future experiments using deception in participants with ASD.

123 **181.123** ABA Parent Training in Spanish for Children with ASD

***E. Rotheram-Fuller**, K. S. Turner, H. Park, T. Pinon, L. Parra and P. Miller, Arizona State University, Tempe, AZ*

Background: Training in Applied Behavior Analysis for parents of children with ASD can be a critical support for both parents and their children (Bearss, Johnson, Smith, Lecavalier, & Swiezy, 2015). Parent trainings have been shown to be effective in helping improve problem behavior (Bearss et al., 2015), reducing feeding issues and parental stress (Sharp, Burrell, & Jaquess, 2014), and increasing children's skill generalization across settings (Ingersoll & Dvortcsak, 2006). Unfortunately, however, these trainings have not been extensively studied with non-English speaking populations.
Objectives: The current study seeks to examine the feasibility and impact of a 10 week parent training intervention program conducted in Spanish, for Spanish-speaking parents of school-aged children with ASD.
Methods: This study was conducted at a clinical site where 75% of families were exclusively Spanish-speaking. Families were recruited who had at least one child with ASD, aged 6-8 years old. Nine families participated in the training program (n = 11 parents overall, with two spouses attending), which consisted of 6 group sessions, followed by 4 individual sessions. Sessions focused on teaching ABA terms, strategies, and application for issues with their own children. Families completed both parent and child measures before the training began (Vineland-II, Aberrant Behavior Checklist, Parent Stress Inventory, Home-Situations Questionnaire, etc.), including a diagnostic evaluation (ADOS-2 and KBIT-2) with their child. Throughout the intervention, ABC data and parent implementation efforts were recorded, and parents repeated the self-report surveys at the end of the training.
Results: Parent trainings are currently in session 5 of the 10 session sequence. Preliminary results suggest that the trainings have been appropriately adapted for the Spanish-speaking parents attending; the majority of parents have consistently attended sessions and report changes in their use of strategies as a result of participation. Participating children have a variety of behavioral challenges, and each family has successfully collected information on their child's behavior. Longer-term effects on parent and child behavior, and social validity of trainings will be collected at completion.
Conclusions: It is important to consider adaptations needed for non-English speaking families with children with ASD. In this particular population, there was a wide variety of parent knowledge and advocacy, which is increasingly difficult with the language barrier. Additional resources are needed to better support non-English speaking families in ways that allow them access and information vital to their child's success.

124 **181.124** ASD Community Interest in an Online National Autism Cohort, Incentives for Participation, Engagement Resources, and Research Topics of Interest

***J. Manoharan**[1], V. J. Myers[2], A. M. Daniels[2], L. Green Snyder[2], P. Feliciano[2] and W. K. Chung[2], (1)Simons Foundation, New York, NY, (2)SFARI, Simons Foundation, New York, NY*

Background:
To further understand the genetic and environmental factors that increase autism risk and to advance the field toward improved treatments, research studies involving thousands of individuals with autism spectrum disorder (ASD) are needed. While a number of large autism cohorts exist, no single nationwide cohort that combines online accessibility, ability to recontact, and the collection of genomic, environmental, and longitudinal behavioral and medical information on all participants is available to the scientific research community. SFARI is launching SPARK to recruit, engage and retain 50,000 individuals with ASD and their family members.
Objectives:
The aims of the current study are to gauge the ASD community's interest in participating in SPARK, to evaluate enablers to participation and engagement, including the extent to which families would be interested in receiving individual genetic results specific to autism from the study, and research topics of interest.
Methods:
An anonymous online survey was distributed to a total of 16,031 research participants of the Interactive Autism Network (IAN) over 5 weeks. Respondents were asked if they were interested in participating in a national autism cohort and in what ways. They were also asked to identify incentives for participation, resources that would enhance participation, and about their interest in receiving personal genetic information about genetic causes of autism in their family.
Results:
A total of 943 parents/legal guardians and 98 adults with ASD completed the survey. 79% of parents/guardians and 80% of adults with ASD reported that they would be interested in participating in a national autism cohort. While 71% of respondents reported that they would be willing to participate online, 28% also reported a willingness to participate in person. When asked to select features that would increase interest in participating, both parents/guardians (69%) and individuals with autism (60%) indicated that they were interested in return of individual genetic results about the cause of their ASD. The most frequently requested resources were access to autism-specific educational apps and websites (57%) and access to articles about ASD research (51%), for parents/guardians and adults, respectively. Both groups indicated interest in participating in a genetic research study that would determine if their child/they had a known genetic cause of autism (71%, 73%, respectively). Overall, topics of greatest interest were related to community services and programs for individuals with ASD (77%) for parents/legal guardians and how autism impacts the brain (81%) for adults.
Conclusions:
Findings from this study indicate that among survey participants there is significant interest in participating in an online national autism cohort. There was strong interest in return of individual genetic results. Respondents reported a high level of interest in participating in research. SPARK aims to fill this knowledge gap and stimulate more robust engagement and participation from a broad and diverse sample of the autism community in clinical research.

125 **181.125** Adaptive Social Communication in Children with ASD As a Predictor of Parent Stress

***S. W. Nowell**[1], J. Amsbary[1], J. Page[2] and G. T. Baranek[1], (1)UNC Chapel Hill, Chapel Hill, NC, (2)Education and Psychology, UNC Chapel Hill, Chapel Hill, NC*

Background: Research examining stress in parents of children with autism spectrum disorder (ASD) indicates that these parents report higher levels of stress in comparison to parents of typically developing children (Dawson et al., 2004) and children with other developmental disabilities (Estes, Munson et al. 2009). Deficits in adaptive behaviors may place increased burden on parents because their child requires more assistance to perform everyday activities. Although there is a body of research examining the correlation of maladaptive behaviors with parent stress (e.g. Hall & Graff, 2011), there is a paucity of research examining the linkages between deficits in adaptive behavior within specific skill domains and parent stress. Identifying the key variables contributing to parent stress is critical to develop targeted interventions that support the whole family (Hayes & Watson, 2013).
Objectives: The purpose of the present study was to explore the specific nature of adaptive social communication skills on parent stress. We were interested in examining if adaptive social communication skills explain a unique amount of variance in parent stress after controlling for age and IQ. We hypothesized that some of the variance in reported parent stress on the *Parenting Stress Index-Short Form*(Abidin, 1990) would be explained by adaptive social communication skills. Further, we hypothesized that adaptive social and communication abilities would account for the most variance in the Parent-Child Dysfunctional Interaction subscale of the PSI because this subscale seemed most likely to be impacted by a child's deficits in social- communication abilities.
Methods: Data for 667 children with ASD between 3 and 14 years were drawn cross-sectionally from an extant longitudinal survey conducted with a national sample. Parent stress was measured using the *Parenting Stress Index-Short Form* (PSI). Measures of adaptive social communication skills included: the Communication Domain Standard Score and the Socialization Domain Standard Score from the *Vineland Adaptive Behavior Scales-Second Edition*(VABS-2; Sparrow et al., 2005) and a parent report of their child's verbal expressive language level. The child's IQ as reported by parents, and the child's chronological age in months were control variables in the model. A multiple regression analysis was conducted to predict PSI Total Score from VABS Socialization Standard Score, VABS Communication Standard Score, and Parent Expressive Language Estimate after controlling for age and IQ.
Results: After controlling for the variance accounted for by chronological age and IQ (1.584%), the adaptive social and communication variables accounted for 7.76% of the variance in parent stress on the PSI Total Score ($p<.001$). Linear regression models were run for each PSI subscale, which confirmed our hypothesis that deficits in social and communication abilities accounted for more variance in the Parent-Child Dysfunction ($R^2 = .070$) subscale than the Difficult Child Subscale ($R^2 = .054$) or the Parent Distress Subscale ($R^2 = .036$) after controlling for age and IQ.
Conclusions: Our findings indicate that adaptive social communication skills in children with ASD are contributing to parent stress. Clinical implications of these findings include further consideration of the needs of the entire family when developing treatment goals for children with ASD.

Table 1: Linear Regression with All Variables

	Constant	Expressive Language	VABS Communication	VABS Socialization	Age	IQ
Raw coefficient	134.31	0.21	-0.18	-0.27	-0.06	0.44
Standard Error		0.75	0.07	0.06	0.03	0.72
Beta Weight		0.01	-0.15	-0.22	-0.10	0.03
t-statistic		0.28	-2.37	-4.26	-2.39	0.61
p-level		0.78	0.02	<0.001	0.02	0.54

VABS=Vineland Adaptive Behavior Scales- Second Edition
Expressive Language = Parent Expressive Language Estimate on scale of 1-8 from BIQ
PSI= Parenting Stress Index Short Form
Age= Chronological Age in Months

Table 2: PSI Subscales Correlations

	VABS Communication	VABS Socialization	Expressive Language	Age	IQ
Parent Distress	-0.21	-0.17	-0.17	-0.09	-0.15
Difficult Child	-0.16	-0.25	-0.43	-0.02	-0.03
Parent-Child Dysfunction	-0.15	-0.29	-0.31	-0.11	-0.15

VABS=Vineland Adaptive Behavior Scales- Second Edition
Expressive Language = Parent Expressive Language Estimate on scale of 1-8 from BIQ
PSI= Parenting Stress Index Short Form
Age= Chronological Age in Months

126 **181.126** Assessing Parents' Perspectives on Autism Biomarker Discovery

A. Yusuf[1] *and M. Elsabbagh*[2]*, (1)McGill University, Montreal, QC, Canada, (2)McGill University, Montreal, PQ, Canada*

Background: Research on understanding biomarkers for autism spectrum disorders (ASD) provides the potential to identify and monitor children at risk for ASD earlier than currently possible, thus facilitating access to personalized care. However, the complexity of the role of biomarkers in ASD coupled with the heterogeneity of ASD warrants a cautious translation of research findings in this field.
Based on previous models of community engagement in autism research (Walsh et al., 2011; Elsabbagh et al., 2014), systematically understanding the priorities and needs of the intended beneficiaries of research would inform this area of research. Our previous scoping review revealed limited examples of an empirical assessment of priorities and needs of beneficiaries (Yusuf and Elsabbagh, under review): thus far, few studies have examined parents' attitudes towards autism research in general and biomarker discovery in particular. Some current knowledge gaps include 1) the extent to which priorities of research on ASD biomarkers are valued by beneficiaries; 2) the potential utility of biomarkers to inform care; and 3) the perceived balance of risk and benefits from putative biomarkers for ASD.
Objectives: Despite emerging findings (Narcisa et al., 2012; Trottier et al., 2013; Wydeven et al., 2012) we could not identify validated tools to assess parent perspectives on biomarker discovery. Therefore, the goal of the study is to develop a questionnaire for use with parents of children with ASD on their needs and priorities for biomarker discovery.
Methods: Questionnaire items were adopted from results of a scoping review, focusing on three constructs: 1) general priorities for research on ASD biomarkers; 2) current and potential utility of biomarkers to inform care; and 3) perceived social impact of biomarker discovery.
The items were reviewed by a parent of a child with autism and by experts in the field of autism biomarkers. The updated version was then *pre-tested* through a series of cognitive interviews of parents of a child with ASD (n=8) to ensure that the items could be understood, in the same way across participants, and as intended (Collins, 2004). The on-line questionnaire was pilot tested among parents of children with ASD (n=10). All participants have a male child with ASD with an average age of 15 years old (SD=3.5).
Results: Pilot data suggest that parents consider the following priorities for biomarker discovery as *very important*: understanding how the brain develops in ASD and the developmental pathways in ASD. Potential uses of biomarkers rated as *very important* include using biomarkers to help develop behavioural interventions and to treat ASD-related medical issues. Half of the participants considered using biomarkers to identify ASD during pregnancy as of little importance. All participants agreed that further understanding of biomarkers for ASD would help others perceive their child more positively, but half did not think that it would change their experience as a parent.
Conclusions: Preliminary results suggest that it is feasible to empirically assess parents' perspectives on autism biomarker discovery. Future administration of the questionnaire in the target population would inform the translation of biomarker discovery to address families' needs.

127 **181.127** Assessment and Intervention for Anxiety and Problem Behavior in Children with Autism Spectrum Disorder and Intellectual Disability

ABSTRACT WITHDRAWN

Background: Despite the increased risk for anxiety disorders in youth with autism spectrum disorders (ASD), there is a lack of research on the functional assessment and treatment of anxiety and related problem behavior in children with ASD, particularly for those with an intellectual disability (ID).
Objectives: (1) To evaluate a multimethod strategy for the assessment of anxiety and problem behavior in children with ASD and ID; (2) To examine a multicomponent intervention plan to treat anxiety and related problem behavior in children with ASD and ID.
Methods: In Study 1 (the Assessment study), for three children with ASD and ID, anxiety was operationally defined using: (1) behavioral data from anxious behaviors, (2) affective/contextual data from parent-report and blind observer ratings of appearance of anxiety, and (3) physiological data (heart rate and respiratory sinus arrhythmia). A functional assessment of problem behavior during High- and Low-Anxiety conditions was conducted. In Study 2, we then developed treatments for the anxiety and associated problem behavior in these same three children. A multiple baseline design was used to evaluate the effectiveness of a multicomponent intervention package, incorporating individualized strategies from Applied Behavior Analysis (ABA), Positive Behavior Support (PBS), and Cognitive Behavioral Therapy (CBT).
Results: In Study 1, higher levels of problem behavior and heart rate, and lower levels of respiratory sinus arrhythmia, were found in the High-Anxiety than Low-Anxiety conditions (Moskowitz, Mulder, Walsh, McLaughlin, Zarcone, Proudfit, & Carr, 2013). In Study 2, following intervention, all three participants showed substantial decreases in anxiety and associated problem behavior in the situations that had previously been identified as anxiety-provoking (Moskowitz, Walsh, Mulder, Zarcone, McLaughlin, Proudfit, & Carr, in preparation). Additionally, the children showed changes in physiological arousal during intervention, suggesting parallel processes of improved coping and habituation (Moskowitz, Walsh, et al., in preparation).
Conclusions: Implications for the assessment and treatment of anxiety in this population using a multimethod approach are discussed.

128 **181.128** Associations Between Co-Parenting Quality and Challenging Child Eating Behaviors in Families of Children with ASD

M. Thullen[1]*, A. Bonsall*[2]*, K. Sohl*[3] *and T. N. Takahashi*[4]*, (1)Health Sciences, University of Missouri, Columbia, MO, (2)Occupational Therapy, University of Missuori, Columbia, MO, (3)University of Missouri - Thompson Center, Columbia, MO, (4)University of Missouri Thompson Center for Autism & Neurodevelopmental Disorders, Columbia, MO*

Background:
While studies have examined stress among parents of a child with Autism Spectrum Disorder (ASD), little research addresses how parents work together in caring for a child with ASD. Different aspects of parental relationships such as support for spouse can promote well-being for parents facing elevated stress related to having a child with ASD

(Brobst et al., 2009). The concept of co-parenting addresses how parents relate to one another specifically in their roles as parents. A common stressor for parents is aversive and restrictive eating-related behaviors among children with ASD (Davis & Carter, 2008; Phetrasuwan & Shandor Miles, 2009)
Objectives:
This paper examines how co-parenting among parents of children with ASD is associated with their assessment of challenging eating behaviors and parenting stress.
Methods:
112 primary caregivers of a child (aged 5-13) with an ASD diagnosis responded to an emailed online survey about their experiences parenting. The mean age of respondents was 39.9 years (*SD* = 6.8), 90% were the child's mother figure (biological, step-, grand-, or adoptive), and 86% were co-residing and married to the co-parent. The mean age of the child was 9.5 years (*SD* = 2.5) and 81% were male.
Co-parenting quality was assessed using The Coparenting Relationship Scale (CRS; Feinberg, Brown, & Kan, 2012), a 35-item questionnaire assessing the degree of agreement on parenting issues, received support, satisfaction with balance of parenting-related labor, and child exposure to conflict.
Perceptions of child eating challenges were assessed using the Brief Autism Mealtime Behavioral Inventory (BAMBI; Lukens & Linscheid, 2008), an 18-item questionnaire that includes frequency of challenging eating behaviors as well as ratings of behaviors as problematic. Four subscales have been demonstrated within this measure (DeMand, Johnson, & Foldes, 2015): food selectivity, disruptive mealtime behaviors, food refusal, and mealtime rigidity.
Parenting stress was measured using the Parenting Stress Inventory Fourth Edition Short Form (PSI-4-SF; Abidin, 1990), a 36-item instrument summed to yield a total parenting stress score.
Results:
Bivariate correlations revealed expected and novel findings (Table 1). As expected, challenging eating behaviors were associated with greater parenting stress and better quality co-parenting was associated with less parenting stress. Co-parenting quality was associated with one particular aspect of eating challenges. When parents reported greater frequency of child disruptive behaviors at mealtimes they also reported exposing their child to more conflict ($r = .24$, $p < .05$). When parents reported a greater number of child disruptive behaviors at mealtimes as problematic they reported exposing their child to more conflict ($r = .20$, $p < .05$), feeling less supported by their co-parent ($r = -.22$, $p < .05$), and less satisfaction with the balance of labor ($r = -.24$, $p < .05$).
Conclusions:
The unique challenge to co-parenting presented by disruptive mealtime behavior is more evident based on parents' assessment of the impact of the behavior compared to their assessment of the frequency. Helping parents to be coordinated in their management of disruptive mealtime behaviors may help reduce the behaviors and support their co-parenting efforts more broadly.

Table 1
Correlations among co-parenting (CRS), child eating challenges (BAMBI), and parenting stress (PSI)

	1	2	3	4	5	6	7	8	9	10	11	12	13
1 PSI total	-												
BAMBI - frequency													
2 Food selectivity	-.00	-											
3 Disruptive mealtime behavior	.59^	.14	-										
4 Food refusal	.27^	.37^	.57^	-									
5 Mealtime rigidity	.42^	.50^	.34^	.33^	-								
BAMBI - # of problems													
6 Food selectivity	.08	.84^	.17	.33^	.41^	-							
7 Disruptive mealtime behavior	.52^	.19	.87^	.46^	.33^	.25*	-						
8 Food refusal	.30^	.33^	.50^	.63^	.33^	.38^	.55^	-					
9 Mealtime rigidity	.33^	.49^	.36^	.24*	.65^	.49^	.35^	.33^	-				
CRS													
10 Agreement	-.26^	.09	-.13	-.02	-.04	.03	-.12	-.10	-.04	-			
11 Support	-.32^	.09	-.13	-.03	-.01	-.04	-.22*	.00	.01	.66^	-		
12 Labor	-.18	-.05	-.16	-.05	-.14	-.17	-.24*	-.16	-.07	.39^	.39^	-	
13 Conflict	.25^	-.12	.24*	.12	-.03	-.07	.20*	.17	.09	-.48^	-.49^	-.11	-
n	110	111	111	110	112	109	108	106	108	112	111	111	112
Mean	96.9	14.4	8.6	5.7	7.7	2.0	.77	.58	.56	3.9	3.9	3.7	1.7
SD	23.2	4.1	3.3	2.5	2.9	1.7	1.1	.85	.85	1.5	1.7	1.6	.51
Range	43-163	4-20	5-25	3-13	3-15	0-4	0-5	0-3	0-3	0-6	0-6	.5-6	1-4

Note: *- $p < .05$, ^- $p < .01$

129 **181.129** Autism Community Interest in and Use of Mobile Applications and Web-Based Tools for Tracking ASD-Related Information

V. J. Myers, *J. Manoharan, A. M. Daniels, L. Green Snyder, P. Feliciano and W. K. Chung, SFARI, Simons Foundation, New York, NY*

Background: The accessibility of mobile applications/web-based tools for tracking health information has increased in recent years, allowing for many new technologies to be developed for tracking autism spectrum disorder (ASD)-related behaviors and information. At the *International Meeting for Autism Research*(IMFAR), technology presentations have increased from eight in 2004 to 36 in 2008 [1]. While there are many education, communication, recreation and tracking technologies available for ASD, few people use them. One study found that only 25% of participants reported using technologies on a range of devices for people with ASD [2]. While many mobile applications/web-based tools are available for tracking ASD-related behaviors and information, more research is needed to ensure that these products align with users' needs and goals.
Objectives: The aim of this study was to survey interest in and use of mobile applications/web-based tools to track ASD-related information within an online community of parents/guardians of children with ASD.
Methods: An anonymous online survey was distributed to 16,031 participants of the Interactive Autism Network (IAN) over five weeks. The survey's primary aims were to assess the autism community's interest in participating in SPARK, a SFARI-supported web-based autism research study, as well as use of/interest in mobile applications/web-based tools to track ASD behaviors and related information. For the latter aims, respondents were asked to report on their past and present use of mobile applications/web-based tools in the areas of recreation, social/communication skills, education, and organizing and tracking, as well as interest in using applications for tracking ASD-related behaviors of their children. Data were abstracted from SurveyMonkey and analyzed using Stata, version 12.0.
Results: A total of 943 parents/guardians of children with ASD completed the survey. Eighteen percent of parents/guardians reported they had used a mobile application/web-based tool to track ASD-related information about their child/dependent. Among all parents/guardians, the most important features in an ASD-related mobile application/web-based tool were ease of use (75%), low cost (63%), ability to use on multiple devices (36%), and multiple features (36%). Among all respondents, parents/guardians were primarily interested in tracking daily behaviors (63%), specific events (51%; e.g. tantrums) and connections between two things (49%; e.g. behavior

and diet). Seventy-four percent of parents/guardians agree that they would be willing to spend several minutes a day (>5 minutes) entering data into a mobile application/web-based tool if they could see those changes in their child's/dependent's behavior visualized over time.
Conclusions: Findings from this study demonstrate that, despite participating in online research, few parents/guardians in IAN use mobile applications/web-based tools to track ASD-related information about their children/dependents. However, many parents/guardians said that they would spend several minutes a day entering data into a mobile application/web-based tool if they could visualize changes in their child's/dependent's behavior over time. Needs and desires of parents/guardians who currently use mobile applications/web-based tools closely matched those that had not previously used these tools. When developing such resources for SPARK, further user-testing is crucial to ensure that technologies are easy to use, engaging and collect/track information that is useful to families affected by ASD.

130 **181.130** Benefits of Physical Play for Fathers of Children with Autism

*J. L. Bloom[1], **M. N. Gragg**[1] and S. Horton[2], (1)Psychology, University of Windsor, Windsor, ON, Canada, (2)University of Windsor, Windsor, ON, Canada*

Background: Research suggests that fathers have become more involved with their children with Autism Spectrum Disorders (ASD) than in previous years, including engaging in play interactions with their children. For fathers of typically developing children, engaging in physical play has been associated with various benefits including greater happiness, a higher sense of self-worth, better communication, and lower stress. The benefits of engaging in physical play for fathers of children with ASD have not been directly studied. Potential benefits for fathers included improvements in parenting stress, which is a challenge that fathers of children with ASD typically experience. Physical play could also work to develop the father-child relationship.
Objectives: The present study investigated fathers' physical play with their children with ASD, and whether this was related to benefits for fathers. The present study also investigated whether physical play was related to fathers' satisfaction with play and relationship quality with their children with ASD. Other exploratory questions were investigated, including fathers' advice about play to other fathers; any similarities/differences in their play with their typically developing children; strategies for facilitating play; future aspirations for play; and how play affects the father-son relationship.
Methods: Fathers (i.e., biological, step-, adoptive-, foster-) of sons with ASD aged 4-11 ($N = 60$) completed an online survey that included ASD screening, questions on the frequency of fathers' physical play and fathers' well-being, and several short-answer questions. Fathers ($M_{age} = 39.9$) were primarily Caucasian, married, from Canada, biological fathers, and lived in the same home as their children with ASD ($M_{age} = 6.9$). A sub-sample of these fathers ($N = 20$) also completed a phone interview during which they answered more exploratory questions.
Results: Multiple regression analyses revealed that more frequent physical play (i.e., tickling, piggyback riding) reported by fathers significantly predicted lower parenting stress scores. More frequent physical play was also significantly related to higher satisfaction with play and higher relationship-quality for fathers with their children with ASD. Themes of *Physical Play, Relationship Building, Child Limitations for Play, Father's Role,* and *Toys and Games*were identified in the interview and short-answer responses.
Conclusions: Results suggested that fathers' benefits of more frequent physical play with their children with ASD included lower stress and greater relationship quality. This finding is consistent with the literature on fathers of typically developing children. Fathers' qualitative responses supported this finding. As one father stated, "to be able to play with him and have that interaction is very good for my emotional kind of state of mind". Implications for conceptualizing father-child play and for fathers' involvement in, and benefits of, intervention programs will be discussed. Fathers also shared a list of the toys and games that they used to facilitate play with their children with ASD, to disseminate to fathers and ASD organizations.

131 **181.131** Bilingualism and Autism: Exploring Parents' Attitudes and Experiences

***S. Hampton**, H. Rabagliati, A. Sorace and S. Fletcher-Watson, University of Edinburgh, Edinburgh, United Kingdom*

Background: Autism is associated with language and communication difficulties including delay in language onset in early childhood. Bilingualism likewise is associated with delayed onset of language in typical children. However, bilingualism may also confer advantages in cognitive domains (e.g. theory of mind) as well as facilitating community integration, family coherence and well-being. Thus parents of children with autism are presented with a dilemma when deciding whether to raise their children bilingually, and require an evidence base to inform their decisions. Research into the implications of bilingualism for those with autism, however, is scarce, meaning families and practitioners have little information to assist them in their decision-making.
Objectives: This study aimed to explore how bilingual parents in the UK decide on what language practices to adopt for their child with autism, in order to identify community priorities and define specific variables for investigation in future research.
Methods: Semi-structured interviews concerning the experience of raising a child in a bilingual household were conducted with bilingual parents with a child with autism (n=17), and a matched group of bilingual parents with a typically developing child (n=18).
Results: Thematic analysis revealed large areas of overlap between parents of children with and without autism in regard to their decision-making about raising their children bilingually. Factors included child characteristics, family dynamics, and preserving heritage. However there were also topics raised by parents of children with autism which were specific to this group. First, parents with a child with autism felt that a bilingual environment would hinder their child's linguistic development, causing confusion and exacerbating existing language delays – and this concern was related to the language level of the child in complex ways. Second, parents identified a number of ways in which they felt bilingualism could provide social and cognitive benefits, particularly in flexible thinking and communication skills. Third, parents reported a negative influence from professionals who sometimes advised against bilingualism, and referenced the lack of availability of resources for early years support in multiple languages. Finally, the findings also indicated an unanticipated role for bilingualism in providing high quality linguistic and social input for children with autism: parents felt less linguistically restricted when interacting with their child using their native language and further felt that this language facilitated a strong emotional bond with their child.
Conclusions: It is essential to build an evidence base to enhance family decision-making in this area. Some influences on the decision-making of parents with a child with autism were shared with parents of typical children but unique concerns were also raised. Our findings point to the importance of considering not just linguistic and cognitive consequences of bilingualism, but also factors such as family coherence and community integration, in future research in this field.

132 **181.132** Building Sibling Relationships: The Effects of Sibling Support on Siblings and Children with Autism

***E. A. Jones**[1], D. M. Fienup[1], N. Neil[2], T. Fiani[1], S. McHugh[3] and S. Izquierdo[1], (1)Department of Psychology, Queens College and The Graduate Center, CUNY, Queens, NY, (2)Michigan State University and the DOCTRID International Research Institute, east lansing, MI, (3)Department of Psychology, Queens College, CUNY, Queens, NY*

Background: Autism spectrum disorder (ASD) affects the entire family system and, in turn, the family affects outcomes for individuals with ASD. Family members, including siblings, may be affected by the presence of a family member with ASD. Siblings may show adjustment and skill needs; the sibling relationship may be strained. Improving sibling adjustment and the sibling relationship may be valuable for lifelong outcomes for individuals with ASD as siblings play a critical support role throughout the life of an individual with ASD. Support groups are one way to address the needs of siblings and improve sibling relationships. Only a few studies (Smith & Perry, 2005) suggested the effectiveness of support groups specifically for siblings of children with ASD. In an initial study, we found improvements in sibling adjustment and relationship following participation in a support group. After this pre-post comparison we are following up with a randomized control trial, comparing a support group to an attention only control condition.
Objectives: The purpose of this investigation was to evaluate the effects of a support group targeting siblings of children with ASD on sibling's knowledge about ASD, coping skills, peer network and, adjustment as well as the sibling relationship using self and parent-reports and observational measures in a randomized-control trial.
Methods: To date, 28 siblings of children with ASD aged between 3 and 16 years have completed participation with their 24 siblings with ASD aged between 3 and 18. An additional 11 siblings and 4 children with ASD will complete participation this fall. We randomly assigned siblings to a 1-hour group social group (control group) or support group, for 10 weeks. The support group lessons and activities focused on issues related to having a sibling with ASD for a period of 10 weeks. The social group involved similar activities with a focus on general social interaction and friendship. Pre- and post-measures evaluated sibling's knowledge and adjustment, family functioning, and sibling relationship measured through sibling and parent report as well as direct observation of sibling interactions.
Results: Initial analyses indicate that children who participated in the support group showed greater improvement on three of the four coping domains from pre to post. We are continuing to analyze other scales and data collection continues with new sibling dyads.
Conclusions: Support groups show promise in addressing the individual needs of siblings of children with ASD as well as fostering the sibling relationship. Findings of the current RCT indicate improvements in coping skills for siblings who attended the support group compared to those who attended the social control group. This builds on our preliminary studies which indicated improvements in depression and anxiety as well as sibling interactions. Continued data collection and analyses will allow us to examine additional measures of sibling adjustment, family functioning, and the sibling relationship.

133 **181.133** Caregiver's Experience of Universal ASD Screening – Would They Do It Again?

***M. E. Villalobos**[1], T. P. Gabrielsen[2], J. Miller[3], N. Buerger[4] and J. Viskochil[5], (1)Psychiatry, TEACCH Autism Program University of North Carolina Chapel Hill, NC, Asheville, NC, (2)Brigham Young University, Provo, UT, (3)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (4)University of Utah, Salt Lake City, UT, (5)Utah Autism Research Program, Salt Lake City, UT*

Background: Universal ASD screening raises a unique set of challenges for families, who likely come from a wider range of ethnic, racial, and socioeconomic backgrounds, and who may not have even considered that their child may have some developmental concerns before they are notified that their child screened positive. A better understanding of caregiver's experiences is needed in order to support early identification efforts.
Objectives: The purpose of the study was to obtain the perspectives of caregiver's experiences as part of a community-based universal screening study as a way to better

identify challenges and supports to early ASD identification.
Methods: Twenty-four caregivers who participated in a universal community-based screening study (The EACH Child Study; Miller et al 2011) participated. Eleven families had a child with language delays and 13 were classified as ASD. Caregivers were interviewed at follow-up (mean age = 43months) and were asked to complete the Parenting Stress Index (PSI), the Reaction to Diagnosis Interview, and a survey about the experience of the screening and diagnostic evaluation, and what they did for follow-up.
Results: Caregivers rated the process of completing the screening measures in the pediatric setting as "easy to complete" and "not bothersome as part of their visit." Overall, caregivers reported positive phone-follow-up and in person screening experiences; however, caregivers of children in the ASD reported the initial diagnostic feedback to be challenging. Reaction to diagnosis results indicated caregivers of children with ASD experienced uncertainty and/or denial initially. Further, ASD caregivers reported cumbersome experiences navigating the EI service system, lack of resources, language barriers, social support, familial support and spousal communication as challenges following initial feedback. Approximately 6/24 caregivers did not report developmental concerns prior to screening; 3 had no previous understanding of ASD; 14 reported minimal understanding and 9 reported "moderate" understanding (e.g. knew someone with ASD). Results of the PSI indicated similarly elevated levels of parental stress in both the ASD and language delay groups (M = 78.15 SD =23.13). Components of the process that helped caregivers navigate the process included positive experiences with providers, family support and entry into early intervention. Despite reporting challenges, all caregivers stated that they would participate in the screening study again for a younger child. Lastly, approximately 16 of the families followed through with treatment recommendations and 8 did not (6/8 were in the language delay group).
Conclusions: While much evidence exists to demonstrate the effectiveness of EI for ASD, we are only beginning to understand the impact of screening in "real world" settings. The caregiver perspectives from this community-based universal screening sample highlight the challenges and supports faced by families following a positive screen for ASD. Caregivers reported high levels of stress-particularly around initial diagnosis and challenges navigating the EI system. Lack of knowledge of ASD and limited social supports/spousal supports significantly impacted access to EI. More research into the experience of families in real world settings is needed in order to ensure the promise of early screening and identification is realized.

134 **181.134** Caregiver's Perspectives on the Sensory Environment and Participation in Daily Activities for Children with Autism Spectrum Disorders

***B. A. Pfeiffer**, Rehabilitation Sciences, Temple University, Philadelphia, PA*

Background: Participation in daily activities is the context in which children acquire valued life skills and competencies (Dunst, 2002; Law, 2002), and as such is an important factor in development, health, and quality of life (WHO, 2009). Caregivers support a child's participation in order to facilitate growth and skill development, ultimately leading to their independence in daily activities. Although participation in these everyday activities is considered routine for most young children and their families, it is often more challenging for children with Autism Spectrum Disorders (ASD). Children with ASD and their caregivers face barriers within the environment due to unique characteristics of ASD that reduce the number and diversity of activities in which they participate (Bedell et al., 2012; Law et al., 2013). For example, it is estimated that up to 95% of individuals with ASD have unusual reactions, such as hyper- and hypo-reactivity to sensory stimuli in the environment (Ben-Sasson et al., 2009). Research identifies differences in sensory processing as a risk factor for limitations in participation (Bar-Shalita, Jean-Jacques & Shula, 2008). This reduced engagement may negatively impact the development and quality of life of the child with ASD.
Objectives: The objective of this study was to explore participation in daily activity among families of children with ASD and the perceived influence of sensory environments. Specifically, the study explored the sensory environmental factors that enhance or limit participation, as well as the methods parents or caregivers use to support participation for their child.
Methods: A phenomenological design was used to guide data collection and analysis of recorded interviews from 34 caregivers of children with ASD ages 3 to 7. Data collected for the study included semi-structured interviews, member checks, and demographic information. Interviews were transcribed and crosschecked. Two or more researchers analyzed the data to ensure the reliability of the analysis. Descriptive statistics were used to analyze demographic information.
Results: Qualitative analysis identified reoccurring themes that describe the impact of the sensory environment on participation in the young child with ASD, as well as a parental decisional-making process and strategies to support participation. Participants reported that environmental match was important in enabling their children's participation. Caregivers described a participation decision-making process in which they distinguished between essential and non-essential activities. Additionally, the amount of effort required by the parents to enable their child's participation was a key factor in deciding what activities parents would prioritize for their children. There were 6 common strategies implemented by caregivers to improve person and environment fit necessary to enable participation. Strategies either directly related to the sensory factors of the environment, or focused on reducing behavioral responses associated with sensory factors.
Conclusions: This study identifies important considerations to enhance participation in the home and community environments for the child with ASD including the decision making process of the family and strategies integrated into daily routines to improve environmental fit.

135 **181.135** Caregivers' Perspectives on Facilitators and Barriers to Early Identification of Children with ASD

***E. Crais**[1], C. S. McComish[2], E. F. Kertcher[3], S. R. Hooper[4], R. Edmondson Pretzel[5], S. Mergner[5] and M. E. Villalobos[6], (1)University of North Carolina at Chapel Hill, Chapel Hill, NC, (2)Division of Speech & Hearing Sciences, University of North Carolina, Chapel Hill, NC, (3)Division of Occupational Science/Occupational Therapy, University of North Carolina at Chapel Hill, Chapel Hill, NC, (4)Allied Health Sciences, University of North Carolina at Chapel Hill, Chapel Hill, NC, (5)Carolina Institute for Developmental Disabilities, University of North Carolina at Chapel Hill, Chapel Hill, NC, (6)Psychiatry TEACCH, University of North Carolina at Chapel Hill, Chapel Hill, NC*

Background: Finding effective solutions to the gap between research and practice presents a major challenge for the autism community. Over the past several decades, there has been an evolving recognition that the traditional intervention research model in which the flow of information is from research to practice is outmoded and ineffective (Wallerstein & Duran, 2010). As noted by Stahmer and colleagues (2011), one means to bridge the gap is through understanding the perspectives of community stakeholders regarding the benefits and barriers of specific practices and early intervention services.
Objectives: The current study was designed to gain the perspectives of North Carolina caregivers of children with ASD regarding the facilitators and barriers to early identification, evaluation, and entry into early intervention services.
Methods: Eight focus groups (4 English speaking, 2 Spanish speaking, 2 American Indian) with 55 caregivers of young children diagnosed with ASD were conducted in six regions of North Carolina. Caregivers were asked to describe the facilitators and barriers within three time periods: between first concerns and consulting with a professional, up through the diagnosis, and through entry into early intervention. Caregivers were also asked to discuss how these processes could be improved.
Results:
Across the three time periods, caregivers highlighted many similar barriers in the early identification and intervention process, including: not knowing who/where to go, getting conflicting advice, disagreements within and outside the family, their own uncertainty or "denial" (as described by caregivers), moving through multiple providers to get answers, limited resources, professional and parental lack of knowledge, and family and cultural beliefs. They also had particularly negative experiences during their first conversations with professionals and within the process of getting a diagnosis. In contrast, caregivers reported few facilitators; however a small minority of families noted professionals (physician, early care provider) or a family member first raised concerns and then linked them with professional services. There were some differences highlighted between cultural groups especially related to language and cultural barriers and lack of resources in rural and American Indian communities. Caregivers provided many suggestions about how early identification, evaluation and diagnosis, and intervention entry could be facilitated. Suggestions included having navigators to guide them through the processes, clear guidelines/roadmaps of printed materials for decision making, better connections with local resources, enhanced education for professionals (physicians, teachers), and more parent-to-parent opportunities.
Conclusions:
The parent perspectives shared during the focus groups contain a rich source of information for professionals interested in improving the early identification, evaluation and diagnosis, and entry into intervention services for children with ASD and their families. In addition, the personal experiences shared by the participants could be influential in affecting policy at local, state, and national levels, as well as informing research agendas in the coming years.

136 **181.136** Caring for Adults with Autism: Impact on Families

***R. K. Sandercock**[1], M. R. Klinger[1], E. M. Lamarche[2] and L. G. Klinger[3], (1)University of North Carolina at Chapel Hill, Chapel Hill, NC, (2)UNC TEACCH Autism Program, Chapel Hill, NC, (3)Psychiatry, University of North Carolina TEACCH Autism Program, Chapel Hill, NC*

Background: While an emerging body of literature addresses the financial and mental health impact of raising a child with Autism Spectrum Disorder (ASD) on the family (e.g., Karst & Van Hecke, 2012), very little is known about the impact of caring for *adults* with ASD on families.
Objectives: Caregiver survey data were used to examine the family impact of caring for an adult with ASD across multiple domains, including: (1) utilization of caregiver support services, (2) time spent providing care, and (3) financial burden.
Methods: A survey was completed by 189 parents or guardians of adults with ASD in middle adulthood (21-64 years of age, *M* = 35.5 years). Adults were diagnosed during childhood between 1970-1999 at the UNC TEACCH Autism Program. The survey included 17 questions regarding various aspects of family impact.
Results: Caregivers were asked about their use of personal mental health services related to caring for an adult with ASD. Overall, 51% of caregivers reported using counseling services since their adult with ASD left high school. However, only 24% reported seeking counseling in the past two years. Similarly, 48% of caregivers reported ever participating in support groups but only 14% reported using a support group in the past two years.
Overall, 47% of adults with ASD were living at home with family members. Families who continued to care for adults with ASD at home reported greater difficulties than families whose adult with ASD was living outside of the home. Specifically, families whose adult with ASD lived with them reported that they spent significantly more time in

caregiving activities (73% reported spending time in caregiving; 34% providing 24 hour per day supervision). In comparison, 31% of caregivers of adults living outside the home reported involvement in caregiving activities with 3% providing 24 hour supervision.
Families reported being involved in a variety of decision making activities for their adult with ASD including healthcare, finances, living situation, legal, treatment, work/day planning, and recreation decisions. 55% of caregivers with adults residing at home reported that they were involved in decision making in all 7 areas compared to 36% of caregivers with adults living outside the home.
Surprisingly, only 14% of caregivers reported increased financial burden since their adult child left high school.
Conclusions: Caregivers of adults with ASD reported significant involvement in decision making across all areas of adult life for their son or daughter. Caregivers of adults who live with family spend an especially large proportion of their time supervising and making decisions for the adult with ASD. Although many caregivers have, at some point, sought out services to support themselves in handling these challenges, there appears to be a decline in professional caregiver support as the adult with ASD ages. Caregivers report a high level of personal burden in supporting their adult children with little professional support. While this pattern may minimize financial costs associated with caring for an adult with autism, long term personal costs both for the caregiver and the adult with ASD need to be examined.

137 **181.137** Characterizing the Relationship Between Autism Severity and Aberrant Behavior on Caregiver Strain and Family Empowerment in a Minority Population

P. Trelles[1], *P. M. Siper*[2], *J. M. Jamison*[3], *E. Fourie*[4], *D. Halpern*[1], *A. T. Wang*[5], *J. Krata*[6], *E. Holl*[6], *J. Shaoul*[6], *B. Hernandez*[6], *L. Mitchell*[6], *J. D. Buxbaum*[5] *and A. Kolevzon*[3], *(1)Icahn School of Medicine at Mount Sinai, New York, NY, (2)Seaver Autism Center, New York, NY, (3)Psychiatry, Seaver Autism Center for Research and Treatment at the Icahn School of Medicine at Mount Sinai, New York, NY, (4)Seaver Autism Center for Research and Treatment at the Icahn School of Medicine at Mount Sinai, New York, NY, (5)Psychiatry, Seaver Autism Center at Mount Sinai, New York, NY, (6)YAI, New York, NY*

Background: Caregiver strain, a measure of burden on emotional and physical health, is significantly higher among parents of children with autism spectrum disorder (ASD) than other developmental disabilities. High levels of parental strain are associated with poor family functioning, inadequate child utilization of mental health services and lower quality of life reported by the parent. Importantly, ethnic disparities in the utilization of mental health services are also well documented and while parent-centered approaches have been shown to be efficacious in Hispanic samples, they are often underutilized. It is therefore necessary to better understand factors, such as parental stress, that may affect service utilization in order to improve long term outcomes for minority families affected by ASD.
Objectives: To characterize caregiver strain, sense of family empowerment and the relationship with symptom severity and cognitive ability in a minority sample of children with ASD.
Methods: Forty-one Black and Hispanic children between the ages of 5 and 12 participated in this study. All children met DSM-5 criteria for ASD based on a consensus diagnosis, which included a psychiatric evaluation, the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) and the Autism Diagnostic Interview-Revised (ADI-R). Standardized measures of cognitive functioning were also obtained. Caregivers completed the Caregiver Strain Questionnaire (CSQ), the Family Empowerment Scale (FES), and the Aberrant Behavior Checklist (ABC). The CSQ measures negative occurrences associated with caring for a child with emotional disturbances (i.e., missed days at work), as well as parental externalizing (i.e., anger) and internalizing (i.e., sadness and guilt) feelings relating to their child. The FES measures attitudes, behaviors, and knowledge of family empowerment. The ABC measures behaviors observed in individuals with developmental disabilities across five subscales: Irritability, Lethargy, Stereotypy, Hyperactivity, and Inappropriate Speech.
Results: The relationship between variables was examined using Pearson correlations. CSQ total scores were significantly correlated with ABC total scores (r=.588, p<.001). The CSQ Internalizing subscale was significantly correlated with several ABC subscales, including Irritability (r=.529, p<.001), Lethargy (r=.62, p<.001), Stereotypy (r=.382, p=.014), and Hyperactivity (r=.571, p<.001). The CSQ Externalizing subscale was significantly correlated with ABC Irritability (r=.426, p=.005) and Hyperactivity (r=.550, p<.001). CSQ total score was negatively correlated with the Attitude (r=-.439, p=.004) and Behaviors (r=-.318, p=.043) subscales of the FES. The FES Knowledge subscale was not correlated with the CSQ. There was no correlation between ADOS-2 total raw scores, ADOS-2 severity scores, or IQ on caregiver strain or sense of family empowerment. Caregiver report did not differ significantly between ethnic groups.
Conclusions: Results indicate that there is a strong relationship between caregiver strain and aberrant behavior in minority families affected by ASD. Children's externalizing behaviors were strongly associated with internalizing symptoms in caregivers. Less strain in caregivers was also correlated with empowering attitudes and behaviors, although greater knowledge was not associated with lower levels of strain. Importantly, ASD symptom severity and cognitive ability

138 **181.138** Communication about Sexuality Between Young Adults with Autism Spectrum Disorder (ASD) and Their Parents

K. Hartmann[1], *M. Urbano*[2], *T. V. Williams*[3], *A. L. Peterkin*[4] *and T. Kozikowski*[2], *(1)P.O. Box 1980, Eastern Virginia Medical School, Norfolk, VA, (2)Eastern Virginia Medical School, Norfolk, VA, (3)Virginia Consortium Program in Clinical Psychology, Norfolk, VA, (4)Psychology, Old Dominion University, Norfolk, VA*

Background: Sexuality is a difficult topic for most people to discuss given social rules, whether they are neurotypical or have any additional challenges such as ASD. Many families opt out of these conversations until a difficulty arises. For neurotypical children, sex education is part of their everyday peer interactions. Children with ASD, by their nature, shy away from peer interaction due to the many environmental and social factors that overwhelm their preference for information and emotion processing. By the time a child with ASD reaches puberty, they have already missed out on valuable peer interactions and learning about sexuality in interpersonal relationships. Exploring intimacies requires social interaction sophistication, self-knowledge, and communication with the other, all difficult for individuals with ASD.
Objectives: The present study intends to add to the current literature by exploring the sexual knowledge and practices of young adults with ASD and their communication with their parents/caregivers. Additionally, it aims to explore the comfort caregivers of young adults with ASD feel when discussing sexually related topics with their child. The level of support caregivers would like in addressing sexual topics with their young adult with ASD will be explored.
Methods:
This study aims to collect responses in an online survey from 200 young adults with ASD and their parents. Participants were asked to complete a series of questionnaires: a demographic questionnaire, a measure to confirm the presence of ASD symptomatology (ASQ-10), several measures related to sexual knowledge, experiences, and orientation (General Sexual Knowledge Questionnaire, Sexual Behavior Scale, Sexual Experiences Survey, Online Sexual Risk Behaviors, Klein Sexual Orientation Scale), and family communication (Family Sex Communication Quotient).
Results: Data analyses will compare descriptive statistics and frequency data to national statistics for sexual behaviors in neurotypical young adult populations. This study aims to investigate reliance on the internet for sexual information and activities, desire for privacy when engaging in sexual behaviors, overall desire for and engagement in sexual behaviors, instances of unwanted sexual advances, asexuality and same sex attraction, caregiver communication about sex, and caregiver concerns about their child's sexual development. Caregiver beliefs about their child's exposure to sex education will be compared to young adult reports of their exposure to sexual education.
Conclusions: This study is currently online but results not yet available. We hypothesize the following: Young adults with ASD will know more about sexuality than their parents anticipate, endorse reliance on the internet for information about sexuality, seek less privacy when engaging in sexual behaviors, express desires for intimate relationships on par with others in their peer group, be subjected to more instances of unwanted sexual interactions, and report higher rates of asexuality and same-sex relationships. Caregivers of individuals with ASD will report communicating with their child about sexual information and express worries about the sexual development of their child. Young adults with ASD engage in frequent family communication about sexual activities and will have accurate sexual knowledge.

139 **181.139** Comparison of Reported Social Support in Single and Two Caregiver Families with a Child with an Autism Spectrum Disorder

E. G. Schreiber, *Center for Autism Spectrum Disorders, Nationwide Children's Hospital, Westerville, OH*

Background: Raising a child with an Autism Spectrum Disorder (ASD) has been linked to significant stress as reported by the caregiver (Bluth et al., 2013; Hill- Chapman et al., 2013; Kissel & Nelson, 2014). Despite the challenges they face, caregivers of children with an ASD have been shown to be resilient. One area of adjustment and adaptation for these caregivers is social support (Bayat, 2007; Greeff & van der Walt, 2010). Parents raising a child with an ASD report higher levels of "actively seeking and accepting help" (Luther et al., 2005), however, they perceive less available social support in their environment as compared to parents raising a child without a disability (Obeid & Daou, 2015). Additionally, single caregivers of a child with an ASD report lower levels of social support than mothers living with a partner (Bromley et al., 2004).
Objectives: The current study aimed to better understand the differences between single caregivers versus two-caregiver families of a child with an ASD with regard to the social support they receive and perceive in their environment.
Methods: Female caregivers of a child (2-18 years) with an ASD were recruited through local autism schools, organizations, and social media to complete the study. Participants in the study were of single-caregiver families (n = 65) and those residing with another adult, regardless of relationship status (n = 188). The caregivers completed a demographic survey, the Family Support Scale, and open-ended questions regarding the support they were receiving and wanted to receive.
Results: The majority of the sample was Caucasian, had completed college coursework or a college degree, and reported to be Christian/ Protestant or of no religious affiliation. The mean age of the caregivers was 38.26 years. Additionally, there was a significant difference in reported household income (single-caregiver Md = under $30,000; two-caregiver Md= $30,000-$59,999).
After adjusting for household income, there was a significant difference in Total Family Support (F[1,250] = 8.87, p= .003) between single-caregiver and two-caregiver families. For single-caregiver families, kinship support and professional support were noted to be significantly more "helpful" than the other sources of support. For two-caregiver families, spouse/ partner support and professional support were noted to be significantly more "helpful" than the other sources of support. Additionally, both samples reported they were not receiving, but desired, both therapeutic resources for their child as well as financial resources.
Conclusions: As social support is associated with a reduction in parental stress, it is important for clinicians to provide support to caregivers directly and to provide information and aid to overcome obstacles in accessing desired social support. Additionally, as single-caregivers report less perceived social support in their environment, it

is essential for clinicians, social workers, case managers, or other individuals working with these families to assess areas of social support need and provide resources to increase the support they receive in order to decrease the discrepancy between types of caregivers.

140 **181.140** Compassion Meditation for Parents: Effects on Stress and Perceived ASD Severity

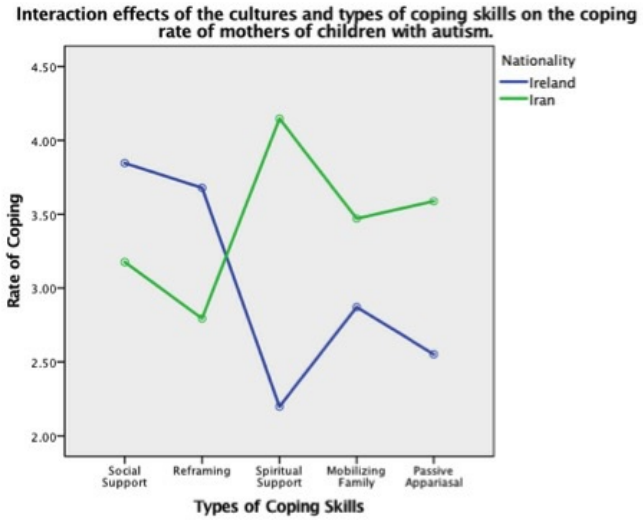
J. Mendelson[1], *S. Fernandez-Carriba*[1], *C. A. Saulnier*[1], *S. E. Gillespie*[2] *and A. Klin*[3], *(1)Department of Pediatrics, Marcus Autism Center, Children's Healthcare of Atlanta, Emory University, Atlanta, GA, (2)Marcus Autism Center, Children's Healthcare of Atlanta, and Emory University School of Medicine, Atlanta, GA, (3)Department of Pediatrics, Emory University School of Medicine, Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, GA*

Background:
Parents of children with Autism Spectrum Disorder (ASD), who are often required to be fully involved in their children's intervention, have higher incidence of depressive symptoms and stress than parents of typically developing children (Jeans et al., 2013). Whereas the practice of mindfulness and compassion meditation is reportedly associated with stress reduction in several populations (Cosley et al, 2010), there are very few studies describing mindfulness based interventions for caregivers of individuals with ASD (Bazzano et al., 2013, Dickens et al., 2014) and none to our knowledge using compassion meditation.
Objectives:
The goal of this research is to pilot-test Cognitively Based Compassion Training (CBCT), a mindfulness and compassion meditation protocol developed at Emory University and empirically validated in other populations, with parents of children with ASD in order to reduce stress in these parents and, in turn, impact the children's outcomes.
Methods:
Participants included 9 caregivers of children with ASD (age in years M±SD = 43.8 ±5.5; 8 females) recruited at the Marcus Autism Center in Atlanta, GA. Participants received CBCT over the course of 8-10 weeks and completed several measures before and after the training, with a follow-up at 2 months: perceived severity of the child's symptoms (Aberrant Behavior Checklist or ABC-Irritability Scale), stress and acceptance (Parenting Stress Index or PSI/SF, Perceived Stress Scale or PSS, and Acceptance and Action Questionnaire or AAQ), empathy and compassion (Interpersonal Reactivity Index or IRI), behavioral flexibility (Mindful Attention Awareness Scale or MAAS, and Behavior Rating Inventory of Executive Function or BRIEF-A), and parent-child relationship (Parenting Sense of Competence Scale or PSS).
Results:
Paired t-tests were utilized to evaluate pre-post changes in scores at the 0.05 significance level. Findings included a significant decrease in perceived severity of the child's symptoms as measured by the ABC-I (Time 1 M±SD = 11.7±8.06; Time 2 M±SD = 7.7±8.2) and a significant decrease in parent stress according to the total stress PSI scale (Time 1 M±SD = 94±28.35; Time 2 M±SD = 76.2±29.6) and the PSS scale (Time 1 M±SD = 21.7±3.09; Time 2 M±SD = 13.1±4.39). There was a significant increase in behavior flexibility according to the Behavior Regulation Index of the BRIEF-A, Inhibit scale (Time 1 M±SD = 11.4±1.26; Time 2 M±SD = 9±1.62) and Shift scale (Time 1 M±SD = 10±0.86; Time 2 M±SD = 7±1.29). Marginally significant differences were found in the direction expected in the Parenting Sense of Competence Scale (Time 1 M±SD = 70.1±9.46; Time 2 M±SD = 82.4±11.65; p=.05) and no significant differences in the three measures related to acceptance (AAQ), empathy (IRI) and mindfulness (MAAS) (n.s.). A second set of analyses including repeated measures analysis of variance for the only four participants that completed follow-up measures suggest that gains were maintained in the PSI, PSS and BRIEF scales.
Conclusions:
Taken together these promising results suggest that CBCT is a feasible training for parents of children with ASD, with potential benefits on their stress and their perceived children's severity. A randomized controlled trial should test its efficacy under controlled conditions.

141 **181.141** Coping Skills Among Mothers of Children with Autism in Ireland and Iran: The Effect of Culture

S. Torabian[1] *and S. A. Samadi*[2], *(1)San Jose State University, Los Altos Hills, CA, (2)University of Ulster, Karaj, Iran (Islamic Republic of)*

Background: Few disorders in children pose a greater threat to the psychosocial well-being of parents than autism. Several studies have demonstrated that many parents of children with autism experience depression or dysphoria. There is much evidence to suggest that the parenting burden falls more heavily on mothers therefore mothers might suffer more emotional consequences of that burden than fathers. The stress and coping processes associated with parenting a child with autism have been the subject of much research, yet the vast majority of this research has been majorly done in the United States and other advanced nations. This is the first study that compared the coping skills of mothers of children with autism between an Eastern Culture of Iran with a Western Culture.
Objectives: The research study was a descriptive survey design based on a convenience sample. Participants completed a 15-question demographic questionnaire and the 30-question Family Crisis Oriented Personal Evaluation Scales (F-COPESs).
Methods: Each respondent completed the Likert-type scale questionnaire ranging from 1 (strongly agree) to 5 (strongly disagree). The coping scale is a reliable and valid tool that measures coping strategies and level of adaptation. F-COPES has a Cronbach's alpha reliability of 0.86 and a test–retest reliability of 0.81. The F-COPES divides coping strategies into five subscales: (a) acquiring social support, (b) reframing, (c) seeking spiritual support, (d) mobilizing family to acquire and accept help, and (e) passive appraisal. For the Ireland population, 30 mothers were recruited from a nonprofit parental support group and various speech-language, occupational, and behavioral treatment centers in London area. For the Iranian population, 30 mothers were recruited from the Iranian Department of Special Education.
Results: A preliminary analyses revealed a significant effect of culture on coping skills of participants, $F(1, 66) = 12.06$, $p < .01$, $eta^2 = .15$. MANOVA further revealed a significant interaction effect between culture and the five subscales of the coping skills, $F(1,68) = 37.22$ $p < .001$, $eta^2 = .35$. Across the two cultures of the Ireland and Iran, mothers in the Ireland significantly displayed the two coping skills of "acquiring social support" and "reframing" more than the other three coping skills whereas mothers in Iran significantly displayed the three other types of coping skills of "seeking spiritual support", "mobilizing family to acquire and accept help, and "passive appraisal" (See Fig. 1).
Conclusions: The results indicate that culture might play a significant role on the coping skills of mothers of children with autism. While mothers in the Western Culture of Ireland might more actively acquired support from relatives, friends, neighbors, and extended family as well having the ability to redefine stressful events in order to make them more manageable (reframing), mothers in Eastern Culture of Iran coped with having a child with autism in a more spiritual way such as believing that it was God's faith, they seeked out more community resources and accepted help from others (mobilizing), and they appraised autism in ways of passive or inactive behaviors such as avoidance.



142 **181.142** Day-to-Day Technology Use and Training Needs of Teens with ASD and Typically-Developing Peers

C. A. Cohen[1,2] *and A. R. Marvin*[3], *(1)Medical Informatics, Kennedy Krieger Institute, Baltimore, MD, (2)University of Baltimore, Baltimore, MD, (3)Painter Bldg 1st Fl, Kennedy Krieger Institute, Baltimore, MD*

Background:

The use of technology is ubiquitous in teens with autism spectrum disorder (ASD) and their typically-developing (TD) peers. Computer competency is needed for many careers. Research has not focused on the how people with ASD use technology in their day-to-day lives and whether that technology is accessible to them to meet their occupational, economic, entertainment, and information needs as they transition into adulthood, independent living, and the world of work.

Objectives:

To understand which technologies are used by teens with ASD and TD peers and parent-perceived needs for technology training.

Methods:

An anonymous 80-question survey developed in SurveyMonkey was administered to parents/ guardians of children ages 13-17 living in the US with and without ASD. Participants were recruited using the Interactive Autism Network (IAN) subject recruitment service and social media. The survey ran 09/09/2015-10/24/2015.

Results:

348 survey instances were completed: ASD= 264 (76%); TD=84(24%). Male-to-female gender ratios for TD (1:1) and ASD (5.87:1) were in the expected range.

Three groups were used for analysis: ASD with normal-or-above intellectual ability (ASD-Normal); ASD with lower-than-normal intellectual ability (ASD-Low); and TD. No TD teens were attributed with lower-than-normal intellectual ability.

Logistic regression was used to compare use of ASD-related apps and dedicated assistive devices (ASD groups only) and general use of devices across groups, controlling for the child's age, gender, race (white/non-white), and ethnicity (Hispanic/Non-Hispanic).

Use of ASD-related apps and dedicated assistive devices – ASD-only: intellectual ability was the only factor that differentiated groups, with use among ASD-Low>ASD-Normal (Apps: χ^2 =28.14; p<.001; d.f.=5. Dedicated Devices: χ^2=13.03;p=.023;d.f.=5).

Use of laptops, desktops, and notebook computers: intellectual ability was the only factor that differentiated groups, with ASD-Low using them less than the other groups (χ^2=22.52;p=.001;d.f.=6).

Use of tablets: Hispanic/Latino teens used tablets more than Not-Hispanic/Non-Latino teens (χ^2=15.61;p=.016;d.f.=6).

Gaming devices: Overall, ASD-Normal were using gaming devices more than other groups (χ^2=37.11;p<.001;d.f.=6). ASD girls (50.0%) were more likely to use gaming devices than non-ASD girls (23.8%) (p=.02 FET) and TD boys (85.7%) were more likely to use gaming devices than ASD boys (65.2%) (p=.01; FET).

Smartphones: 58.0% of ASD-Low, 75.8% of ASD-Normal, and 86.9% of TD teens were using Smartphones (χ^2=30.37;p<.001;d.f.=6).

Technology careers and training: ASD-Normal teens were more likely to be considering a career that highly-involved computers (53.9%) than TD (20.2%) or ASD-Low (23.3%) teens (χ^2=41.02;p<.001;d.f.=6). ASD-Normal teens also more likely to be learning computer repair (17.1%) than TD (7.1%) or ASD-Low (5.2%) teens; however, only boys were doing so (χ^2=19.31;p=.004;d.f.=6). ASD-Normal teens also more likely to be learning computer programming (38.0%) than TD (16.7%) or ASD-Low (12.7%) teens; however, more ASD-Normal boys (40.0%) were doing so than girls (22.2%) (χ^2=34.16;p<.001;d.f.=6). 86.5% of parents of ASD-Low, 68.8% of parents of ASD-Normal, and 41.7% of parents of TD teens wanted more computer training for their child (χ^2=48.02;p<.001;d.f.=6).

Conclusions:

Teens with autism are active technology users and many are considering careers in technology; however, technology training is falling short.

143 **181.143** Defining Parenting and the Role That It Plays in the Relationship Between Complexity of the Child's Neurodevelopmental Disorder and Family Impact

ABSTRACT WITHDRAWN

Background:

Parenting, a complex concept, with numerous definitions, has been defined as the attributions parents make regarding a child's behavior. Similarly, another definition centers around parents' use of certain types of behaviors, such as hostility. Parenting, as defined by both attributions and behaviors, is hypothesized as one factor that leads families to report a positive impact or negative impact in raising their child. For example, the parenting behavior of providing emotional support has consistently been associated with positive developmental outcomes in neurotypical children (Gray & Steinberg, 1999). Mothers of children with disabilities who make higher proportions of positive appraisals throughout their day, have families with higher levels of healthy adjustment (Trute et al., 2010). Whether parenting plays a similar role in families with a child with a neurodevelopmental disability (NDD) was investigated.

Objectives: To investigate whether parenting could be defined as a concept using a latent variable consisting of both attributions and behaviors; and, to verify whether it partially mediates the relationship between complexity of a child's neurodevelopment impairment and the family impact of raising a child with a NDD.

Methods: This study was part of the Parenting Matters! study (PI: Lucy Lach, Ph.D., Dafna Kohen, Ph.D., & Peter Rosenbaum, M.D.). A convenience sample was collected in major health centers servicing families with a child with a neurodevelopmental disorder across Canada. Mothers of 190 children age 4 to 13 years old (M = 8.11 years, SD = 2.41 years), and primarily male participated (62.1%). Children had diagnoses of either cerebral palsy (36.8%), ASD (27.9%), global developmental delay (19.5%), epilepsy (8.9%) or multiple impairment (6.8%). Measures used to collect data, included About My Child – 26 (AMC; Rosenbaum et al., 2008), Parenting Attribution Test (Bugental, 2004), National Longitudinal Study of Children and Youth Parenting Scales - Consistency, Positive Interaction, and Hostile/Ineffective (Strayhorn & Weidman, 1988), and the Family Impact of Child Disability Scale (Trute et al., 2009).

Results:

A model in which a latent variable for parenting was created from parenting attributions and parenting behaviors was tested with exploratory factor analysis. The goodness of fit indices were poor (e.g., CFI = 0, $RMSEA$ = .38, $SRMR$ = .27). Subsequently, individual parenting variables were entered as mediators between AMC complexity score and both positive and negative family impact but revealed no significance. The direct effect of AMC complexity score was significant and explained 44.7% of the variance in negative family impact of disability (R^2 = .195, F(1, 183) = 45.65, p < .001).

Conclusions: The latent variable of parenting was not established as consisting of both parenting attributions and behaviors. This affirms that defining parenting is complex, and may differ for children with a NDD. The results suggest that measures targeted specifically for the unique situation of parenting a child with a NDD are needed. The relationship between sources of stress such as complexity of the child's neurodevelopmental impairment and negative family impact suggests the need to address concerns about function in order to improve parents' appraisal of negative family impact.

144 **181.144** Defining the Characteristics and Needs of Females with ASD: An Inductive Approach

*S. N. Bargiela[1], R. L. Steward[2] and **W. Mandy**[3], (1)UCL, London, United Kingdom, (2)Robyn Steward, Suffolk, England, United Kingdom of Great Britain and Northern Ireland, (3)University College London, London, United Kingdom*

Background: Females are at substantially elevated risk of their autistic symptoms being unrecognised: their difficulties are commonly mislabelled, or missed entirely. In non-referred samples there are approximately two or three males for each female with autism spectrum disorder (ASD); whereas in clinically-ascertained samples the male-to-female ratio is at least four-to-one. This shows that many females with ASD never receive a clinical diagnosis, and the help that comes with it. Even when females with ASD are identified, they receive their diagnosis (and associated support) later than equivalent males. Females require more severe autistic traits compared to males to come to clinical attention, and teachers underreport autistic traits in their female pupils. This gender bias has serious consequences for the health and well-being of girls and women with ASD, and has been identified by the autism community as a key problem to be addressed by research.

Females with autistic difficulties are at high risk of going unnoticed and unhelped because there is a female autistic phenotype - a female-specific manifestation of autistic strengths and difficulties that does not fit the current, male-based consensus. To overturn current discrimination against girls and women with autistic difficulties, clinical scientists must provide a valid, empirically-based description of the female autistic phenotype; and the ways it impacts on likelihood of receiving a diagnosis.

Objectives: To study, in depth, the experiences and characteristics of females with ASD who had not received their diagnosis in childhood, in order to: (1) generate hypotheses about the female ASD phenotype and (2) to understand how the female phenotype impacts upon under-diagnosis of females' ASD.

Methods: Fourteen women aged between 18 and 30, with a clinical diagnosis of ASD in received in adolescence or adulthood, were recruited via snowball sampling and participated in a semi-structured interview. The data were subjected to intensive framework analysis.

Results: Framework analysis of the data yielded the following four themes specific to being a woman with ASD: (1) 'You're not autistic', which centred on experiences of having autistic difficulties missed by professionals who considered ASD to be a male condition, and included consideration of the costs of a late diagnosis; (2) 'Pretending to be normal' focusing on efforts made by females to camouflage their autistic characteristics; (3) 'Forging an identity as a woman', which concerned perceived conflicts between having an autistic and a feminine identity, and how this was resolved; (4) Passive to assertive described experiences women had of being victimised, and how some had grown more confident and less vulnerable as they embraced the positive aspects of their ASD.

Conclusions: The research highlights camouflaging of autistic characteristics as a key process for women with ASD, suggesting that it brings both advantages (e.g. better social function, higher employability) and disadvantages (e.g. missed diagnosis, pretending to be someone else). Also, further attention should be paid to the vulnerability to exploitation, including sexual abuse, reported by a substantial proportion of the sample; and to improving the knowledge of healthcare professionals about ASD in girls and women.

145 **181.145** Development and Validation of a Survey of Knowledge of Autism Spectrum Disorder

***L. K. Hansen**[1] and T. D. Barry[2], (1)University of Southern Mississippi, Hattiesburg, MS, (2)Psychology, Washington State University, Pullman, WA*

Background:

As autism spectrum disorder (ASD) is more commonly diagnosed, having knowledge of the disorder becomes increasingly important for educators, parents, and the general public. Previous research regarding knowledge of ASD has found that teachers may perceive themselves as possessing average knowledge regarding ASD but have low actual knowledge regarding specific aspects of the disorder (Williams et al., 2011). However, there has been little research regarding the level of awareness concerning ASD possessed by individuals outside of the educational sphere.
Objectives:
The primary goal of this study was to create a reliabile, valid measure to evaluate perceived versus actual knowledge of ASD. Furthermore, the current study also investigated factors related to ASD knowledge, including having a personal relationship with an individual with ASD, participating in ASD training, and source of ASD knowledge.
Methods:
A sample of 487 undergraduate students (86% female; 60% White, 35% Black, 5% Other race) was administered A Survey of Knowledge of Autism Spectrum Disorder (ASK-ASD). The ASK-ASD original item pool was comprised of 51 items, all of which were reviewed by experts with advanced degrees from a variety of disciplines (i.e., clinical child psychology, school psychology, occupational therapy, and physical therapy). Additionally, participants were administered a demographic form, a measure of knowledge of ADHD, and a measure of knowledge of HIV/AIDS.
Results:
Participants were moderately knowledge (65%) regarding ASD and perceived themselves to be moderately knowledgeable (M = 1.8, SD = .41). The correlation between perceived and actual knowledge was significant, r = .25, indicating a tendency for participants to accurately evaluate their own knowledge levels. An exploratory factor analysis (EFA) of the ASK-ASD revealed a two-factor structure of knowledge of ASD: Prognosis/Risk Factors Subscale (PRFS) and General Features Subscale (GFS). Twenty-eight items were deleted to facilitate the EFA and achieve simple structure. The ASK-ASD demonstrated test-retest reliability, with bivariate correlations between the first and second administrations ranging from .48 to .72. Internal consistency was adequate, with alpha values ranging from .57 to .61 for the total scale and subscales. The ASK-ASD also showed construct validity through bivariate correlations of both perceived and actual knowledge with ASD training and relationship with an individual with ASD. Furthermore, convergent validity was demonstrated through correlations between the ASK-ASD and a measure of ADHD knowledge, as well as a measure of HIV/AIDS knowledge. Moreover, significant correlations were found between gender and ethnicity with actual knowledge, r = .15 and r = -.20, respectively.
Conclusions:
The ASK-ASD was supported as a valid, reliable method to evaluate perceived and actual knowledge of ASD. In general, participants were moderately knowledgeable regarding ASD and could accurately perceive their own knowledge. Additionally, exploratory analyses revealed several interesting correlations between ASD knowledge, demographic characteristics, and source of ASD knowledge. Relations between gender, ethnicity, and actual knowledge indicated that female participants had higher knowledge compared to male participants and Non-White participants had lower levels of knowledge than White participants. Limitations of the study included the sample being limited to undergraduate students and the online survey format.

146 **181.146** Discrepancy in Social Support Perceptions As a Risk Factor for Siblings of Individuals with ASD

***J. A. Rankin**, T. S. Tomeny, L. K. Baker and S. W. Eldred, Psychology, The University of Alabama, Tuscaloosa, AL*

Background: Typically-developing (TD) siblings of individuals with ASD are at risk for negative outcomes due to a variety of factors. One such factor is the severity of their sibling's ASD deficits (Meyer et al., 2011). Social support has been identified as a protective factor against these deficits on sibling adjustment (Hastings, 2003). However, the availability of support may not be as meaningful as the discrepancy between one's perceived importance of support and the amount of support available (Newcomb, 1990). Further, social support encompasses many distinct domains of support. Research in other populations illustrates that different forms of support may have differential effects on physical and mental health (Wong et al., 2014). However, social support discrepancy has not been examined in the adjustment of TD siblings of children with ASD.
Objectives: This study explored: 1) If social support discrepancy moderates the relation between ASD symptom severity in siblings with ASD and TD sibling adjustment problems, overall, and in terms of emotional and externalizing problems. 2) Which domain(s) of support discrepancy uniquely predict(s) TD sibling adjustment, while controlling for ASD symptom severity in siblings with ASD. 3) If the relation between ASD symptom severity in siblings with ASD and TD sibling adjustment is moderated by the unique domain(s) of support.
Methods: 113 Families completed study measures. Parents completed the Children's Social Behavior Questionnaire (CSBQ) about the child with ASD, assessing ASD symptom severity. TD siblings (Mage = 13.33, 50% male) self-reported emotional and behavioral functioning via the Strengths and Difficulties Questionnaire (SDQ), and social support availability and importance via the Child and Adolescent Social Support Scale (CASSS).
Results: Moderated multiple regression analyses were conducted to examine interactions via the computational tool, PROCESS (Hayes, 2013). Significant interactions emerged between ASD symptom severity and greater social support discrepancy (coded: importance minus availability) when predicting overall sibling maladjustment, B = .09, SE = .04 p = .03, and emotional problems, B = .04, SE = .02 p = .01. Separate regression analyses (Table 1) revealed that emotional support discrepancy was the only unique predictor of overall sibling adjustment,$\boldsymbol{\beta}$ = .51, p = .001, and externalizing and emotional problems (both $\boldsymbol{\beta}$ > .37, both p < .02). Finally, significant interactions between ASD symptom severity and emotional support discrepancy emerged predicting overall sibling maladjustment, B = .10, SE = .04, p = .01 (Figure 1), and both emotional, B = .04, SE = .02, p = .02, and externalizing problems, B = .03, SE = .01, p= .03.
Conclusions: Social support discrepancy moderates the relations between ASD symptom severity and overall and emotional adjustment problems in TD siblings. This was driven by emotional support discrepancy, which also moderated the relation between ASD symptom severity and externalizing problems. Findings highlight that support discrepancy may be more predictive of sibling adjustment than actual perceived support. Further, emotional support may be a particularly useful area to target for siblings and has unique predictive value over and above total and other domains of support discrepancy.

Table 1

Results of Multiple Regression Analyses of Support Discrepancy Types Predicting TD Sibling Overall Adjustment, Emotional Problems, and Externalizing Problems

	Criterion Variables		
Predictor Variables	Overall Problems	Emotional Problems	Externalizing Problems
Model 1			
ASD Symptom Severity	.25**	.09	.23*
R^2 (df)	.06** (1, 110)	.01 (1,110)	.05* (1,110)
Model 2			
ASD Symptom Severity	.24**	.08	.23*
Emotional Support Discrepancy	.51***	.37*	.53***
Appraisal Support Discrepancy	-.01	-.07	.004
Informational Support Discrepancy	-.18	-.03	-.23
Instrumental Support Discrepancy	.04	.20	-.11
ΔR^2 (df)	.17*** (4,106)	.22*** (4,106)	.12** (4,106)

Note. Standardized beta-weights reported for each predictor. Degrees of freedom reported in parentheses following each R^2 value.
*** $p < .001$. ** $p < .01$. * $p < .05$.

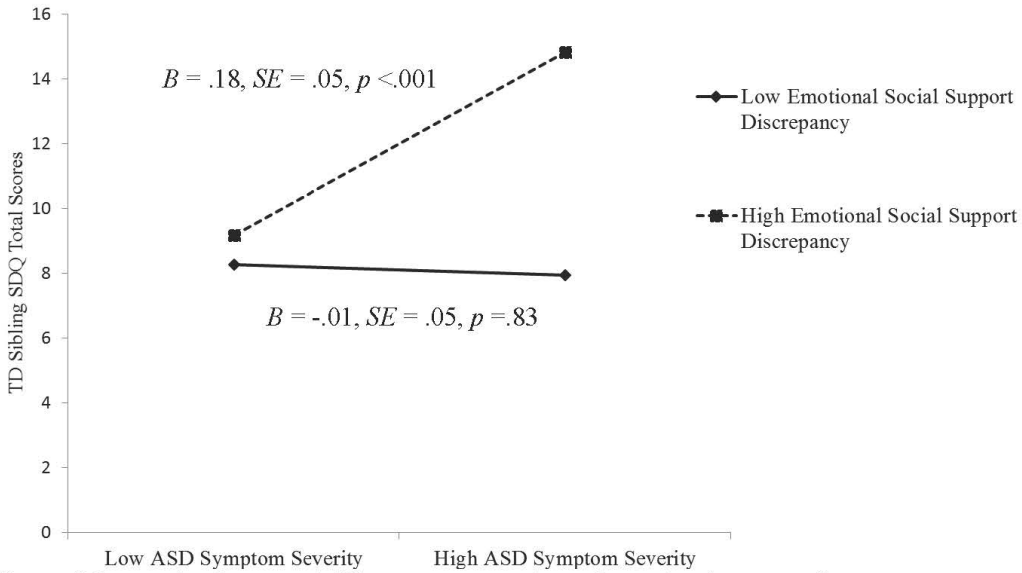


Figure 1. Interaction between ASD symptom severity and emotional support discrepancy predicting TD sibling's SDQ overall adjustment problems score. $B = .10$, $SE = .04$, $p = .01$.

147 **181.147** Effectiveness of a Family Psychoeducation Program for Parents of Young Children with ASD

T. Takezawa[1], *T. Yoshikawa*[2] *and M. Inoue*[3], *(1)Education and Social Service, Institute for Developmental Research, Aichi Human Service Center, Kasugai, Aichi, Japan, (2)Child and Adolescent Psychiatry, Central Hospital,Aichi Human Service Center, Kasugai, Aichi, Japan, (3)Tottori University, Yonago, Tottori, Japan*

Background: Many parents of children with Autism Spectrum Disorders (ASD) are more likely to experience depression and stress than those of children with/without other types of disabilities. It could become much more pronounced when their children are diagnosed. Therefore, an appropriate program should be provided to reduce the parent's anxiety and parenting stress at a crucial time.
Objectives: The purpose of this study was to examine the effectiveness of a family psychoedeucation program for parents of young children with ASD.
Methods: Thirty-one parents participated in the program, and received a series of lectures on ASD and other related topics for 3 months. Beck Depression Inventory-Second Edition (BDI-II) and Parenting Stress Index Short Form (PS-SF) were used to measure the parent's anxiety and parenting stress. The participants also answered a questionnaire on degree of understanding and satisfaction with the program.
Results: BDI-II scores of the participants significantly decreased at the end of the program. Similarly, PS-SF scores also tended to decline although it was not a statistically significant change. Most participants developed a better understanding of ASD and had a high level of satisfaction with the program.
Conclusions: The results revealed that the program could be effective for reducing the depression of parents of young children with ASD. However, the program was not

effective enough to reduce parenting stress. A likely explanation is that the participants reacknowledged the problems and their responsibility as parents through the program. The program needs to be revised, focusing on reducing parenting stress more effectively. Starting at an early stage of awareness and diagnosis, family psychoeducation program could play an important role as one of the early family intervention programs for ASD.

148 **181.148** Emotional Difficulties in Parents of Children with Autism Spectrum Disorder

***A. P. Costa**, G. Steffgen and D. Ferring, University of Luxembourg, Esch sur Alzette, Luxembourg*

Background: Previous studies have demonstrated that parents of children with ASD are at a greater risk of increased stress and mental health problems (e.g., Totsika et al., 2011). Children with ASD have several emotional difficulties such as increased reactivity, difficulties with emotion regulation, and higher levels of alexithymia, which have been reported to be more important in the explanation of parents' difficulties than child's diagnosis (ASD/non-ASD; Herring et al., 2006). Family is the primary context where children learn emotional display and regulation rules and often parents and children share similar emotional styles. Therefore, it is possible that parents of children with ASD also present more emotional difficulties than parents of typically developing (TD) children.
Objectives: The aim of the present study was to analyze if parents of children with ASD present more emotional difficulties than parents of TD children and whether emotional difficulties in parents are related to their children's difficulties.
Methods: Seventy-eight dyads of parents-children participated in the study. Thirty-seven children were diagnosed with ASD and forty-one were TD children. Parent self-report, parent-informant report, and physiological measures were used as indicators of emotional difficulties in parents and children.
Results: *t*-tests revealed that parents of children with ASD reported significantly more difficulties with emotion regulation [$t(64) = -2.36$, $p < .05$], reported using less reappraisal [$t(76) = 2.13$, $p < .05$], and had lower respiratory sinus arrhythmia (RSA) at rest [$t(45) = 2.55$, $p < .05$] than parents of TD children. Parent-reported emotional reactivity in children was related to parents' self-reports of difficulties with emotion regulation [$r = .37$, $p < .01$], to self-report use of less reappraisal [$r = -.35$, $p < .01$], and to lower RSA [$r = -.30$, $p < .05$]. Additionally, lower RSA in children was related to parents' self-reported difficulties with emotion regulation [$r = -.26$, $p < .05$]. Two-path mediations revealed an indirect effect of children's parent-reported emotional reactivity in the relation between child's diagnostic and parents' self-reported difficulties with emotion regulation [$b = 6.67$, $\kappa^2 = .15$; $b = 2.27$, $\kappa^2 = .06$] and an indirect effect of children's RSA in the relation between child's diagnostic and parents' self-reported use of less reappraisal [$b = -0.44$, $\kappa^2 = .15$].
Conclusions: Although causality between emotional difficulties in parents and children with ASD could not be determined, the present study offers strong evidence for the presence of emotional difficulties in parents of children with ASD. Furthermore, it is suggested that emotional difficulties in children might play a determinant role in the understanding of emotional difficulties of parents that goes beyond their child's diagnostic (ASD/non-ASD).

149 **181.149** Emotional and Physiological Responses to Infant Crying in Parents of Children with ASD

***Y. Ozturk**[1], A. Bizzego[2,3,4], N. Mazzoni[5], T. Del Bianco[5], C. Furlanello[3] and P. Venuti[5], (1)Department of Psychology and Cognitive Science, University of Trento, Rovereto, Italy, (2)Department of Information Engineering and Computer Science, University of Trento, Trento, Italy, (3)FBK - Fondazione Bruno Kessler, Trento, Italy, (4)SKIL Lab, Telecom Italia, Trento, Italy, (5)Department of Psychology and Cognitive Science, University of Trento, Rovereto, TN, Italy*

Background: Cry is a communication way children use to express their needs or wants. Numerous studies have indicated that adults perceive cry of infants with atypical development (in our case ASD) differently compare to cry of typically developing (TD) infants, such as unexpected and more negative.
Objectives: Our aim was to evaluate the emotional and physiological responses of parents of children with ASD and compare with parents of typically developing children during the listening of crying of children with two different developmental conditions: autism and typical development.
Methods: The participants comprised 30 parents (15 mothers: M age = 33.9 years, SD = 6.02; 15 fathers: M age = 38.1 years, SD = 7.15) of typically developing children (M age = 3.0 years; SD = 1.70) and 19 parents (11 mothers: M age = 40.5 years, SD = 3.78; 8 fathers: M age = 40.8 years, SD = 3.15) of children diagnosed with ASD (M age = 5.7 years; SD = 1.82). The experiment was structured into two parts; the first part stands for the physiological data acquisition (heart rate), whereas the second one stands for the behavioral data acquisition (stress, arousal and valence) during the listening of crying of children with ASD and TD.
Results: Parents of children with ASD and parents of TD children are not differentiated in terms of how they reported TD cry and ASD cry. Interestingly, physiological results showed that parents of children with ASD have higher heart rate than parents of TD children during both ASD cry and TD cry.
Conclusions: These findings highlight how parents of children with ASD perceive a signal from a child with ASD. Regarding to the clinical implications, an intervention program for parents of children with ASD might be helpful to attend atypical crying episodes so parents can correctly interpret the signal from their children.

150 **181.150** Engaging Underserved Communities in Identifying Barriers to Early ASD Diagnosis and Treatment

***J. Elder**[1] and S. N. Brasher[2], (1)College of Nursing University of Florida, Gainesville, FL, (2)Nursing, University of Florida, Gainesville, FL*

Background:
Clinical accounts indicate that disparities exist among families of children with Autism Spectrum Disorders (ASD), and that these disparities impede timely diagnosis and intervention. Further, families living in rural areas are more likely to have reduced access to proper care and use alternative, unproven, and potentially harmful treatments. Thus it is imperative to identify disparities among families of children with ASD, particularly those living in rural underserved communities, in order to minimize such disparities and improve diagnosis and intervention in children with ASD.
Objectives: To begin addressing disparities among families of children with ASD living in rural and typically underserved areas by engaging providers and families of children with ASD.
Methods: The investigators established a Community Advisory Board (CAB) of major stakeholders (e.g., parents of individuals with ASD, community-based healthcare service providers, school teachers). Next, they conducted four focus groups comprised of a total of 45 participants to determine barriers to early diagnosis/treatment, potential resources, and alternative treatment use. Sessions were audio-recorded, transcribed, and analyzed by three trained independent coders.
Results: Focus group participants reported several barriers to early diagnosis that included pediatricians' lack of knowledge related to ASD, parents' not recognizing signs and symptoms of ASD, inadequate screening tools, parental denial, prolonged wait time to see a developmental pediatrician, insufficient time spent with pediatricians during scheduled visits, and parental fear of social stigma associated with an ASD diagnosis. Barriers to early treatment were identified as cost of treatments, delayed diagnosis, lack of local providers, complicated referral process for treatments, limited transportation, parental denial, and lack of pediatricians' knowledge of available treatments and how to obtain those treatments. Participants also identified several alternative treatments commonly used in children with ASD, such as the gluten-free and casein-free (GFCF) diet, sensory integration therapy, B12 vitamins and other added vitamins, aromatherapy, chelation therapy, hyperbaric oxygen therapy, fish oils/omega-3 supplements, melatonin, music therapy, and forced eye contact.
Conclusions: As noted, participants reported barriers to early diagnosis and treatment as well as frequently used alternative treatments. There were also unique cultural issues in these remote communities that were identified as worthy of consideration in clinical practice and future research. To our knowledge, this project was the first to bring together both lay and professional stakeholders to identify the needs of underserved families of children with ASD living in these rural areas. Academic collaboration with stakeholders and community members who provide care to children with ASD is a critical step in addressing what is most important to these typically underserved individuals and their families and is a promising way to inform clinical practice and future research. Results from this initial work set the stage for an ongoing PCORI-funded Tier 1 project that is currently underway and aimed at improving the overall quality of life for all individuals with ASD and their families.

151 **181.151** Engaging the Next Generation in ASD Research – Experiences of the Ssc@IAN Family Registry

***J. S. Toroney**[1], J. K. Law[2], A. R. Marvin[3], C. White[4], E. Brooks[4], E. M. Arthur[5], W. K. Chung[6] and P. H. Lipkin[5], (1)Medical Informatics, Interactive Autism Network, Baltimore, MD, (2)Interactive Autism Network, Baltimore, MD, (3)Department of Medical Informatics, Kennedy Krieger Institute, Baltimore, MD, (4)Simons Foundation, New York, NY, (5)Kennedy Krieger Institute, Baltimore, MD, (6)SFARI, Simons Foundation, New York, NY*

Background:
ASD patient registries engage families in new research initiatives and facilitate longitudinal data collection. Child registrants who transition into adulthood provide a unique opportunity to enroll the next generation in ASD research. Established in 2011, the SSC@IAN represents over 1400 families who participated in the original Simons Simplex Collection study. In 2015, efforts were undertaken to engage and consent nearly 600 childhood participants from this cohort who had reached 18 years.
Objectives:
To determine the ability to engage and consent young adults, with and without ASD, who have been previously enrolled for research as children and require re-consent upon reaching 18 years.
Methods:
Parents of over-age-18 children were invited to complete an online form designating their child's appropriate legal status – legally independent vs. dependent. If independent, parents were given the option to invite the over-18 child to continue his/her participation in the registry. Over-age-18 participants, with and without ASD, were notified by email about the SSC@IAN and given the option to participate. Electronic consent was obtained. New participants were asked to provide current sociodemographic and medical information.
Results:
Invitations were sent to parents of 567 children who had reached 18 years: 304 probands with ASD (53.6%) and 263 unaffected siblings (46.4%). Parents were more likely to

respond for their children with ASD than their unaffected children [Proband: n=92 (30.3%); Sibling: n=47 (17.9%); $p<.001$; Fischer Exact Test (FET)]. Of the 92 probands, 43 (46.7%) were reported to be independent adults, 47 (51.2%) were dependent adults and 2 (2.2%) were reported as "other." One unaffected sibling was reported as "other" and the remaining 46 (97.9%) were reported as independent adults. There was no significant difference between the percentage of independent probands (n=37; 86.0%) and unaffected siblings (n=39; 84.8%) that parents invited to join the study as consented adults, and no significant difference between the percentage of independent probands (n=17; 45.9%) and unaffected siblings (n=23; 59.0%) who agreed to join the study as a consented adult (Figure 1).
Efforts to recruit adult probands took place with the re-engaging all registry participants. Overall, parents were less likely to engage if the proband was over age 18: 92 of 304 (30.3%) families of adult probands responded compared to 493 of 1082 (45.6%) families of child probands, $\chi^2(1, N=1386) = 9.49$; p=.002 (Yates correction).
Conclusions:
Established ASD patient registries provide a unique opportunity to engage multi-generational cohorts in research. Enrolled parents are able to be engaged to facilitate continued participation of their young adult children – an often difficult population to recruit. Parents were more likely to provide information about their adult son/daughter with ASD compared to his/her adult sibling; however there were no significant differences in obtaining consent from independent young adults with and without ASD. Overall, families with adult children were less likely to respond than families with children under 18. Specific challenges include re-engaging parents of over-age-18 participants, identifying appropriate legal status for adults with ASD, and communicating the potential role of unaffected adult siblings in future ASD research.

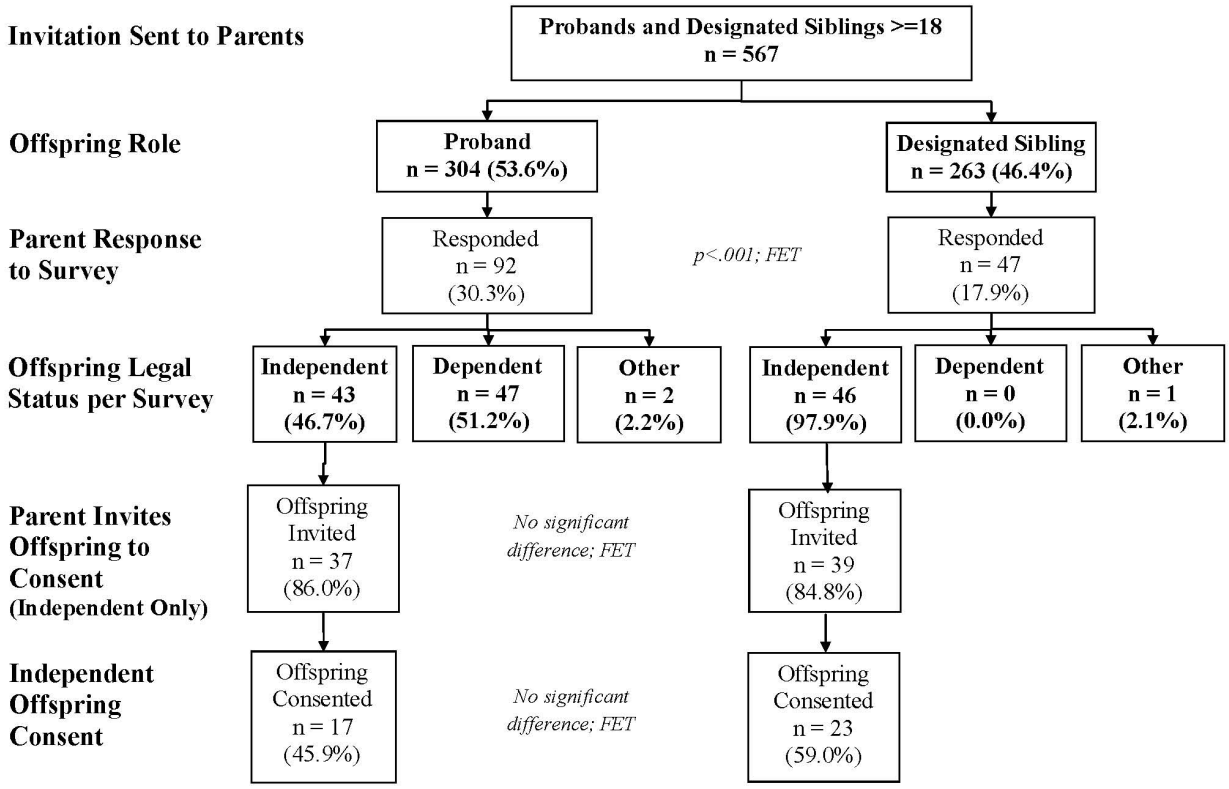


Figure 1. **Study Workflow**

152 **181.152** Engaging with Adults on the Autism Spectrum and Their Relatives about Effective Longitudinal Cohort Research

J. E. Mackintosh[1], *T. L. Finch*[1], *H. McConachie*[1], *A. Le Couteur*[2], *D. Garland*[3], *A. M. Petrou*[4], *D. Brett*[5], *C. Michael*[6], *T. Goth*[7], *C. Mitchell*[8] *and J. R. Parr*[9], *(1)Institute of Health and Society, Newcastle University, Newcastle upon Tyne, United Kingdom, (2)Northumberland, Tyne and Wear NHS Foundation Trust, Newcastle Upon Tyne, Northern Ireland, United Kingdom of Great Britain and Northern Ireland, (3)Northumberland, Tyne & Wear NHS Foundation Trust, Newcastle upon Tyne, England, United Kingdom of Great Britain and Northern Ireland, (4)Institute of Neuroscience, Newcastle University, Newcastle Upon Tyne, United Kingdom, (5)Newcastle University, IHS, Newcastle Upon Tyne, England, United Kingdom of Great Britain and Northern Ireland, (6)c/o Institute of Neuroscience, Autism Age, Newcastle upon Tyne, United Kingdom, (7)c/o Institute of Neuroscience, National Autistic Society, UK, Newcastle upon Tyne, United Kingdom, (8)c/o Institute of Neuroscience, Autismworks, Newcastle upon Tyne, United Kingdom, (9)Institute of Health and Society, Newcastle University, Newcastle Upon Tyne, United Kingdom*

Background:
We know very little about how autism is experienced in adulthood or its impact on the lives of individuals across the lifecourse. Although it has long been acknowledged that research with specific communities is important (Dickson-Swift, et al. 2008) there has been little guidance available on how best to undertake research with autistic adults and their relatives.
Objectives:
To develop a stakeholder-informed research approach for the meaningful engagement of adults on the autistic spectrum, and relatives, in a cohort study.
Methods:
A series of consultation meetings including autistic adults and family members was held over a 2 year period, prior to and during the initial stages of setting up a longitudinal cohort study (http://research.ncl.ac.uk/adultautismspectrum/). Around 50 individuals from the autism community contributed. Detailed notes were made at each of eight meetings that lasted between 2 hours and 1 day. All 'learning points' were extracted from multiple sets of notes by an experienced qualitative researcher, and mapped across four general themes.
Results:
Engaging adults with autism in cohort research
Recommendations included having autistic adults as paid researchers/advisors within the team, and identifying some of the range of challenges and needs of individuals so as to develop 'user-friendly' research processes. The need to gather information from a range of individuals, e.g. adults who are, and are not in contact with services; parents, siblings, partners, carers and others was identified. Ways of including individuals with intellectual impairment were suggested.
Quantitative research methods and materials
A range of ways to invite people to engage with a cohort study were discussed, e.g. mailshots, email, flyers, posters, online forums. Cohort questionnaire development focused on font size, spacing, and using plain text in materials, in addition to specific research question wording. The importance of individual variation in the time taken to complete questionnaires was identified. A key point was making the utility of the research for adults clear, and sending regular updates with snapshots of findings.
Qualitative research
Recommendations focussed on flexibility and respect as the key factors in approaching people and asking questions. Some key areas were: allowing different ways to

exchange information (for example text messages, emails or face to face discussions); setting aside extra time in discussions and interviews for information processing; exploring the use of visual materials for questions and responses; and not making assumptions that adults cannot do things but instead finding ways to support them in overcoming challenges.

Getting the environment right

The size and sensory impact of any meeting venue should be considered, to reduce overload from environmental stimuli. Interviews should be conducted where people are most comfortable. Payment for participation in interviews, in addition to reimbursement of travel costs, is appropriate.

Conclusions:

Our findings emphasise the need to utilise the skills and expertise of autistic adults and family members as part of the research team. We consider this has led to our research being more effective in involving, recruiting, engaging and encouraging adults on the autistic spectrum and their relatives to participate in the cohort study.

153 **181.153** Evaluating Patterns of Service Access and Interest in Families of Individuals with ASD

L. A. Pepa[1] *and S. L. Harris*[2]*, (1)Rutgers University, Douglass Developmental Disabilities Center, New Brunswick, NJ, (2)Rutgers University, Douglass Developmental Disabilities Center, Piscataway, NJ*

Background: The literature on family psychosocial outcome suggests that parents of individuals with ASD are at an increased risk of developing negative health outcomes, including anxiety and depression (Dunn et al., 2001). While the sibling outcome literature is more mixed, typically developing (TD) siblings may also be at an increased risk for psychosocial difficulties (Verte et al., 2003), with parent stress acting as a mediating factor (Meyer et al., 2011). Services for families are important to ensure their health and wellbeing, as well as their ability to be effective caretakers for individuals with ASD. Research on family support has several limitations, including fundamental difficulties with recruitment and retention of parents and siblings in projects aimed at family support (Ferraioli & Harris, 2013). Understanding the service interests of families, as well as factors predicting treatment access, is crucial in order to better serve families in the future.

Objectives: This study aims to identify 1) what support/services families are interested in, 2) what factors limit service access, and 3) what factors facilitate service access for this population.

Methods: An online survey was distributed to 158 families of individuals with ASD across the U.S. Families were recruited through a university-based program for individuals with ASD as well as ASD service and support networks. Respondents to the survey were parents who had one child with ASD and at least one TD child, per parent report. Parents filled out a series of questionnaires to measure ASD symptom severity (GARS-3; Gilliam, 1995), parent psychosocial health (GHQ-28; Goldberg, 1978), parent stress (PSI-4-SF; Abidin, 1995), and perceived social support (ISSB; Barrera et al., 1981). Participants were also given a family support questionnaire, inquiring about parent and sibling access to a set of 13 support services.

Results: Participants in the sample were largely women (59.5%), married (94.9%), White (85.4%), Non-Hispanic (85.4%), and had a Bachelor's level education (62.7%). Results suggest that parents have accessed support services for themselves (*M=8.23)* and for their TD child (*M=7.38)* in the past, and endorse a positive view of these services. A greater number of past services accessed was associated with the absence of a diagnosed psychiatric condition in the parent or sibling, higher severity scores on the GARS-3, lower scores of anxiety on the GHQ-28, increased social support on the ISSB, and increased parent stress as measured by the PSI. Family demographic variables (e.g., parent and child gender, child age, etc.) were also found to be related to service access. Descriptive information regarding interest in individual service type will be discussed, as well as models of service prediction.

Conclusions: Parents endorsed having accessed a range of services for themselves and their TD child. Certain individual and family-level variables were found to be significantly related to treatment access. Understanding factors that limit and facilitate treatment access can help guide clinical and research approach to family support. Future directions include replicating results in a more diverse sample, and investigating strategies for making services more accessible to families (e.g., integrating family support into ASD services).

Table 1

Means and Standard Deviations of Service Access/Interest for Parents and Siblings

	Whole Sample	Screen Pass	Screen Fail
Past Service Access			
Parents	8.23 (2.95)	8.59 (2.98)	6.77 (2.38)**
Siblings	7.38 (3.54)	7.71 (3.66)	6.09 (2.68)*

*$p<0.05$, **$p<.01$

Note. Parents reported accessing less services for their typically developing children, than for themselves, in the past ($M=7.38$) $t(156)=4.777$, $p<.01$. The Screen Fail sample (e.g., those families with a diagnosed psychiatric condition in a parent or TD sibling) was found to have accessed significantly less services than the Screen Pass sample across both parent $F(1,155)=81.79$, $p<.01$ and sibling areas $F(1,156)=66.36$, $p<.05$.

Table 2

Correlations Between Dependent Variables and Number of Past Services Accessed

	1	2	3	4	5	6
1. # Past Parent Services	-					
2. # Past Sibling Services	.78**	-				
3. Autism Index	.47**	.44**	-			
4. ISSB Total	.50**	.68**	.52**	-		
5. PSI-4-SF Total	.38**	.43**	.34**	.39**	-	
6. GHQ-28 Anxiety Total	-.17*	-.18*	-.29**	-.29**	-.10	-

*$p<.05$, **$p<.01$

Note. Autism Index=GARS-3

181.154 Examining the Impact of Medication Side Effects on Problem Behavior Displayed By Children with Autism Spectrum Disorder (ASD)

J. D. Bleiweiss, *Special Education, Hunter College, New York, NY*

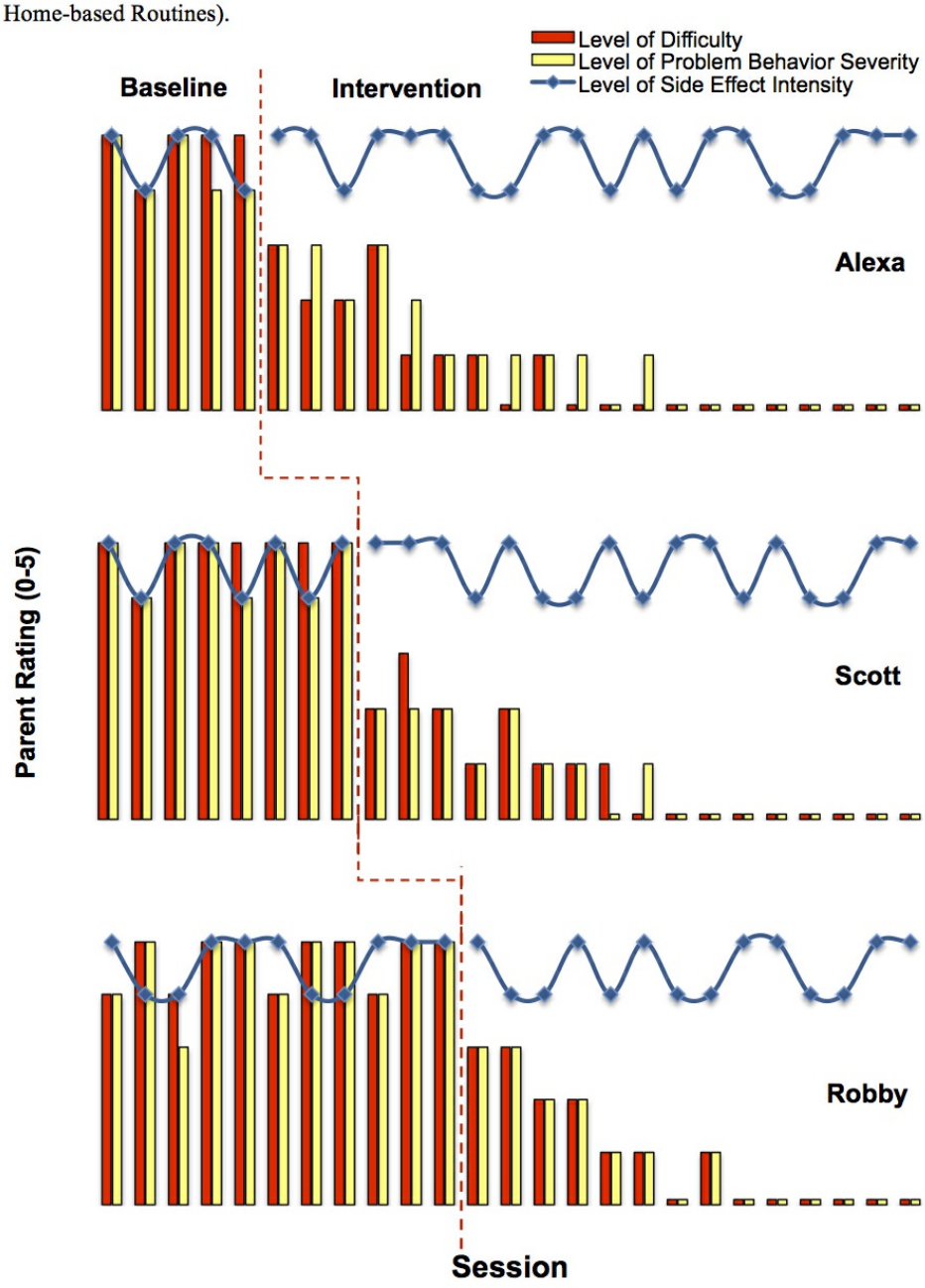
Background: Problem behavior significantly impedes multiple aspects of quality of life for individuals with autism spectrum disorder (ASD), and thus represents a major priority for intervention. Psychotropic medications are commonly administered to treat such behavior; however, these agents are often associated with adverse side effects that may have a negative impact on daily activities. Many of the same symptoms such as fatigue, increased anxiety, and gastrointestinal discomfort have been identified in the behavioral literature, where they are referred to as "setting events," and are often associated with elevated levels of problem behavior. Thus, it is plausible that medication side effects may function as biological setting events, paradoxically exacerbating the very behavior the medication aims to treat.

Objectives: (1) To develop a comprehensive, contextualized assessment measure that assessed commonly occurring medication side effects to determine whether there is an association between the presence of these symptoms in specific home and community activities and a subsequent increase in problem behavior displayed in those same routines; (2) To demonstrate the effectiveness of using a multicomponent intervention plan to mitigate problematic routines during which side effects are present, resulting in a reduction in problem behavior displayed by individuals with ASD, as well as an overall improvement in family quality of life.

Methods: A series of studies were conducted, exploring the possibility that commonly occurring medication side effects may function as setting events, a class of contextual variables that alter ongoing stimulus-response relationships (Kantor, 1959). That is, the presence of side effects purportedly made certain home and community routines

more difficult for individuals, and this, in turn, produced greater levels of problem behavior. Nine children with autism spectrum disorder who were prescribed psychotropic medication to treat severe problem behavior participated. A comprehensive assessment was conducted to identify problematic contexts in which side effects were present, and multicomponent intervention packages were developed and implemented collaboratively with each family. A multiple baseline experimental design was used to demonstrate intervention effects for these high priority contexts.
Results: We demonstrated, experimentally, that the presence of medication side effects (such as fatigue, increased hunger, gastrointestinal discomfort, etc.) did negatively impact particular family-based activities, resulting in an exacerbation of problem behavior (see Figure 1 for results of Study 1 which examined problematic home-based routines). Additionally, significant improvements were noted in problem behavior, activity completion, and overall family quality of life following the implementation of the multicomponent interventions.
Conclusions: The value of conceptualizing medication side effects as biological setting events and the direct intervention implications arising from such a conceptualization are discussed.

Figure 1. Ratings of the level of intensity of medication side effects present in the experimental context, the level of difficulty of the routine, and the level of severity of problem behavior displayed in experimental context, as rated on 5-point Likert scales ranging from 1 "mild" to 5 "severe," for three participants in the baseline and intervention phases of Study 1 (Context: Home-based Routines).



 181.155 Examining the Relationship Between Gender, Age, Anxiety and Aggression in Children with ASD Using the Child Behavior Checklist
***A. K. Walsh**, K. Derochea, D. Peterson and E. Hanson, Developmental Medicine Center, Boston Children's Hospital, Boston, MA*

Background: Because it is frequently noted that aggressive behavior and anxiety problems are often seen in children with Autism Spectrum Disorders (ASD) and that these problems can have extremely negative consequences (Farmer, 2011; Kerns 2012), further examination is needed to fully understand the prevalence of anxiety and aggression in ASD at different ages and between genders. The Child Behavior Checklist (CBCL) is a widely used quantitative assessment that measures a child's mental health that includes levels of anxiety problems and aggressive behavior. This present study examines the relationship between age, aggression and anxiety; gender, aggression and anxiety as well as the correlation between aggression and anxiety in children with ASD.
Objectives: N/A
Methods: A sample of 843 children (69.5% male) with an ASD diagnosis who also met research criteria for ASD were examined. Participants' ages ranged from 22 months to 226 months (Mean= 102.5, SD= 43.8). CBCLs were examined with focus on Aggressive Behavior totals and Anxious/Depressed totals. Correlations between age and anxiety, age and aggression, gender and anxiety, gender and aggression, and aggression and anxiety were examined using Pearson Correlation in SPSS.
Results: Pearson Correlations were run using SPSS and measured relationships between age and anxiety, age and aggression, gender and anxiety, gender and aggression, and aggression and anxiety. Preliminary analyses indicated that there was no significant relationship between gender and anxiety (r=-.025, p-value=.474) or gender and aggression (r=-.067, p-value=.053). However, there was a positive, significant correlation between anxiety and age (r=.230, p-value≤.000) and between anxiety and aggression (r=.365, p-value≤.000). Analyses also suggested a significant negative correlation between age and aggression (r=-.318, p-value≤.000).
Conclusions: Results suggest that a strong, positive relationship between anxiety and age as well as between anxiety and aggression exists, while a strong negative relationship exists between age and aggression. Future research is needed to explore and further confirm these findings. Longitudinal data should also be examined to explore correlations within an individual's lifespan. Further research could also examine the relationship between rates of aggression and anxiety in children receiving appropriate therapies.

156 **181.156** Experiences Related to Deployment for Military Families with Children with ASD

J. Davis[1] *and E. H. Finke*[2]*, (1)Pennsylvania State University, State College, PA, (2)Pennsylvania State University, University Park, PA*

Background:
Military families are an underrepresented group in the ASD literature, despite the number of military dependents with a diagnosis of ASD reaching approximately 23,500 (Tricare, 2011). There has been little peer-reviewed research to date on military families with children with special needs or children with ASD; however, previous research has indicated the presence of need within this population. A survey by Ferrell and colleagues (2014) found that military spouses with a child with special needs perceived less informal and formal support than other military spouses. Davis and Finke (2015) interviewed 15 military spouses with children with ASD about their therapeutic experiences. Military spouses from this investigation reported challenges with relocation, deployment, Tricare, and military programs that resulted in negative impacts on their child's autism related services. Although Davis and Finke (2015) was a first step toward understanding this population, the experiences and needs of a larger sample of military families with children with ASD should be examined. Due to specific characteristics of military families, military families who have children with ASD may have unique service needs. The purpose of the current study was to describe the experiences of a larger sample of military families with a child with ASD during military deployments and separations to determine possible supports and factors related to their experiences.
Objectives:
The main objectives of this investigation were to describe the experiences of military families with a child with ASD during military deployments and separations, determine possible supports for these families, and investigate factors that may influence their experience (e.g., is the number of deployments related to the military spouse's rating of deployment satisfaction?).
Methods:
In order to determine the deployment experiences of a larger sample of military families with children with ASD, a self-administered online survey design was chosen. Surveys are a time and cost efficient design allowing researchers to collect self-reported data on personal experiences and generalize findings to a larger population (Rea & Parker, 2005). The survey was administered online mode to extend the "reach" of respondents who may live in a number of geographic regions (van Selm & Jankowski, 2006). Further, online surveys are cost effective, contain no interviewer bias or data entry error, and allow for easy follow-up and quick data collection (Rea & Parker, 2005; van Selm & Jankowski, 2006). A review of the literature on families of children with ASD and/or other disabilities (e.g., Renty & Roeyers, 2006; Dunst, Jenkins, & Trivette, 1984) and military families (e.g., Huebner et al., 2010; Blue Star Families, 2013) was used to generate the questions and responses for the survey.
Results:
Approximately 175 military spouses with children with ASD completed the deployment section of the online survey. Data analysis is currently on-going, but preliminary results suggest military families with a child with ASD experience challenges related to deployments and separations of their military member.
Conclusions:
Data analysis is currently on-going, but conclusions may impact clinical service providers, military programming and providers, and laws and policies.

157 **181.157** Factors Associated with Parent Satisfaction with Emergency Department Visits When the Patient Has Autism

S. Kirsch[1]*, J. Weaver*[2] *and D. Meryash*[3]*, (1)Pediatrics, Cohen Children's Medical Center, Lake Success, NY, (2)University of Toronto, Toronto, ON, Canada, (3)Pediatrics, Cohen Children's Medical Center / Hofstra NS-LIJ School of Medicine, Lake Success, NY*

Background: Providing optimum care in an emergency department or urgent care center (ED) to autistic (ASD) patients, who often have limited communication, hypersensitivity, ritualistic behavior, and need for routine, can be challenging for both families and ED staff. Published and anecdotal reports reveal that parents of autistic children are often frustrated with ED care, but associated or potentially causative factors have not been systematically studied. By tapping the unique perspective and insight of parents of children with ASD, effective opportunities for improvement can be identified.
Objectives: To identify factors influencing parent satisfaction with ED visits in order to inform both parents and ED staff on how better to prepare for effective care of their ASD children.
Methods: With the assistance of the Interactive Autism Network (IAN) Research Database at Kennedy Krieger Institute, Baltimore, an invitation was sent to 10,000 parents of ASD children to complete an anonymous internet survey if their child received care at an ED in the U.S. within the last 3 years and was 3-21 years old at the time. Using a 5-level Likert scale the respondents were asked whether they were "satisfied with the experience and the care provided." The survey also included questions about parent education and occupation, patient characteristics, parent expectations and preparation for the visit, and the ED experience itself, including ED staff characteristics and behaviors.
Results: Of 404 completed surveys, 379 (93.8%) were analyzed (excluding 25 reported patients without ASD). Of these, 223 (58.8%) respondents expressed satisfaction and 156 (41.2 %) dissatisfaction or neutrality with their ED experience. In bivariate analyses satisfaction was considerably less common when the patient was disruptive (50.7%) versus not disruptive (82.5%) during the visit (X^2=30.1; df=1; p<0.001). Satisfaction with the visit was also associated with waiting and treatment room wait times (both p<0.001) *that were shorter than expected* but *not* with *actual* waiting room time. Parent positive assessments of the ED staff on a variety of communication and professionalism skills parameters (e.g. talked with patient at appropriate developmental level) were also associated with satisfaction (all p<0.001). There was a trend toward satisfaction if the parent notified the staff at arrival of their child's disability (p=.072). Satisfaction was *not* associated with either of two proxies of severity of the patient's disability (restrictiveness of educational environment; communication competence), whether the patient has increased sensitivity to sensory stimuli, or parent education. Interestingly satisfaction was not more likely if the parent brought the patient's medical records to the visit. Further analysis using multiple logistic regression will assess the independent effects of these correlates on ED experience satisfaction. In addition the factors that correlate with disruptive behavior during an ED visit will be separately analyzed.
Conclusions: The patient's manifestation of disruptive behavior is a potent predictor of whether an ED visit is perceived by the parent as a positive experience or not. Otherwise, it appears that perception of a positive ED experience depends more on ED preparedness and staff training than on patient characteristics, including extent of disability.

158 **181.158** Families of Youth with ASD and Other Developmental Disabilities: A Theory-Based Intervention

J. J. Diehl[1,2]*, K. N. Bergman*[2]*, J. Kaboski*[2]*, C. Lee*[2]*, J. Likens*[1]*, H. Miller*[2] *and E. M. Cummings*[2]*, (1)LOGAN Community Resources, Inc., South Bend, IN, (2)University of Notre Dame, Notre Dame, IN*

Background: Few evidence-based programs exist to support families that include a child with Autism Spectrum Disorder (ASD) or other intellectual or developmental disability (IDD), despite documented evidence of their risk for heightened stress and conflict. Parents in these families are at heightened risk for increased stress, marital conflict, and parenting difficulties, particularly with the typically developing (TD) siblings. TD siblings are at risk for maladjustment and relationship problems. A critical need exists for an evidence-based program to ameliorate the impact of family stress and conflict on the overall well-being of parents and TD siblings.
Objectives: Our objective is to test the efficacy for parents, TD siblings, and children with ASD or other IDDs of the adaptation of a psycho-educational and communication training approach (Cumming & Schatz, 2012) and to examine the mechanisms associated with change processes that occur as a result of the program.
Methods: Participants were 30 families with a child with IDD and a TD sibling (11-17 years old) in a pilot intervention program designed to improve family communication. The majority of participants (N=20) were diagnosed with ASD (confirmed with the ADOS-2, Social Communication Questionnaire, and clinical judgment). Families were randomly assigned to either: 1) a parent-sibling (PS) treatment condition, or 2) a self-study (SS) control condition. Families completed prescreen, baseline, and posttest assessments of marital quality/satisfaction, parent-child communication and attachment, emotional security and adjustment, and dyadic (marital) and quadratic (i.e. parents,

TD sibling and child with IDD) problem-solving tasks that were coded for constructive and destructive conflict tactics and resolution. Families in the PS condition made four visits to the laboratory, during which parents and TD siblings received psychoeducational training and practiced a communication technique with a trained coach. Individuals with IDD in the PS condition participated in a structured activity during the first three weeks, which was incorporated into a family-wide psychoeducational session at week 4. Parents in the SS condition were given a syllabus and research-based materials to review over three weeks.
Results: Mixed ANOVAs revealed differences in the quality of dyadic and quadratic interactions from the pretest to posttest. Consistent with expectations, a statistically significant interaction was found between condition and time on observed constructiveness in family-wide interactions including the parents, TD sibling, and child with IDD, $F(1,11) = 5.16$, $p = .04$, with treatment families using more constructive strategies than control families at the posttest. In dyadic interactions, the degree of resolution for fathers, $F(1, 37) = 12.27$, $p = .001$, and mothers, $F(1,37) = 14.84$, $p < .001$, and constructiveness for mothers, $F(1,37) = 5.03$, $p = .03$, improved over time. Improvement in constructiveness of marital conflict was associated with increases in adolescents' emotional security at the posttest, $F(1,15) = 14.40$, $p < .001$.
Conclusions: Preliminary data showed promising benefits for both parents and TD siblings of individuals with ASD and other IDDs. The expected outcome of this study is an evidence-based, cost-effective intervention that is readily transferable to community-based centers, but additional research is needed with a larger sample size.

159 **181.159** Family Empowerment Among Parents of Children Newly Diagnosed with ASD

L. Corona[1], *S. A. Fox*[1], *M. L. Rinaldi*[1] *and K. V. Christodulu*[2], *(1)Center for Autism and Related Disabilities, Albany, NY, (2)Center for Autsim and Related Disabilities, Albany, NY*

Background: Parents of children diagnosed with autism spectrum disorder (ASD) often report high levels of parenting stress and low levels of parenting self-efficacy and overall well-being (Karst & Van Hecke, 2013). Parent empowerment has been implicated as a potential factor influencing parent responses to challenges associated with parenting a child with ASD (Weiss, MacMullin, & Lunsky, 2015). This suggests the value of targeting interventions to increase parent empowerment. Prior research has reported gains in family empowerment following participation in a parent support group (Banach et al., 2010). The present study sought to investigate changes in family empowerment following participation in an education-focused parent group for children newly diagnosed with ASD.
Objectives: The first objective of the present study was to examine relations among family empowerment, parent stress, and family quality of life in a sample of parents of children newly diagnosed with ASD. The second objective was to assess change in family empowerment following participation in a parent education program.
Methods: Participants in the present study were parents participating in a five-session parent education program designed to provide information and resources to families. Criteria for participation included having a child between the ages of twelve months and five years, six months who had been diagnosed with ASD within the past year. Prior to and following program participation, participants completed the Family Quality of Life Scale (FQOL; Summers et al., 2005), the *Parenting Stress Index – Short Form* (PSI-SF, 4th ed., Abidin, 2012), and the Family Empowerment Scale (FES; Koren, DeChillo, & Friesen, 1992). The FES has been used extensively with parents of children with disabilities and has three subscales targeting different aspects of parent empowerment (Family, Child Services, and Community Advocacy). Current results are based on data from 27 mothers and 19 fathers who attended the education program between July 2014 and October 2015. Data collection is ongoing.
Results: Bivariate correlations were used to investigate relations among family quality of life, parenting stress, and family empowerment (see Table 1). All FES subscales were positively correlated with family quality of life. However, only the Family subscale was significantly correlated with parenting stress ($r = -.56$, $p < .01$). Paired-sample *t*-tests were used to assess differences in family empowerment prior to and following the program. Caregivers reported higher family empowerment on all three subscales following program participation (Family, $t = 3.10$, $p < .01$; Child Services, $t = 3.04$, $p < .01$; Community Advocacy, $t = 2.51$, $p < .05$).
Conclusions: The results of the present study suggest that among parents of children newly diagnosed with ASD, family empowerment is positively associated with family quality of life. However, only empowerment specific to family interactions is associated with parenting stress. This finding indicates that empowerment related to community participation and service access may be less impactful for parenting stress. Finally, the present study provides initial support for the hypothesis that providing education to parents of children newly diagnosed with ASD may increase parent empowerment.

Table 1.

	Family Quality of Life	Parenting Stress	Parent Empowerment: Family	Parent Empowerment: Child Services	Parent Empowerment: Community Advocacy
Family Quality of Life	1.00				
Parenting Stress	-.536**	1.00			
Parent Empowerment: Family	.770**	-.556**	1.00		
Parent Empowerment: Child Services	.492**	-.138	.609**	1.00	
Parent Empowerment: Community Advocacy	.435**	-.183	.414**	.744**	1.00

**Correlation is significant at the 0.01 level (two-tailed).

160 **181.160** Feasibility and Initial Efficacy of Primary Care Stepping Stones Positive Parenting Program (Triple P) on Reducing Maladaptive Behaviors in Children Newly Diagnosed with Autism Spectrum Disorder

D. Zand[1], *M. W. Bultas*[2], *S. E. McMillin*[3], *K. Pierce*[4] *and D. McNamara*[4], *(1)General Academic Pediatrics, Saint Louis University, St Louis, MO, (2)School of Nursing, Saint Louis University, Saint Louis, MO, (3)Social Work, Saint Louis University, Saint Louis, MO, (4)General Academic Pediatrics, Saint Louis University, Saint Louis, MO*

Background: Concomitant behavioral problems, including tantrums, noncompliance, aggression and self-injury[1,2]are common among children with Autism Spectrum Disorder (ASD). These behaviors can be of comparable or greater concern to parents than the core symptoms of ASD and often are chief motivating factors for seeking diagnosis and treatment. While emerging parent mediated interventions (PMI) exist to address maladaptive behaviors among children with ASD, no evidence based practices exist for intervening with parents at the time of initial ASD diagnosis in a systematic, strength based, parent driven, and practitioner guided manner.
Objectives: To determine the feasibility and preliminary efficacy of a manualized, one-on-one, 4 session PMI (Triple P) with parents of children (ages 2 to 12 years) newly diagnosed with ASD.
Methods: A two-group, pre- post-test, open trial design with random assignment to intervention (N= 9) versus treatment as usual control (TAU; N=6) was employed. Eligible parents were recruited from an urban Autism Speaks-Autism Treatment Network diagnostic clinic, as well as from the surrounding community. Parent inclusion criteria consisted of being at least 18 years of age, being the child's legal guardian, having primary responsibility for raising the child, and having a specific behavioral concern about their child. Child inclusion criteria consisted of receiving a DSM 5 ASD diagnosis within the past year from either a psychologist or physician, being > 2 years and < 12 years old, and displaying moderate to severe behavior problems (Eyberg Intensity T-Score > 60).
Results: Compared to TAU, parents who received the intervention, reported statistically and clinically significant changes 4 weeks post-baseline in: child externalizing behaviors, ECBI Intensity $F(1,13) = 5.16$, $p < .05$, partial $\eta^2 = .31$; parenting competence $F(1,13) = 6.64$, $p < .05$, partial $\eta^2 = .36$; parenting resilience $F(1,13) = 6.52$, $p < .05$, partial $\eta^2 = .35$; family functioning $F(1,13) = 6.03$, $p < .05$, partial $\eta^2 = .35$; overall parenting stress $F(1,13) = 19.38$, $p < .001$, partial $\eta^2 = .66$; and parent-child interaction stress $F(1,13) = 6.66$, $p < .05$, partial $\eta^2 = .40$. Analyses indicated a 93% level of fidelity to the intervention, and high participant satisfaction with services ($M = 6.6$, $SD = .41$).
Conclusions: For children newly diagnosed with ASD, a 4 session PMI was superior to TAU in improving child behaviors, fostering parenting competence, reducing parenting stress, and improving family functioning. The intervention's focus on empowering parents is an innovative approach to current service delivery models, and holds the potential for assisting in the development and use of more family friendly, strength-based, patient-centered practices for working with parents of children newly diagnosed with ASD to diminish problematic child behavior.

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161 **181.161** Five Factor Structure of Parenting Stress Index – Short Form in Evaluating Stress in Parents of Children with ASD

R. Mahajan[1], *V. Singh*[2], *A. Schrembs*[1], *J. Neely*[1], *M. Pinkett-Davis*[1] *and R. Landa*[1], *(1)The Kennedy Krieger Institute, Baltimore, MD, (2)Kennedy Krieger Institute, Baltimore, MD*

Background:
Parents of children with autism spectrum disorder (ASD) experience high levels of stress compared to parents with children without ASD (Baker-Ericzn, Brookman-Frazee, & Stahmer, 2005). This has been attributed to child factors, parent factors, as well as dysfunctional parent-child interactions (Rivard, Terroux, Parent-Boursier, & Mercier, 2014). Parenting Stress Index-Short Form (PSI-SF; Abidin, 1990) is a quick screen for all 3 domains of parenting stress in a clinical setting (Parental Distress, PD, Difficult Child, DC and Parent Child Dysfunctional Interactions, P-CDI). It has been used to provide parent focused interventions to improve child outcomes in primarily non-ASD familes, but may also be of utility in assessing parenting stress in families with ASD children (Rao & Beidel, 2009). Given the unique multidimensional parenting challenges of ASD families, it is not known if the 3 factor structure of PSI-SF is valid for them and if the individual line items congregate within the same domains in ASD families as in families with non-ASD children (Zaidman-Zait et al., 2011).
Objectives:
To assess the validity of the three factor structure and individual line items of the Parenting Stress Index-Short Form (PSI-SF) in a large clinical sample of parents of children with ASD.

Methods:
The participants included 685 parents (90.51% mothers) of children evaluated at Kennedy Krieger Institute's Center for Autism and Related Disorders in an ongoing clinical research registry between June 2014 and June 2015. Mean child age was 6.02 years (range =1.42-11.95; 17.7% female). The parent completed PSI- SF prior to the child's evaluation. The 685 children were then evaluated by a multidisciplinary team to determine the presence or absence of ASD diagnosis using DSM – IV criteria. Of these, 410 were also administered ADOS-2. ASD diagnosis status was determined either from the child's medical record or from adapted Ohio Autism Clinical Impressions Scale (OSU Research Unit on Pediatric Psychopharmacology, 2005) filled by the evaluating clinicians. 458 children (66.86%) had a confirmed ASD diagnosis; in 177 children (25.84%) ASD was ruled out; for 50 children (7.30%), data were not available.
Results:
Unlike the 3 factor domains previously described in PSI-SF, exploratory factor analysis revealed the presence of a 5 factor structure for parents of children with ASD. The first domain was similar to the original PD domain in the PSI-SF. Differences were noted in DC domain and the P-CDI domains from the original with some items crossing over across the domains. We identified a 4thand a 5th domain specifically pertaining to "socio-emotional expectations" and "learning expectations" respectively. 3 items were found to be unique and did not correlate well with any of the domains.
Conclusions:
The three factor structure in the original PSI-F may be more valid for the normative sample of the population. For ASD families, the five factor structure identified in this sample may help identify the focus of parenting needs including parental socio-emotional and learning expectations so as to provide interventions that may positively influence child outcomes.

163 **181.163** How Do Parents Conceptualize Their Children's Autism Spectrum Disorder? Validating a Measure of Caregiver Perceptions

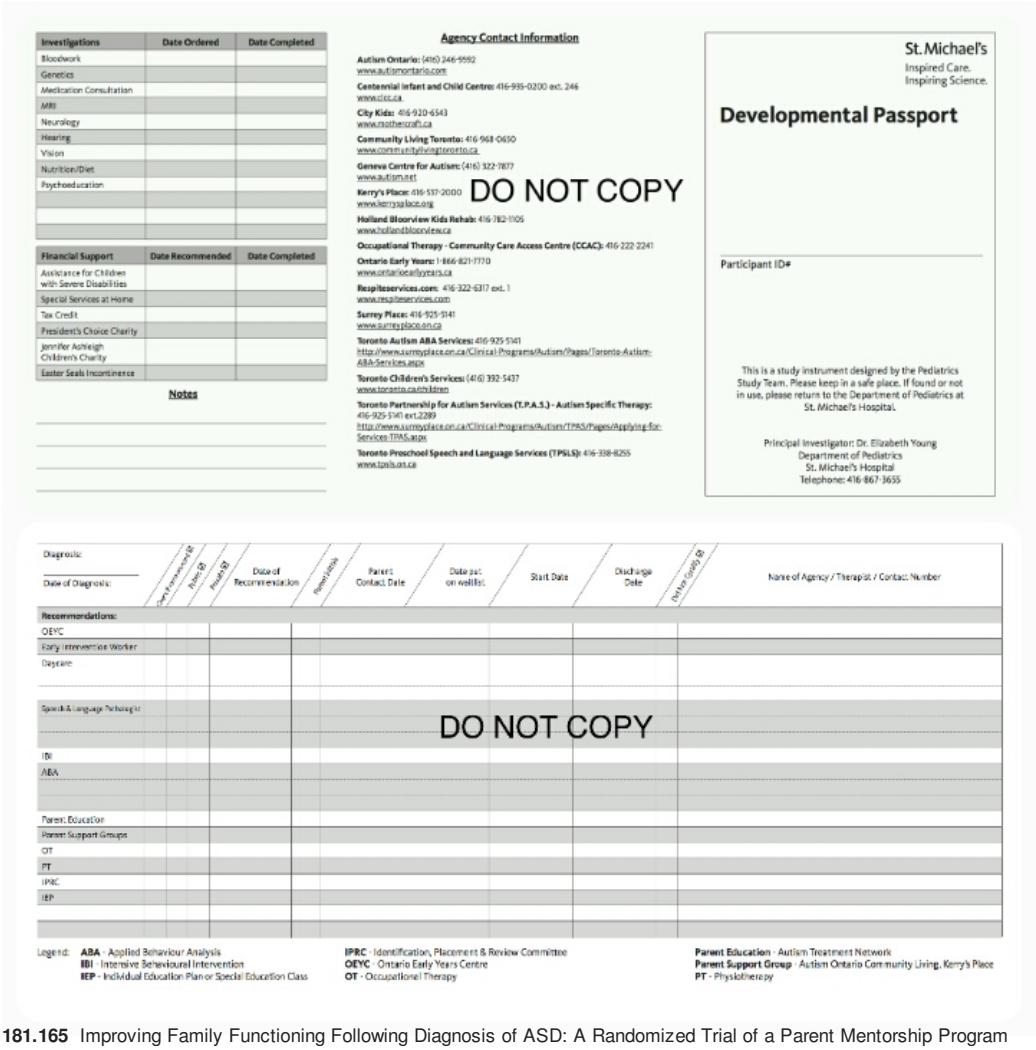
***S. S. Mire**, T. Tolar, J. R. Anderson, N. S. Raff and C. M. Brewton, Psychological, Health, & Learning Sciences, University of Houston, Houston, TX*

Background: Understanding how parents conceptualize their child's ASD diagnosis (i.e., understanding it, beliefs about course, perceptions of control over course and/or treatment) may help researchers and practitioners better support families. The Illness Perception Questionnaire-Revised (*IPQ-R*; Moss-Morris et al., 2002) is widely-used in studying chronic illness and is based on Leventhal et al.'s (1984) illness representation model. Though not an "illness", ASD is a chronic condition, requiring various treatment approaches across the lifespan (Aman, 2005; Shea & Mesibov, 2009). The *IPQ-R* was modified for use with ASD (Al Anbar et al., 2010); parent scores on this measure may predict ASD treatment selection (Dardennes et al., 2011; Mire et al., 2015). Perhaps parent perceptions as measured by the *IPQ-R* also represent cognitions that impact families of children with ASD in other important ways (i.e., parent and/or family stress, coping). However, to date the only investigation into the psychometric properties and use of the *IPQ-R* in ASD is limited to a small sample of French families (n=89) with parent-reported ASD diagnoses.
Objectives: Examine construct validity of the *IPQ-R* for families of children with confirmed ASD diagnoses, which allows investigating function of *IPQ-R* ordered categorical response items for assessing parental perceptions, and to verify the factor structure of *IPQ-R*as it relates to the constructs central to chronic health condition conceptualizations.
Methods: Parents of children and adolescents (n=362; child age M=13.44, SD=3.43) with confirmed ASD diagnoses from across North America were asked to complete the *IPQ-R*; data collection is complete. We are in process of evaluating different polytomous IRT-CFA models (e.g., direct and indirect IRT model) to analyze the ordinal (i.e., Likert scale) item-level data yielded from the collected *IPQ-R* to determine the number and nature of dimensions (i.e., factors) measured when used with families affected by ASD.
Results: Parents in this study (age *M*=46.10, *SD*=5.93) were likely to have a bachelor's degree or higher (73.5%) and higher-than-average family income (median: $100,000). In this sample, 72.6% of parents reported that their child's overall ASD severity was "moderate". Using the scoring criteria based on the original *IPQ-R* model (i.e., not with families of ASD), initial correlation analyses indicated the relationships of the items and subscales ranged from .12 to .80. An exploratory factor analysis indicated two additional factors when comparing with the original measure structure. Confirmatory factor analysis of the original *IPQ-R* factor structure indicated differences in the structure of three subscales when the measure is used with ASD. Forthcoming analyses will further examine construct validity of the *IPQ-R*for families of children with ASD using polytomous item response theory (IRT) models embedded in a confirmatory factor analytic (CFA) model.
Conclusions: Parents' cognitions may be critical mediators between family functioning and child outcomes among children with ASD. However, measurement of such parent perceptions and attributions is lacking. The *IPQ-R* has been widely used to study many chronic health-related conditions and may be a viable measure for better understanding parents' conceptualizations and ultimately treatment-seeking and coping behaviors among families of children with ASD.

164 **181.164** Improving Access to Care in Families of Children with Autism Spectrum Disorder: A Mixed Methods Study to Establish the Pediatric Developmental Passport As a Resource Tool for Parents

***E. Young**[1,2], C. R. Brown[1,3], M. C. Tassone[1,4,5], E. Lung[1], N. Bechard[1,3], J. Huber[1,6,7,8] and T. Jegathesan[1], (1)Pediatrics, Saint Michael's Hospital, Toronto, ON, Canada, (2)Department of Pediatrics, Division of Developemental Pediatrics, University of Toronto, Toronto, ON, Canada, (3)Faculty of Medicine, University of Toronto, Toronto, ON, Canada, (4)Department of Pediatrics, Faculty of Medicine,, University of Toronto, Toronto, ON, Canada, (5)Michael G. DeGroote School of Medicine,, McMaster University, Hamilton, ON, Canada, (6)Department of Pediatrics, Division of Pediatrics, University of Toronto, Toronto, ON, Canada, (7)School of Graduate Studies, Department of Rehabilitative Sciences (Department of Speech-Language Pathology), University of Toronto, Toronto, ON, Canada, (8)Division of Neurology, The Hospital for Sick Children, Toronto, ON, Canada*

Background: Receiving a new developmental diagnosis is challenging for families. Following a diagnosis of ASD, developmental pediatricians typically make recommendations for caregivers to access developmental services within their community. This self-referral process poses problems for families' access and navigation of developmental services. At St.Michael's Hospital, a large urban hospital focused on inner city health, pediatricians recognized many families were not accessing developmental services in a timely manner. Given the evidence for early intervention in children, there was enormous public pressure to reduce barriers for families' access to developmental services for their children.
Objectives: To address families' barriers to accessing and navigating developmental services, the aim of this study was to determine the utility and design of the Pediatric Developmental Passport (Passport) for physicians and families in our community using the Knowledge to Action Framework (KTA). We sought 1) to establish the current practice of recommending developmental services by physicians, 2) to identify gaps in practice and 3) to design a tool embedded within physician and caregiver needs.
Methods: A sequential exploratory mixed method study design within a KTA framework was used to study the creation and utility of the passport. The quantitative component of the study included a cross-sectional survey with developmental pediatricians and the qualitative component of the study included focus groups with developmental pediatricians and semi-structured interviews with caregivers. Descriptive statistical analysis and comparative thematic analysis was used.
Results: ***Quantitative: Needs Assessment.*** Eighty-eight percent of physicians reported to follow-up on their recommendations to families and most physicians (75%) felt their current approach could be improved**.** ***Qualitative Component*****: *Need for Tool.*** Physicians noted a need for a novel tool to communicate developmental recommendations as a result of their perception of families' poor compliance to developmental recommendations. As such physicians approved the initial design of the passport with recommendations. They suggested the utility of the passport needed to be verified among families, as they would be the primary users of the tool. ***Supports, Opinions and Reflections of the Passport.*** Caregivers reported the passport to identify clear goals for child's care and served as a quick summary of services in one document, highlighting the utility of knowing at a glance their progress in accessing developmental agencies. Caregivers also noted the potential impact of the passport in reducing caregiver stress. One parent said "*It would be really helpful when you go to the family doctor, or any other healthcare person, to catch them up on what's being done without having to explain it all.*" – *Caregiver 10*
Conclusions: Using a mixed method design with a KTA framework a novel tool called the Pediatric Developmental Passport was developed to be used as a communication tool for physicians and families to communicate recommendations for services and to track access at follow-up visits. The Passport will be an effective tool for physicians to communicate recommendations to families, reduce caregiver stress and increase physicians' ability to support and advocate for families. Further studies are being conducted to demonstrate successful implementation within a clinical setting.



165 **181.165** Improving Family Functioning Following Diagnosis of ASD: A Randomized Trial of a Parent Mentorship Program

E. Moody[1], *K. E. Kaiser*[2], *L. Kubicek*[3], *D. L. Sharp*[3] *and C. Robinson*[4], *(1)13121 E 17th Avenue, University of Colorado Anschutz Medical Campus, Aurora, CO, (2)JFK Partners University of Colorado, Aurora, CO, (3)University of Colorado School of Medicine, Aurora, CO, (4)University of Colorado, Aurora, CO*

Background: Despite the growing prevalence of autism, there is a confusing array of treatment options available and little clinician support to families in acting on the treatment recommendations. Therefore families must often coordinate their own services. As a result, there is tremendous need for interventions that will help families understand and access the existing systems of care. Parent-to-Parent (P2P) mentoring programs are one strategy do this; however, there are few empirically validated P2P programs.

The ***Colorado Parent Mentoring Program*** (CPM) is a comprehensive support program that provides two sources of support: 1) parent training and education, and 2) P2P mentoring. Parent mentors were trained in a two-day program and paired with mentees. For mentees, study staff provided individualized education through individualized Action Plans. This is a family-centered process for determining treatment priorities, accessing resources, strategies for school collaboration and family care. They then received in -depth training regarding navigating systems of care in Colorado. Following these meetings, Mentors continued to support the family for 6 months.

Objectives: Develop and test a systematic P2P and parent education model.

Methods: CPM evaluated with a randomized controlled trial (RCT) with participants randomly assigned to either active participation (n=29) or a waitlist control group (n=32). Families were recruited following diagnosis from partner clinics and complete assessments prior to participation. Families in the active group are paired with a trained mentor and receive Action planning/Navigation meetings within 3 months of diagnosis. They then interacted with mentors at least monthly for 6 months. Waitlist control families received only care through usual sources. Post measures are collected after 6 months for all participants. Measures include satisfaction with program, Family Quality of Life Scale, Parenting Stress Index, Parenting Sense of Competence Scale, Monthly service utilization and qualitative interviewing.

Results:

Quantitative—Linear mixed models were used to assess the program's impact between the two groups over time. Significant improvement in Satisfaction with Disability Related Services was found in the active group. The waitlist group showed increased Rigidity in family functioning.

Qualitative—Thematic analysis of exit-interviews by two separate reviewers uncovered 6 major themes: 1) the program is highly acceptable and satisfying, 2) action planning is highly valuable in prioritizing services and locating access points, 3) families appreciate having actionable items to address their child's and family's needs, 4) families feel more empowered, less isolated and have a greater sense of community, 5) families often make a wide variety of intervention choices regardless of education, and 6) families appreciate having mentor for ongoing support.

Conclusions: The CPM program is a promising family support program with preliminary efficacy for improving satisfaction with care and preventing rigidity in the family dynamic. Parent mentors can be effectively trained to provide emotional support to other parents of children with ASD. Newly diagnosed families appear to have improved functioning as a result of this intervention; although, more research is needed on how best to support families.

166 **181.166** Informant Discrepancies in Parent and Sibling Self-Reported Emotional and Behavioral Adjustment Problems in Siblings of Individuals with ASD

J. A. Rankin*, L. K. Baker, S. W. Eldred and T. S. Tomeny, Psychology, The University of Alabama, Tuscaloosa, AL*

Background: The adjustment of typically-developing (TD) siblings of individuals with ASD is often of interest to researchers and clinicians (e.g., Hesse et al., 2013). Parents and siblings of individuals with developmental disabilities often differ in their reports of sibling adjustment, with parents tending to report more sibling adjustment problems (Guite et al., 2004). Little work considers whether these discrepancies exist specifically in ASD. ASD symptom severity, broader autism phenotype (B.A.P.) symptomatology, social support, and parenting stress have previously been evinced as predictors of sibling adjustment (Hesse et al., 2013; Meyer et al., 2011), but have not been explored in terms of the discrepancy between parent and sibling self-report. Further, consideration is lacking in how these discrepancies might affect parental functioning, although they may be related (Guite et al., 2004).

Objectives: This study explored if discrepancies between parent and self-reported sibling adjustment problems existed, and if so, which factors predict these discrepancies. Finally, the relationship between discrepancy and parent psychopathology was examined.

Methods: 113 parents completed the Strengths and Difficulties Questionnaire (SDQ) and Children's Social Behavior Questionnaire (CSBQ) about the TD sibling (*M*age = 13.33, 50% male), assessing emotional and behavioral functioning and B.A.P. symptoms, respectively; the CSBQ about the child with ASD, assessing ASD symptom severity; and the Symptom Checklist Revised - 10 (SCL-R 10) and Questionnaire on Resources and Stress (QRS-F) about themselves, measuring broad psychopathology and parenting stress, respectively. 113 TD siblings self-reported on the SDQ and the Child and Adolescent Social Support Scale (CASSS), measuring perceived social support.

Results: Paired sample t-tests revealed that siblings self-reported significantly more overall and externalizing adjustment problems compared to parent-report, (no significant differences in internalizing problems; see Table 1). Social support from parents, B.A.P. symptoms, and ASD symptoms and externalizing problems in the child with ASD

negatively correlated with sibling-parent SDQ discrepancy (Table 2). Regression analysis revealed that social support from parents, β = -.36, p < .001, and B.A.P. severity, β = -.50, p < .001, were unique predictors of SDQ discrepancy. Additionally, in parents who report more sibling maladjustment than their child, greater discrepancy predicted broad parent psychopathology over and above ASD and externalizing symptoms in the child with ASD and parental stress $\Delta F(1, 56) = 12.48$, p = .001, ΔR^2 = .16. This effect was not significant in overall discrepancy (p = .17).

Conclusions: On average, siblings self-reported more adjustment problems compared to parent-report, particularly in externalizing behaviors. This is surprising considering parents are thought to be better at rating externalizing behaviors than children, and alarming, as this scenario is often related to serious adjustment problems (Bein et al., 2015). Greater B.A.P symptomatology and support from parents predicted less discrepancy. Siblings who have higher B.A.P. symptomatology may report fewer adjustment issues, which closely resembles parent reports. Greater support from parents may result in a closer relationship where parents can better observe adjustment. Finally, parents who report more adjustment problems than their TD child's self-report may have more psychological adjustment problems themselves.

Table 1

Comparison of Mean Parent- and Self-Reported SDQ Overall and Sub-Scale Scores

SDQ (Sub)Scales	Parent-Report *M* (*SD*)	Self-Report *M* (*SD*)	Mean difference	Significance of difference (*p*-value) [1]
Total	7.56 (6.21)	10.13 (5.80)	-2.57	< .001
Externalizing Composite	1.76 (1.64)	2.61 (1.84)	-0.85	< .001
Emotional	2.64 (2.62)	3.11 (2.29)	-0.47	.061
Conduct Problems	1.01 (1.54)	1.83 (1.73)	-0.82	< .001
Hyperactivity	2.52 (2.32)	3.42 (2.47)	-0.90	< .001
Peer Problems	1.38 (1.80)	1.77 (1.60)	-0.39	.012
Prosocial Behavior	8.80 (1.72)	8.48 (1.60)	0.32	.052

Note. [1] Significance of difference calculated via two-tailed paired sample *t*-tests. SDQ = Strength and Difficulties Questionnaire. The externalizing composite was created by averaging the Conduct Problems and Hyperactivity Subscales.

Table 2

Correlations Among Variables of Interest

	1	2	3	4	5	6	7
1. SDQ Discrepancy	—	-.19*	-.43***	-.20*	-.13	-.22*	-.11
2. SDQ Externalizing – Child w/ ASD		—	.25**	.65***	-.10	-.115	.49***
3. CSBQ – TD Sibling			—	.36***	-.35***	-.25**	.20*
4. CSBQ – Child w/ ASD				—	-.09	-.11	.57***
5. CASSS Total					—	.74***	-.20*
6. CASSS from Parents						—	-.10
7. QRS-F Total							—

Note. SDQ = Strength and Difficulties Questionnaire. CSBQ = Children's Social Behavior Questionnaire SCL-R 10 = Symptom Checklist Revised – 10. QRS-F = Questionnaire on Resources and Stress (QRS-F). CASSS = Child and Adolescent Social Support Scale. SDQ Discrepancy = standardized difference score between sibling and parent report; positive scores indicate higher sibling reported adjustment problems compared to parent report.
*p < .05, **p < .01 ***p < .001.

167 **181.167** Investigating Relationships Among Parental Cognitions and Emotions, Child Characteristics, and Family Demographics Among Parents of Children with Autism Spectrum Disorder

ABSTRACT WITHDRAWN

Background: In recent years, research has demonstrated that parental cognitions and emotions predict family engagement in intervention programs developed for children with Autism Spectrum Disorder (ASD). For example, our previous research found that baseline measures of parental insightfulness moderated treatment effects among mothers of children with ASD participating in a randomized controlled trial of a responsiveness-based parent-mediated intervention (Focused Playtime Intervention [FPI]; Siller, Hutman, & Sigman, 2013). Therefore, there is a necessity to better understand parental cognitions and emotions among families of children with ASD.
Objectives: The current study aimed to investigate baseline relationships among the Insightfulness Assessment (Oppenheim & Koren-Karie, 2002) and the Reaction to Diagnosis Interview (Pianta & Marvin, 1993) in relation to a range of other parental cognitions and emotions (i.e., stress, understanding of child development, self-efficacy, perception of child attachment, and social support); child characteristics (i.e., nonverbal and language abilities and ASD symptoms); and family demographics among 70 mothers of children with ASD (chronological age: $M = 57.13$ months; $SD = 12.30$; male: $n = 64$) who participated in FPI.
Methods: At baseline, parents were asked to participate in two semi-structured interview measures: (1) the Insightfulness Assessment (IA) and (2) the Reaction to Diagnosis Interview (RDI). Parents were also asked to complete five questionnaires: (1) the Questionnaire of Resources & Stress (Konstantareas, Homatidis, & Plowright, 1992); (2) the Concepts of Development Questionnaire (Sameroff & Feil, 1985); (3) the Parenting Sense of Competence Scale (Johnston and Mash, 1989); (4) the Maternal Perception of Child Attachment (Hoppes & Harris, 1990); and (5) the Perceived Social Support Scale (Procidano & Heller, 1983). Children were administered the Mullen Scales of Early Learning (Mullen, 1995) and the Autism Diagnostic Observation Schedule (Lord et al., 2000). Parents were asked to complete a demographic questionnaire that included questions about the child's ethnicity/race, family constellation, and various indicators of family socioeconomic status.
Results: Analyses included a series of multiple regression models using SAS PROC REG. Findings revealed that mothers who demonstrated higher levels of insightfulness on narratives elicited by the IA demonstrated lower levels of stress, $t(62) = -2.24$, $p < .05$ and higher levels of self-efficacy, $t(62) = 2.19$, $p < .05$ and understanding of child development, $t(63) = 3.23$, $p < .01$. In addition, mothers who demonstrated higher levels of resolution in regards to their child's diagnosis on narratives elicited by the RDI demonstrated lower levels of stress, $t(62) = -2.84$, $p < .01$ and higher levels of self-efficacy, $t(62) = 2.67$, $p < .01$ and perceived social support, $t(64) = 2.98$, $p < .01$. None of the interaction terms were significant. Child characteristics and family demographics were unrelated to parental narratives on the IA and RDI.
Conclusions: The current study allows researchers to better understand relationships among parental cognitions and emotions, child characteristics, and family demographics among families of children with ASD. Findings contribute to research that aims to inform the efficacy of intervention programs.

168 **181.168** Links Between Autism Spectrum Disorder Diagnostic Status and Family Quality of Life

*A. G. McKechanie[1,2], **S. Fletcher-Watson**[3], V. Moffat[4] and E. C. Johnstone[5], (1)The Salvesen Mindroom Centre, The University of Edinburgh, Edinburgh, United Kingdom, (2)The Patrick Wild Centre, The University of Edinburgh, Edinburgh, United Kingdom, (3)University of Edinburgh, Edinburgh, Scotland, United Kingdom, (4)University of Edinburgh, Edinburgh, United Kingdom, (5)University of Edinburgh, Edinburgh, United Kingdom of Great Britain and Northern Ireland*

Background: Quality of life is often lowered, relative to the norm, in families with children with additional needs. This may be particularly the case where additional needs are accompanied by an autism spectrum disorder (ASD). Rates of diagnosis in Scotland (where this study took place) are low relative to the UK average, and global prevalence estimates. Therefore it is likely that some cases of ASD remain undiagnosed in Scotland. It is unclear what the consequences of this may be.
Objectives: We explore the effects of autism diagnostic status, investigating impact on family well-being of: i) diagnostic status; ii) access to services; iii) ASD symptom intensity; iv) presence of challenging behaviours and v) IQ.
Methods: Mothers (n=76) of young people (aged 13-22 years) with educationally-defined additional needs completed standardised questionnaires about quality of life, stress, service provision, challenging behaviour (Child Behaviour Checklist, CBCL) and presence and severity of ASD traits (Social Communication Questionnaire, SCQ). Participants were a sub-group selected from a large national teacher-referral study (n=465). The sample was divided, based on case history and SCQ scores into three groups: a) additional needs, SCQ score below threshold; b) additional needs, SCQ score above threshold and ASD diagnosis; c) additional needs, SCQ score above threshold, no diagnosis. In addition, a group of mothers of typically developing young people (n=17) completed standardised questionnaires on quality of life and on the behaviour of their son or daughter.
Results: Quality of life was highest, and stress lowest, in mothers of TD young people. Among the three groups with additional needs, higher SCQ scores were related to poorer quality of life and higher stress. This relationship was not explained by levels of challenging behaviour or IQ and was apparent across groups with and without a pre-existing ASD diagnosis.
The lowest quality of life and highest stress scores were evident in the group of mothers of young people who did not have a diagnosis of ASD but did exceed threshold on the SCQ. The two high-SCQ groups (with and without ASD diagnosis) did not differ on access to service provision, mean SCQ score or mean CBCL score. However mothers of young people with high SCQ scores but without ASD diagnosis did rate services as less useful than other groups.
Conclusions: Mothers of young people with additional needs experience lower quality of life and higher stress than mothers of typically developing young people. These adverse effects are stronger in the presence of ASD diagnosis, and strongest when there are signs of ASD but no diagnosis. This pattern is not explained by young people without ASD diagnosis having: higher levels of challenging behaviour; less access to services; low IQ. The study demonstrates that presence of ASD-like symptoms in the absence of diagnosis may be a particular cause of stress and poor quality of life for families.

169 **181.169** Living with Autism without Knowing: Receiving a Diagnosis after 50

***S. D. Stagg** and H. L. Belcher, Anglia Ruskin University, Cambridge, United Kingdom*

Background:
Autism was first included in the DSM in 1980, and classifications and behavioural symptoms have been refined in subsequent editions. Since its inclusion in DSM, the number of cases of diagnosed autism has been increasing, and prevalence rates are continually revised upwards. Individuals with autism born before 1980 are less likely to have received a diagnosis of autism, especially if they are relatively high-functioning. Our study investigated the experiences of individuals receiving a diagnosis of autism in their 50s.
Objectives:
Our aim was to recount the experiences of receiving a diagnosis of autism later on in life and to uncover commonalities within this experience.
Methods:
A free association narrative interview was conducted with nine individuals all of whom had received a diagnosis of autism within the past two years. Key questions were asked, but the individuals where able to take the interview in any direction they wished. A thematic analysis was performed on the data using an interpretive phenomenological perspective.
Results:
Participants recounted feeling different from others from an early age. All of the individuals had come to identify themselves as bad, evil or alien. Diagnosis, even in later life, was seen as a relief and a revelation, which enabled participants to re-evaluate their pasts and begin to explore their new identites. Many of the participants had sought a diagnosis after one of their children received a diagnosis of autism.
Conclusions:
Research into older adults with autism is an underdeveloped field. Researchers first need to explore the experiences of older adults with autism, in order to produce useful stakeholder centred research. The experience of receiving a diagnosis later on in life is largely positive and liberating. More research needs to find ways of identifying autism in individuals who may have jobs and families and do not consider themselves to fall within the traditional stereotyped image of autism.

170 **181.170** Making Your Own Way: A Qualitative Study of How Ontario Parents of Children with Autism Navigate Intervention

***S. J. Gentles**[1], D. B. Nicholas[2], K. A. McKibbon[3], S. M. Jack[4] and P. Szatmari[5], (1)CanChild Centre for Childhood Disability Research, McMaster University, Hamilton, ON, Canada, (2)University of Calgary, Edmonton, AB, Canada, (3)Clinical Epidemiology and Biostatistics, McMaster University, Hamilton, ON, Canada, (4)School of Nursing, McMaster University, Hamilton, ON, Canada, (5)Centre for Addiction and Mental Health, Toronto, ON, Canada*

Background: Parents face substantial uncertainty and stress as they assume an unusually high proportion of the responsibility for navigating intervention to address autism-related concerns. There is a lack of holistic research explaining how parents cope and respond to the complexity and obstacles that characterize their situation as they navigate multiple forms of intervention across multiple systems of care, whether publicly-funded or private.
Objectives: The purpose of this qualitative study was to develop a social psychological explanation in the form of a substantive theory of how Ontario parents of children with autism navigate intervention under the complex informational conditions that characterize parents' shared situation.
Methods: Grounded theory methods, a constructivist approach, and symbolic interactionist analytic framework were chosen as appropriate means to guide research and achieve the study objectives. The findings are primarily based on 45 in-depth (90-minute) interviews with 32 mothers from different urban and rural Ontario regions (fathers participating in 3 cases), and 9 professionals with extensive expertise supporting parents. Documents were also analyzed.
Results: The central process of navigating intervention, labeled *making your own way*, consists of *adjusting to the need to navigate intervention*, in which parents construct the meanings that prepare and motivate them for responding to their contextual situation by *taking action to navigate intervention. Adjusting* consists of 4 interdependent sub-processes that together explain parents' action: *defining concerns*, *informing the self*, *seeing what is involved*, and *emotionally adapting* to problematic aspects of parents' situation. Emotionally adapting for new parents commonly involves accepting the possibility of autism, releasing culturally-based hopes and expectations for the child's future, accepting an uncertain and fearful future for the child, enduring the strains, and redefining one's roles and self according to new occupational requirements—all important and necessary means by which parents become prepared and motivated for *taking action*. The central process of *making your own way* can be further understood

according to three overlapping heuristic stages: *beginning the autism journey*, *handling transitions*, and *easing off*. Many parents develop a strong sense of urgency at one or more key points in their journey to which they commonly respond by *going into high gear*, expending substantial personal resources sometimes at unsustainable rates in the pursuit of intervention. Consequences of *going into high gear* and other aspects of *making your own way* will be discussed.
Conclusions: This research outlines a process in which parents' social psychological understandings provide an explanation for their actions as they navigate intervention, including an outline of the mechanisms by which both harms and benefits (affecting the child, parent, or family) can occur as a specific consequence of parents' process of *making their own way*. The findings will be informative to people from any jurisdiction concerned with modifying individual professional practice or broader care systems to optimize support for parents at various stages of their process, or journey; additionally, they suggest ways to harness parents' exceptional expertise, motivation, and energy to achieve better outcomes for the autism unit within a cooperative family-centered approach to intervention.

171 **181.171** Maternal Health of Transition Age Individuals with ASD

J. K. Law[1], *A. R. Marvin*[2], *J. S. Toroney*[3], *E. M. Arthur*[4] *and P. H. Lipkin*[4], *(1)Interactive Autism Network, Baltimore, MD, (2)Painter Bldg 1st Fl, Kennedy Krieger Institute, Baltimore, MD, (3)Medical Informatics, Interactive Autism Network, Baltimore, MD, (4)Kennedy Krieger Institute, Baltimore, MD*

Background:
Previous studies have focused primarily on the well-being of mothers of young, school-aged children; however, little is known about the well-being of mothers of teens/young adults with ASD, despite the recognized challenges of the transitional period.
Objectives:
To determine health outcomes, including contributing factors, in mothers of teens/young adults with ASD
Methods:
Maternal participants in the Interactive Autism Network (IAN) with at least one teen/young adult aged 15-29 were recruited to complete a questionnaire that incorporated the PROMIS Global Short Form, the Perceived Stress Scale (PSS), and the Waisman Activities of Daily Living Scale (W-ADL). Additional demographic questions were asked of the mother and general health-related questions for the child.
Results:
488 mothers completed responses for the PROMIS Global Short Form and the Perceived Stress Scale for themselves, and the W-ADL for their teen/young adult.
Primary factors associated with decreased health for mothers of teens/young adults with ASD are increased stress (strongly influenced by household income and the teen/young adult's general health), the presence of another child/young adult with ASD/other disability in the home, and the male gender of the affected child with ASD. See Path Analysis below ($\chi^2(54) = 173.13$; p<.001) and Figure 1.
Comparison to norms:
* Z-test for means compared mothers' mean score (*M*=48.51, *SD*=8.16) to the normed mean value of the **Global Physical Health** (PROMIS) Score (μ=50; σ=10); the result was statistically significant (*z*=-3.29, *p*<.001, two-tailed).
* Z-test for means compared mothers' mean score (*M*=45.88, *SD*=9.50) to the normed mean value of the **Global Mental Health** (PROMIS) Score (μ=50; σ=10); the result was statistically significant (*z*=-9.10, *p*<.001, two-tailed).
* Z-test for means comparing the mothers' mean score (*M*=17.34, *SD*=7.28) to the normed mean value of the **PSS** for females (μ=13.7; σ=6.6); the result was statistically significant (*z*=12.18, *p*<.001, two-tailed).
Path Analysis:
* Greater maternal perceived stress (PSS) + presence of another teen/young adult (15-29 years) in the home with ASD/disability were associated with lower **Global Physical Heath** (T Score), R^2 =.33, *F*(2,482)=116.51, *p*<.001.
* Greater maternal perceived stress + presence of another teen/young adult (15-29 years) in the home with ASD/disability + male gender of the ASD teen/young adult were associated with lower **Global Mental Health** (T Score), R^2=.56, *F*(3,479)=199.47, *p*<.001.
* Lower Household Income + poorer General Health of the teen/young adult were associated with increased p**erceived stress ,** R^2=.11, *F*(2,477)=28.99, *p*<.001.
* Mother being part of a couple (married/unmarried), white, having at least a two-year college degree, and being employed were all associated with higher **Household Income**, R^2=.37, *F*(4,466)=69.26, *p*<.001.
* Greater independence on the W-ADL is associated with better **General Health** in the teen/young adult, R^2=.11, *F*(1,486)=57.07, *p*<.001.
* Greater severity of ASD in the teen/young adult, the presence of intellectual disability, and poorer verbal skills were all negatively associated with independence as measured by the **W-ADL**, R^2=.50, *F*(3,465)=153.53, *p*<.001.
Conclusions:
This combination of child, maternal and social factors is similar to that reported for mothers of younger children with ASD. Family-centered ASD programs are needed to effectively address this complex set of issues.

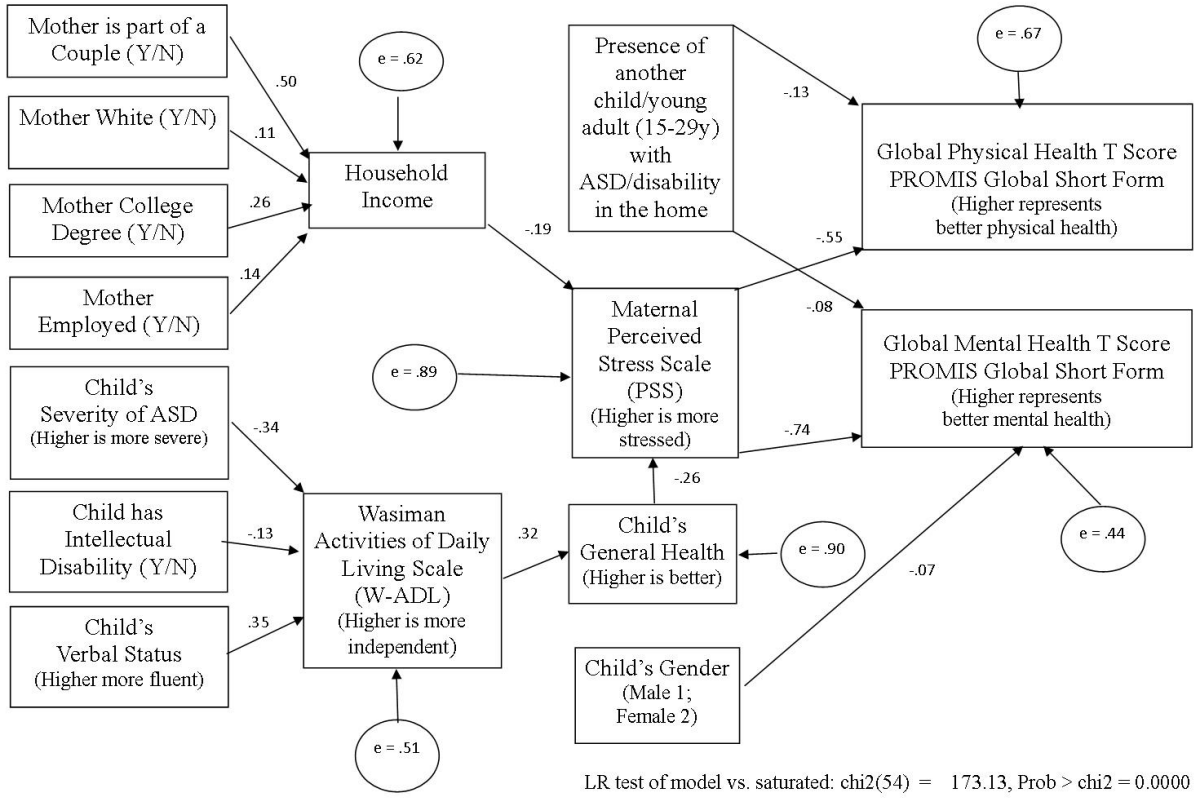


Figure 1 Path Analysis/Structured Equation Modeling

172 **181.172** Mindful Parenting: A New Approach to Supporting Parents of Children with Autism Spectrum Disorder

A. C. Voos[1], *T. Vernon*[1], *A. Navab*[2] *and E. McGarry*[3], *(1)University of California, Santa Barbara, Santa Barbara, CA, (2)University of California Santa Barbara, Los Angeles, CA, (3)Koegel Autism Center, University of California Santa Barbara, Santa Barbara, CA*

Background: Research has consistently demonstrated that parents of children with Autism Spectrum Disorder (ASD) experience elevated levels of stress when compared to parents of typically developing and developmentally disabled children (e.g. Hayes & Watson, 2013). High levels of stress have been associated with more negative parenting practices (Baydar et al., 2003), and eliminate the positive effects of intervention for young children with autism (Osborne et al., 2008). Historically, parent stress has been targeted through skills based parent training programs. While parent training can help support parents around the time of initial diagnosis (Keen et al., 2010), reports of elevated levels of stress persist in those who have received extensive parent training (e.g. Singh et al., 2006; 2014). Research also suggests that parent training may be less effective for parents experiencing high level of stress (Robbins, Dunlap & Pleinis, 1992). This combined with research demonstrating that stress related to having a child with autism tends to be chronic and persistent over time (Dyson, 1993) calls for additional support for these parents.
Mindfulness, or awareness that emerges through nonjudgmentally paying attention, on purpose, to the unfolding of experience in the present moment (Kabat-Zinn 2003), is associated with increased life satisfaction, decreased depression and anxiety, improved emotion regulation, and decreased experiential avoidance (Keng, Smoski & Robins, 2011). Due to the normative level of stress that comes with parenting in general, researchers have introduced mindfulness to parents. Mindful parenting has been utilized with parents of children with disruptive and externalizing behaviors, and developmental disabilities (e.g. Bogels et al., 2008). Results indicate that mindfulness training increased happiness for the individual with the disability (Singh et al., 2004), decreased child behavior problems (Singh et al., 2006; 2007), and decreased parental stress (e.g. Ferraioli & Harris, 2013). Importantly, research also demonstrates that for parents of children with autism specifically, higher levels of mindful parenting are associated with lower levels of parental distress (Beer et al., 2013) and improvements in parent-child interactions (Coatsworth et al., 2010).
Objectives: The current study aims to investigate whether an 8 week mindful parenting group for parents of children with ASD (based on the curriculum by Bogels & Restifo, 2014) will increase parents' mindfulness, as measured by the Five Facet Mindfulness Questionnaire (Baer et al., 2006: FFMQ), and decrease parenting stress, as measured by the Parent Stress Index (Abdin, 1990; PSI)
Methods: Two groups (n=14) met weekly for 90 minutes, during which time parents were introduced to a meditation and mindful parenting exercise, and discussed their patterns and experience of parenting stress. Preliminary pre-post data will be assessed using dependent measures t-test.
Results: After participation, parents demonstrated decreased total stress $t(13) = -2.29$, $p = .020$ and child related stress, $t(13) = -2.10$, $p = .028$. Parents did not demonstrate significant increases in overall mindfulness, but importantly, demonstrated an increase in nonjudgmental attitude towards themselves $t(13) = 2.69$, $p = .009$.
Conclusions: This preliminary data suggests that group mindfulness training may help to support parents of children with ASD by reducing overall stress and self-judgment about their own experiences.

173 **181.173** Minimal Risk of Internalizing Problems in Typically-Developing Siblings of Children with HFASD

J. D. Rodgers[1], *A. Warhol*[1], *J. D. Fox*[2], *C. A. McDonald*[1], *M. L. Thomeer*[1], *C. Lopata*[1], *A. M. Darrow*[1], *A. L. Szyszkowski*[1], *A. A. Biscotto*[1] *and T. Sheffield*[1], *(1)Institute for Autism Research, Canisius College, Buffalo, NY, (2)Abilities First, Poughkeepsie, NY*

Background: There is a paucity of research on internalizing difficulties of siblings of children with high-functioning autism spectrum disorder (HFASD). Reviews describe a limited and conflicted field of findings (Meaden et al., 2010; Orsmond & Setzer, 2007) for research on siblings of children on the autism spectrum across the range of functional levels. Only three studies of internalizing problems in TD siblings of children with HFASD are available and these are limited in quality. Specifically, all three available studies (Verté, Roeyers, & Buysse, 2003; Ross & Cuskelly, 2006; Rao & Beidel, 2009) used only parent report information from the CBCL. If sibling depression and anxiety are clinically elevated, developing interventions and increasing focus on these children would become a priority for community and school-based mental health providers.
Objectives: This group comparison study examined (1) symptom level differences in anxiety and depression between TD siblings of children with HFASD and TD siblings of children with TD siblings and (2) source differences between parent-rated and child self-reported anxiety and depression across these groups.
Methods: Eighty-four children, ages 6-16 were participants in the study. Within the total sample were two groups: 42 TD siblings of children with HFASD and 42 TD siblings of TD children. Participating TD siblings were matched on age, gender, and ethnicity. Groups were equivalent on parent education. The TD siblings from both groups had no identified developmental, psychiatric, or educational conditions other than anxiety or depression. The HFASD reference siblings had to have a WISC-IV short-form IQ > 70, VCI or PRI factor score > 80 and an independent diagnosis of ASD from a licensed physician or psychologist. A majority of reference siblings (33, 78.6%) also had ADI-R confirmation of the diagnosis. The *Behavior Assessment System for Children-2* (BASC-2; Anxiety and Depression clinical scales), parent (PRS) and child report (SRP) were

collected. Siblings of reference children with HFASD were recruited from a pool of families participating in psychosocial interventions for their sibling with HFASD. TD siblings of TD children were recruited through public advertisement.
Results: Comparison of TD siblings of children with HFASD to TD siblings of TD children indicated no significant multivariate effect between groups for parent-reported internalizing problems (Wilk's $\lambda = 0.997$, $F[1,82] = 0.119$, $p = 0.888$) or self-reported internalizing problems (Wilk's $\lambda = 0.982$, $F[1,82] = 0.724$, $p = 0.488$). Source differences indicated no within-group (parent vs. self) multivariate effect for siblings of HFASD children (Wilk's $\lambda = 0.980$, $F[1,82] = 0.829$, $p = 0.440$) or siblings of TD children (Wilk's $\lambda = 0.992$, $F[1,82] = 0.336$, $p = 0.715$).
Conclusions: The current study did not support an increased risk of internalizing problems (anxiety and depression) in the TD siblings of children with HFASD. This is strengthened by consistent levels of internalizing problems by source. The current result does not support a higher risk of internalizing symptoms for siblings of children with HFASD, though clinicians should maintain awareness of these children and attend to clinical warning signs if presented.

174 **181.174** Parent Expectancies: A Self-Fulfilling Prophecy?

C. Kang[1], *A. C. Holbrook*[1], *S. Y. Shire*[1], *T. Smith*[2], *R. Landa*[3], *A. Kaiser*[4], *A. Gulsrud*[5] *and C. Kasari*[1], *(1)University of California Los Angeles, Los Angeles, CA, (2)Division of Neurodevelopmental and Behavioral Pediatrics, University of Rochester Medical Center, Rochester, NY, (3)The Kennedy Krieger Institute, Baltimore, MD, (4)Vanderbilt University, Nashville, TN, (5)UCLA Semel Institute for Neuroscience & Human Behavior, Los Angeles, CA*

Background:
Parental beliefs and expectancies about their children's treatment may influence the overall outcome of treatment. This is because it is generally parents who provide consent for their children, determine their treatment participation, and manage attendance.
The Parent Expectancies for Therapy Scale (*PETS*, Kazdin & Holland, 1991) is a measure for assessing expectancies in parents of children treated for conduct disorder. Adapted versions of the *PETS* have been administered in several treatment studies for children with autism spectrum disorder (ASD). However, to our knowledge, analyses of the *PETS* and its correlates have not been conducted or validated with a sample of parents of children with ASD.
Objectives:
The current study determined the underlying factor structure of parent expectancies for parents of children with ASD using the *PETS*. Additionally, we examined the relationship between parent expectancies and parent participation in treatment.
Methods:
Participants:
The study is a secondary data analysis of three social communication intervention studies. Participants included 294 parents of preschoolers and toddlers with ASD.
Measures:
The *PETS* is a parent questionnaire that assesses the broad range of pre-treatment expectancies on a 5-point scale. The current study examined adapted versions of the *PETS* used across studies. The dataset only included questions that all three adapted scales had in common, leaving a total of 16 questions.
The Caregiver Quality of Involvement Scale (*CQIS*) is a therapist-rated, 4-item scale used to evaluate caregivers' levels of comfort, confidence, enthusiasm, and accuracy in implementing intervention strategies learned during parent training sessions. The *CQIS* was completed at the end of each parent training intervention session by the therapist.
Procedure:
An exploratory factor analysis (EFA) was conducted to determine the structure and relationships between variables of parent expectancies in the *PETS*. Data were analyzed using maximum likelihood with Comprehensive Exploratory Factor Analysis software. Composites of parent expectancies factors were then analyzed through correlations and linear regression with each of the parent involvement subscale scores.
Results:
The EFA revealed a four-factor structure, with latent factors related to credibility of treatment, belief in child improvement, parent involvement in treatment, and comparability to other treatments. Expectancies of treatment credibility were significantly correlated with all four components of parent involvement. Expectancies for child improvement were significantly correlated with three parent involvement subscales (comfort, confidence, accuracy). Regression analyses indicated that only expectation of child improvement significantly predicted level of parent comfort in implementing intervention during parent training ($F(1,180)=8.067$, $p=0.005$); all other regression analyses were nonsignificant.
Conclusions:
Parent pre-treatment expectancies pertaining to treatment credibility and child improvement were related to parents' involvement as rated by therapists. These findings indicate that credibility of treatment and belief in child improvement may be especially salient and motivating to parents of children with ASD. However, parent expectancies regarding their own involvement in treatment were not reflected in their involvement scores, highlighting that there may be additional factors influencing the predictive relationship between expectancies and involvement. As parent training in ASD intervention is a growing field, there is a need to better understand parent perspectives and experiences.

Table 1. Factor structure of the PETS

Item	Description	Factor 1 Credibility	Factor 2 Child Improvement	Factor 3 Parent Involvement	Factor 4 Comparison to Other Treatments
11	I believe this treatment will be valuable in treating areas of concern that I have for my child.	.71			
9	I believe that this treatment sounds reasonable for the difficulties that I have been experiencing with my child.	.68			
12	I believe this treatment will improve my child's adjustment at home or at school.	.59			
15	I believe the therapy described will be worthwhile.	.50			
6	I believe that all the information that I give out will be confidential.	.44			
*13	I believe this treatment will make my child worse.	.41			
1	How much do you believe the treatment will help you in being a parent?	.36			
7	Once therapy begins, I believe that my child will improve.	.35	.49		
4	I believe that my child will improve quickly.		.83		
*5	I believe that it will take a long time for my child to improve.		.58		
2	How much time do you think you will have to spent outside of sessions on task or activities related to treatment?			.76	
16	I believe I will have to do a lot of work outside of the sessions in order for my child to improve.			.52	
3	How much of a role do you believe that you will have in your child's treatment?			.35	
17	How will this treatment compare in effectiveness with medical treatment (e.g., medication) for your child?				1.00
18	How will this treatment compare in effectiveness with your own attempts at dealing with areas of concern you have for your child?				.38
**10	I believe that I will be motivated to work in this type of treatment with a therapist.				

* reverse-coded in analysis
** deleted from analysis

175 **181.175** Parent Perceptions of an Adapted Evidence Based Practice for Toddlers with Autism in a Community Setting

S. R. Rieth[1], *A. C. Stahmer*[2], *L. Brookman-Frazee*[3] *and T. Wang*[4], *(1)San Diego State University, San Diego, CA, (2)University of California at Davis MIND Institute, Sacramento, CA, (3)Autism Discovery Institute at Rady Children's Hospital – San Diego, San Diego, CA, (4)University of California, San Diego, La Jolla, CA*

Background:
Although data from parent-implemented Natural Developmental Behavioral Interventions (NDBIs) have shown positive effects on decreasing core symptoms of autism, there has been limited examination of the effectiveness of NDBIs in community settings. Additionally, parent perspectives of their involvement in parent-implemented early intervention have not been well studied. Project ImPACT is an NDBI that teaches families techniques to improve child social engagement, language abilities, imitation skills, and play (Ingersoll & Dvortscak, 2010). Rigorous single-subject methodology demonstrates children receiving Project ImPACT demonstrate gains in targeted skills, and parents use the intervention with fidelity in research settings.
Objectives:
The purpose of the current study is to examine parent perspectives and the initial impact on parent behaviors of Project ImPACT for toddlers at-risk for ASD when delivered by community providers. Specifically, mixed quantitative and qualitative methods were used to assess (1) observed changes in parent use of strategies to facilitate their child's social communication skills following community-implemented Project ImPACT; and (2) parent perceptions of effectiveness and feasibility of Project ImPACT.
Methods:
Participants included thirteen parents and their children with risk for ASD, recruited from four community-programs. Primary eligibility criteria included referral to a community provider trained in Project ImPACT and a child with a diagnosis of ASD or risk for ASD who was under 24 months of age at intake. Mean child age at intake was 15 months (*SD*= 3.01; range = 8-21 months) and a majority (76%) of families self-identified as Caucasian.
All families received a 12-week Project ImPACT curriculum to support their use of strategies to facilitate interaction and skill building in their children during daily routines and activities. Measures utilized for the current study included parent fidelity of implementation as rated by the research team, a satisfaction survey completed by the parents at the end of intervention, and qualitative, semi-structured exist interview completed with the parents by a member of the research team.
Results:
Significant improvements in parents' overall fidelity were observed from baseline (*M*=3.13) to 12 weeks (*M*=3.77; p< .01). Twenty percent of parents were considered to have met overall fidelity at baseline compared to 90% of parents at 12 weeks. Parent improvement on individual strategies will be examined and discussed.
Parents reported overall high satisfaction with the intervention (*M*=6.46; *SD*= .41; range = 5.7-7, out of 7 possible). Parent responses in the interviews also supported that general satisfaction was very high; all parents indicated they "believed" in the approach. Results will be described based on the emergent interview themes related to the parent coaching process, impressions of the intervention, and impact of the intervention on their own and their child's behavior.
Conclusions:
Findings from both qualitative and quantitative data indicate that parents had very positive perceptions of the feasibility, utility, and effectiveness of Project ImPACT when implemented by community early intervention providers. Further, observational data indicate that parents were able to learn and implement the Project ImPACT strategies in the relatively brief 12-session intervention period. Implications for the feasibility of adopting a parent-implemented treatment program will be discussed.

176 **181.176** Parent and Teacher Reported Child Characteristics Related to Parenting Stress in ASD

T. Ward[1], *T. Estrada*[1], *E. A. Lovell*[1], *R. Kramer*[1] *and B. Wilson*[2], *(1)Seattle Pacific University, Seattle, WA, (2)Clinical Psychology, Seattle Pacific University, Seattle, WA*

Background:
Parents of children with autism spectrum disorder (ASD) report higher parenting stress than parents of typically developing (TD) children (McStay et al., 2014). Research suggests children with ASD have more externalizing behaviors and lower adaptive functioning than TD peers (Towle et al. 2014), both of which predict higher parenting stress in this population (Hall, 2011; McStay et al., 2014). Further, agreement between parent-teacher ratings of behavioral and adaptive skills vary (Lane, Paynter, & Sharman 2013) and not entirely attributable to differential sample environments (Reed & Osborne 2013). This study helps elucidate the child characteristics related to parenting stress.
Objectives:
The purpose of this study was to examine how child behaviors influence stress in parents of children with ASD and to determine if there are differences among parent and teacher reports.
Methods:

Our sample included 138 children (ages 3:1 to 6:11), their parents, and their teachers. Eighty-one TD children (45% female) and 57 children with ASD (23% female) were examined. Intensity and frequency of parenting stress was measured using the parent-reported Parenting Events Questionnaire (Crnic & Greenberg, 1990). Externalizing behaviors and adaptive functioning was measured using parent- and teacher-reported Behavior Assessment System for Children (*BASC-2*; Reynolds, & Kamphaus, 2004).
Results:
Two separate serial mediation models were conducted using the SPSS macro PROCESS (Hayes, 2008), which provided bootstrapped estimates of the indirect effects based on 5000 resamples. In the parent report mediation model, results indicated status was positively associated with parent-reported externalizing behaviors (B = 8.03, $p < .001$) and negatively associated with parent-reported adaptive skills (B = -9.94, $p < .001$). The direct effect of status on parenting stress was not significant (B = -3.45, $p = .42$). Results supported the mediating role of the child's externalizing problems ($B = 6.28$, CI_{95} = 2.52 to 12.85) and the mediating role of the child's adaptive skills (B = 4.29, CI_{95} = .75 to 8.84) in the association between status and parental stress. Additionally, the results indicated that, compared to TD children, children with ASD had greater externalizing problems, which predicted lower adaptive skills and associated with higher parental stress (B = 1.62, CI_{95} = .39 to 3.80). An identical teacher report mediation model revealed a nonsignificant indirect effect of externalizing problems (B = 3.81, CI_{95} = -1.028 to 8.36) and the mediating role of the child's adaptive skills (B = 2.40, CI_{95} = -.16 to 6.42). Figures 1 and 2 display these results.
Conclusions:
Our results suggest greater parenting stress in parents of children with ASD occurs through a serial mediated pathway such that higher parent-reported externalizing behaviors predicted lower parent-reported adaptive functioning which predicted increased parental stress. However, when using teacher-reported externalizing behaviors and adaptive functioning, this association was no longer significant. Future research should explore if the differences in parent and teacher report of child behaviors indicate a true difference between parental and teacher perceptions of behaviors and how these perceptions may perpetuate or alleviate parent stress.

Figure 1. Parenting stress on parent reported child externalizing problems and adaptive skills

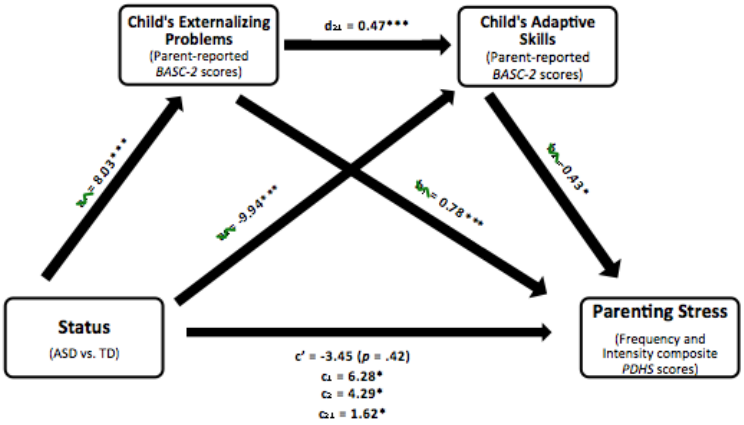
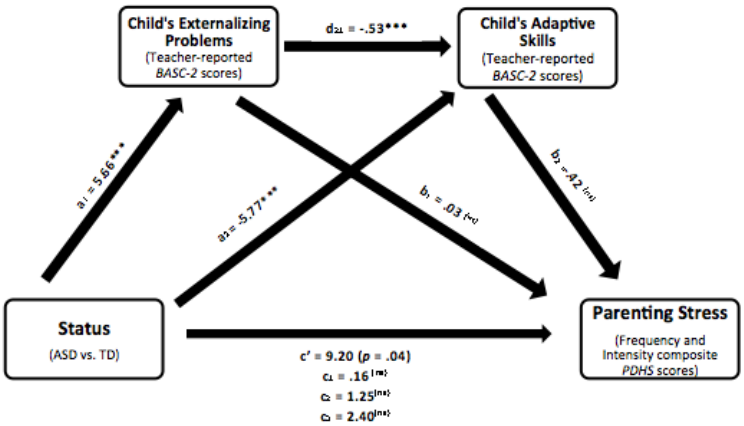


Figure 2. Parenting stress on teacher reported child externalizing problems and adaptive skills

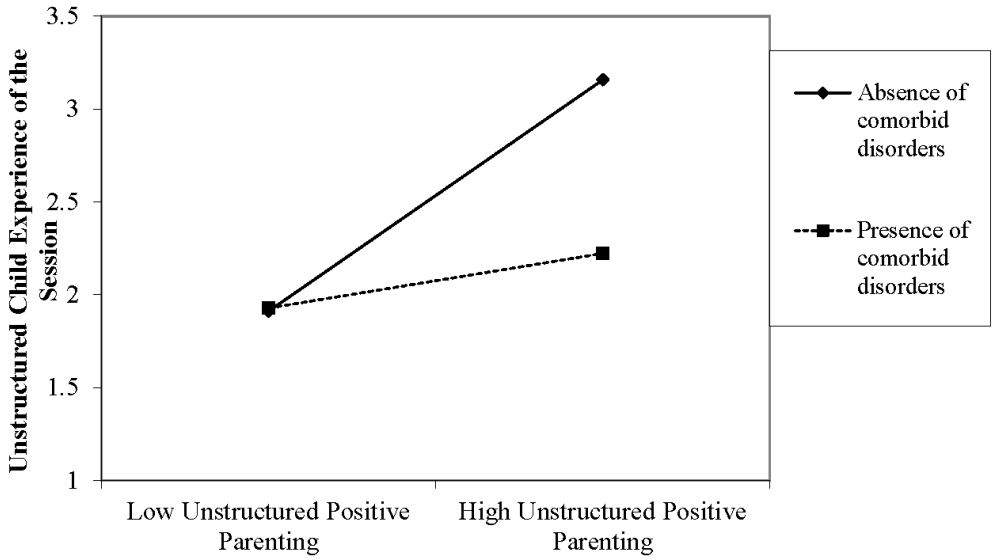


177 **181.177** Parent-Child Interaction in Children with Autism Spectrum Disorder Who Vary in Symptom Severity and Level of Functioning

L. J. Donnelly[1], *M. R. Brassard*[2], *A. Kolevzon*[1], *J. M. Jamison*[1] *and E. Fourie*[1], *(1)Psychiatry, Seaver Autism Center for Research and Treatment at the Icahn School of Medicine at Mount Sinai, New York, NY, (2)School Psychology, Health and Behavior Studies, Teachers College, Columbia University, New York, NY*

Background: Parenting children with autism spectrum disorder (ASD) is understood to be extremely stressful and presents unique challenges. Research with typically developing (TD) children suggests that parent-child relationship difficulties and ineffectual/negative parenting practices are likely to exist in the context of high parental stress and child behavior problems. However, few studies have examined the full continuum of parenting behaviors in families of children with ASD.
Objectives: To examine three well-established components of parenting (emotional support, instruction/patience, and negative parenting) using a parent-child interaction task in a sample of children with ASD and a parent or caregiver.
Methods: Thirty children with ASD were included in this study (ages 5-12; racially and ethnically diverse sample). Diagnostic symptoms were assessed using the Autism Diagnostic Interview – Revised and the Autism Diagnostic Observation Schedule, Second Edition. The parent-child interaction was assessed using the Psychological Multifactor Care Scale – ASD Adapted Version (PMCS-ASD; Donnelly, Brassard, & Hart, 2014; Brassard, Hart, & Hardy, 1993); making this study the first time the PMCS-ASD was adapted for use in this population. Sessions were coded by independent raters for both child and parent behaviors. Through observations, two positive parenting factors were assessed: emotional support (e.g., displaying a supportive presence, praising, encouraging, calming, and warmth) and patience (e.g., scaffolding, guidance, limit setting, and positive affect). One negative parenting factor was also assessed (e.g., negative talk, interfering with materials or learning, lack of instruction, & absence of emotional support). Additionally, coders rated the child's experience of the session (e.g., observed success and competence, positivity of interactions) and child negativity towards the caregiver during the parent-child interaction. Correlational and regression analyses were conducted.
Results: Parents and caregivers of children with ASD demonstrated high rates of positive parenting and low rates of negative parenting. Similar to what has been reported in TD children (e.g., Brassard et al., 1993; Patterson et al., 1990; Webster-Stratton & Eyberg, 1982), children with ASD acted more negatively towards their parents when negative parenting was exhibited in the structured task (r_S=.433, p<.05). Positive parenting was positively correlated with the degree to which children were observed to have a good experience of the session (b=.671, p<.001), and this relationship was moderated by comorbidity of other disorders (mostly ADHD) in the unstructured session (b=-.513, p<.05), such that children without comorbid disorders were observed to have better experiences in the session when their parents exhibited greater amounts of positive parenting. The presence of comorbidity was also associated with the degree to which parents exhibited patience during the structured task (b^*=-.469, p<.01). Parents of children without comorbid diagnoses displayed higher levels of patience (r=-.538, p<.01) and less negative parenting (r=.471, p<.01).
Conclusions: Findings of high levels of positive parenting and low levels of negative parenting suggest that, despite challenging behaviors associated with ASD, parents of children with ASD generally display supportive and flexible parenting. However, the presence of comorbid diagnoses can negatively impact the parent-child relationship. Future directions include clarifying moderators of the parent-child relationship and developing tools to better support parents.

Figure 1. *Graph of the interaction between Unstructured Positive Parenting and Comorbid Disorders on Unstructured Child Experience of the Session*



Note. N=29; Absence of comorbid disorder n = 20 (this represents children only diagnosed with ASD or diagnosed with ASD and Intellectual Disability (ID)), Presence of comorbid disorder n = 9 (this represents children diagnosed with ASD and other comorbid disorders, including children diagnosed with ID if they were also diagnosed with other comorbid disorders).

178 **181.178** Parent-Teacher Communication about Children with Autism Spectrum Disorder: An Examination of Collaborative Problem-Solving

G. Azad[1], *M. Kim*[1], *D. S. Mandell*[1] *and S. Sheridan*[2], *(1)University of Pennsylvania School of Medicine, Philadelphia, PA, (2)University of Nebraska-Lincoln, Lincoln, NE*

Background: Parent-teacher communication is an essential component to establishing and sustaining successful family-school partnerships (Cheatham & Ostrosky, 2011; Dunst, 2002). One aspect of effective communication is the ability to problem-solve when presented with a student concern (Allen & Blackston, 2003). The extent to which parents and teachers problem-solve may be as important as any direct intervention for children with Autism Spectrum Disorder (ASD). There are numerous opportunities for parents and teachers of children with ASD to problem-solve, such as parent-teacher conferences and Individualized Education Program (IEP) meetings. However, a large percentage of families reported feeling dissatisfied during these interactions with school staff (Lake & Billingsley, 2000). Schools continue to struggle in creating consistent, reliable, two-way communication systems, particularly with low-income, minority families (Lo, 2008; Tucker & Schwartz, 2013). However, limited studies have examined the interactions between parents and teachers of children with ASD. There is a pressing need to investigate parent-teacher communication, particularly with regard to problem-solving behaviors.

Objectives: The purpose of this study was to examine the problem-solving behaviors of parents and teachers of children with ASD. Our aims were: 1) To examine the extent to which parents and teachers engaged in problem-solving behaviors when discussing students' concerns; 2) To examine differences between parents' and teachers' problem-

solving behaviors; and 3) To examine whether reported problem-solving behaviors differed from observed problem-solving behaviors.
Methods: Participants included 18 kindergarten-through-fifth grade autism support teachers and 39 parents of children with ASD. A majority of the teachers were female (89%) with an average age of 36 years (SD = 11.3); 83.3% identified as White. Parents were primarily mothers (95%) who averaged 34.9 years of age (SD = 6.2); 56.4% identified as African American/Black. Parent-teacher dyads were prompted to discuss and provide a solution for a problem that a student experienced at home and at school. Parents' and teachers' problem-solving behaviors were coded using the Engagement in Consultation Scale – Observer Form Revised (Sheridan et al., 2005). Parents and teachers self-reported on their problem-solving behaviors using the Parent/Teacher Participation in Problem-Solving Scales, respectively.
Results: Analyses included paired sample t-tests and McNemar's tests. Results showed that parents and teachers displayed low levels of the core elements of problem-solving. However, teachers were observed to display more problem-solving behaviors compared to parents. Generally, both groups reported engaging in more problem-solving behaviors than they were observed to display during the dyad observation.
Conclusions: The results from the present study were consistent with prior investigations examining communication between parents and teachers. Our findings suggest that teacher and parent training programs should include collaboration and positive approaches to problem-solving. A better understanding of how to support parent-teacher communication may empower family-school partnerships, and ultimately, outcomes for children with ASD.

179 **181.179** Parental Stress in Families with 16p11.2 Duplications and Deletions with and without ASD

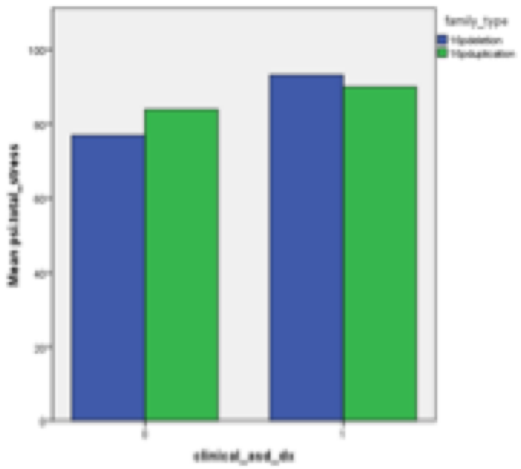
T. Ward[1], *M. Frye*[2], *C. M. Hudac*[3], *J. Gerdts*[3], *F. K. Miller*[4], *R. Kincade*[5], *R. Bernier*[3], *E. Hanson*[6], *R. P. Goin-Kochel*[7], *J. E. Spiro*[8] *and W. K. Chung*[9], *(1)University of Washington Autism Center, Seattle, WA, (2)University of Washington, Psychiatry and Behavioral Sciences, Seattle, WA, (3)University of Washington, Seattle, WA, (4)Mary A. Rackham Institute (MARI), University of Michigan, Ann Arbor, MI, (5)University of Washington Psychiatry and Behavioral Sciences, Seattle, WA, (6)Children's Hospital Boston, Boston, MA, (7)Baylor College of Medicine, Houston, TX, (8)Simons Foundation, New York, NY, (9)SFARI, Simons Foundation, New York, NY*

Background:
Extant literature indicates parents of children with autism spectrum disorders (ASD) experience higher levels of parenting stress than parents of children with other disabilities and typically developing children (Dumas, et al., 1991). ASD related deficits in social and behavioral functioning are the factors associated with overall parenting stress (Davis & Carter, 2008). Given the incidence of 16p11.2 duplications and deletions implicated in ASD (Sanders et al., 2011), knowledge related to parental stress in families in this population with copy-number variations (CNVs) and ASD is needed.
Objectives:
The current study aimed to examine parental stress for parents of children 16p11.2 duplications and deletions with and without ASD from the well characterized Simons VIP sample (Simons VIP Consortium, 2012). Additional child phenotypic variables were examined in this population.
Methods:
Our analysis included parent and child data from probands with 16p11.2 duplications (n = 107) and deletions (n = 113), ages 10 months to 23 years 5 months and their parents. Of the probands examined, 36 had a diagnosis of ASD (assessment using ADOS-2, ADI and DSM-IV criteria). Parental stress was measured by the Parenting Stress Index (PSI; Abidin, 1990) total score. Child factors, including internalizing and externalizing t-scores from the Child Behavior Checklist (CBCL; Achenbach, 1991) and Full Scale IQ Standard Score from the Differential Ability Scale for Children (DAS; Elliot, 1990) were examined.
Results:
A 2 (ASD diagnosis, fixed, between groups) x 2 (CNV status, fixed, between groups) factorial ANOVA on parental stress showed a significant effect of ASD on parental stress, $F(1,213) = 7.416$, $p = .007$, $\eta^2 = .033$. There was no main effect of CNV status and no significant interaction between CNV status and ASD, indicating significantly higher levels of stress in parents with children diagnosed with ASD regardless of CNV type (see Figure 1). In children with ASD and 16p11.2 deletions there was strong positive correlations between externalizing behaviors and parental stress, $r = .61$, n = 23, p = .003; internalizing behaviors and parental stress $r = .49$, n = 23, p = .018; and no correlation between IQ and parental stress. No significant correlations were found in children with ASD-16p11.2 duplications. See Table 1 for correlations.
Conclusions:
Results indicate significantly elevated stress in parents with children ASD regardless of 16p11.2 duplication/deletion status. This suggests, that even when strongly controlling for etiological factors within a biologically defined group, it is ASD-associated behaviors and symptoms that are playing a strong role in parental stress. We further examined variables that have been previously associated with parental stress in the ASD population. These correlations revealed significant associations of parental stress in the ASD-deletion group and non-ASD-deletion/duplication groups with externalizing and internalizing behavior. Small sample size is likely driving the nonsignificant correlations of the ASD-duplication group (n=12), as it appears that many factors contribute to the complexity of parental stress in this population. Future research should examine parent-child traits that serve to precipitate, perpetuate and protect parental stress in this unique population affected by 16p11.2 CNVs.

Table 1. Correlations between CNV type, diagnosis, parental stress and child variables

		Variables	1	2	3	4
16p Deletion	No Autism					
		1. Total Stress	--			
		2. Full Scale IQ	-.15	--		
		3. Externalizing Behaviors	.45**	-.28*	--	
		4. Internalizing Behaviors	.46**	-.31*	.65**	--
16p Deletion	Autism					
		1. Total Stress	--			
		2. Full Scale IQ	-.11	--		
		3. Externalizing Behaviors	.60**	-.24*	--	
		4. Internalizing Behaviors	.49*	-.34*	.26	--
16p Duplication	No Autism					
		1. Total Stress	--			
		2. Full Scale IQ	-.29*	--		
		3. Externalizing Behaviors	.81**	-.47**	--	
		4. Internalizing Behaviors	.43**	-.34**	.66**	--
16p Duplication	Autism					
		1. Total Stress	--			
		2. Full Scale IQ	-.25	--		
		3. Externalizing Behaviors	.36	.37	--	
		4. Internalizing Behaviors	.39	.26	.45	
		*p<.05				
		**p<.01				

Figure 1. Mean parental stress scores by CNV type



180 **181.180** Parenting Children with ASD and Children with Anxiety Disorders: The Relationship Between Parental Stress, Anxiety, and Parenting Style and Child Symptom Presentation

C. A. Paisley, *S. M. Abdullahi, M. L. Braconnier, W. Silverman and P. E. Ventola, Yale Child Study Center, Yale School of Medicine, New Haven, CT*

Background: Extant literature illustrates higher stress in parents of children with autism spectrum disorder (ASD) than those with other developmental disabilities and those with typically developing (TD) children. Child symptom severity, externalizing symptoms, parent-child relationships, and parent support have been shown to contribute to this increased stress, although results vary.

Objectives: We examined differences in parental stress and symptoms of psychopathology between three groups: parents of TD children, parents of children with anxiety disorders, and parents of children with ASD. This is the first study to examine differences between parents with children with ASD and parents of children with anxiety disorders and how child variables may differentially influence parenting stress and psychological functioning.

Methods: Participants included mothers or fathers of 47 children with ASD, 23 parents of TD children, and mothers of 101 children with anxiety disorders (e.g. generalized anxiety disorder, specific phobia, and selective mutism). Children were between 4 and 16 years of age. Parenting stress was assessed was using the Parental Stress Index-4th Edition (PSI-4), and symptoms of anxiety and depression were examined using the Beck Anxiety Inventory (BAI) and Beck Depression Inventory- Second Edition (BDI-II) respectively. To address parenting behaviors, parents completed the Parent's Report of Parental Behavior Inventory (PRPBI). Childhood anxiety and autism symptom severity were evaluated with the SCARED, CASI, and SRS, respectively.

Results: Parents of typically developing children and parents of children with ASD and anxiety disorders reported similar levels of anxiety and depressive symptoms, as assessed using the BAI and BDI-III. However, parents of children with ASD reported significantly higher levels of parenting stress than parents of typically developing children ($p < 0.05$). In both clinical groups, child anxiety symptom severity correlated significantly with parent anxiety symptom severity ($r=0.460$, $p < 0.01$ for ASD group; $r=0.219$, $p< 0.03$ for anxiety group).

In terms of parenting behaviors, as assessed using the PRPBI, parents of children with anxiety disorders reported higher levels of acceptance and firm control (the degree to which parents use strict discipline to control their child's behavior), as compared to parents of TD children or children with ASD ($p < 0.01$). In the children with anxiety disorders, child anxiety symptoms were positively correlated with parent acceptance, firm control, and psychological control (e.g. guilt or intrusiveness). In the children with ASD, social communication symptom severity, as assessed by the SRS, was negatively correlated with parent acceptance and psychological control.

Conclusions: Parents of children with ASD experience a high level of parenting stress; however symptoms of anxiety and depression are comparable to parents of TD children and parents of children with anxiety disorders. Child symptom presentation, though, is correlated with parent anxiety symptoms as well as parenting behaviors in both clinical groups.

The challenge of parenting a child with a developmental disability or psychiatric disorder cannot be understated, and it may lead to distinct parenting styles, views, and approaches. Continued work will further elucidate this relationship with the overall goal of developing more effective strategies for parents of children with disabilities,

particularly ASD.

181 **181.181** Parenting Work and Trajectories of Care – How Parents Develop a Sense of Personhood and Future Possibilities for Children with Autism

***J. S. Singh**, School of History and Sociology, Georgia Institute of Technology, Atlanta, GA*

Background:
Caring for and loving a child with autism can be an emotional journey for parents due to the many ambiguities and uncertainties tied to the diagnosis and potential for long-term care. There is also a limited understanding of the causes and no clear consensus on the most effective treatments and developmental outcomes. In the face of these many unknowns, parents must proactively adjust to an alternative destination, lead by love and determination, as well as hope for themselves, their family, and their child's future.
Objectives:
The purpose of this study is to investigate the ways in which parents rearticulate the meaning of autism to establish a sense of personhood for their child and possibilities for their future.
Methods:
This study is based on in-depth interviews with parents who have a child diagnosed with autism in the U.S. Twenty-three families were interviewed from May 2009 – October 2012. Nineteen family interviews consisted of the mother only and four family interviews consisted of both the father and mother. The data was analyzed using grounded theory methods in order to develop and refine ideas based on responses to questions that addressed parents' experiences of raising a child with autism and how they adjusted to limits place on their child and the uncertainties of the future.
Results:
Parents conducted a range of biographical work in order to maintain a positive identity of their child who does not fit the normative expectations of our society. At the diagnostic phase, parents had to first resist the narrow boundaries of what to expect in a child with autism. They did this by creating a range of positive expectations and opportunities for their children to grow mentally and emotionally. Second, these parents challenged and shaped their child's sense of personhood beyond the clinical diagnostic boundaries of autism by emphasizing various qualities and skills embodied by their child. As their children grew older, parents also described how they had to readjust their own expectations by focusing on ways to help their children be happy and able to care for themselves in the future.
Conclusions:
The experiences of how parents manage the daily and life long expectations of their child with autism are important perspectives, especially as the number of children diagnosed with ASD continues to increase. In the U.S., there are limited services once children with autism reach adulthood, making the impact on parents and caregivers of people with autism an important health policy issue. The data presented in this study offers a glimpse of the invisible work conducted by parents who challenge and negotiate the limits placed on their child and the types of work they conduct to create futures that only they can imagine. Parents are integral to the daily life and futures of children with autism and this study begins to acknowledge how specialized and important this type of work is toward shaping autism trajectories.

182 **181.182** Past, Present, and Future Self-Concepts in Undergraduates with ASD and Other Disabilities in Relation to Chronic Bullying and Use of Labels in Disclosure

***D. DeNigris**[1], P. J. Brooks[2], R. Obeid[3], C. Shane-Simpson[4], S. Shnaidman[5], E. Wawrzonek[6], W. Long[6], B. Cheriyan[6], J. D'Onofrio[7] and K. Gillespie-Lynch[8], (1)The Graduate Center & College of Staten Island, CUNY, New York, NY, (2)College of Staten Island, Staten Island, NY, (3)CUNY Graduate Center, New York, NY, (4)The Graduate Center & College of Staten Island, New York, NY, (5)Staten Island Technical High School, Staten Island, NY, (6)The College of Staten Island, CUNY, Staten Island, NY, (7)Center for Student Accessibility, City University of New York, College of Staten Island, Staten Island, NY, (8)CUNY Graduate Center, Brooklyn, NY*

Background: Although more students with ASD are entering college (Van Bergeijk et al., 2008), they have lower graduation rates than students with other disabilities (Newman et al., 2011). Despite challenges (Van Hees et al., 2014), many undergraduates with ASD do not disclose their disability to obtain accommodations (Newman et al., 2011). A history of bullying may contribute to disclosure decisions. Youth with ASD often experience bullying (Schroeder et al., 2011) and those who are bullied have difficulties trusting others (Humphrey & Symes, 2010). Adolescents with ASD who negatively define themselves and their disabilities may do so due to negative feedback from others (Humphrey & Lewis, 2011). Although emerging evidence suggests that bullying may continue into college (Gelbar et al., 2014), little is known about the degree to which bullying affects undergraduates with ASD in particular.
Objectives: We examined identity formation in undergraduates with ASD and other disabilities by relating a novel measure of identity (6-word autobiographies) to past and current bullying experiences and disability disclosure. We explored how the valence of 6-word self-descriptions changed over time (past: 5 years before college, present, future: 5 years after college) in relation to bullying and disability.
Methods: Undergraduates with ASD (n=12) or other disabilities (OD; n=6) were asked to provide six terms describing their past, present, and future selves, and to answer questions about bullying, disclosure, and college-related challenges. Students completed the SRS-2 (Constantino & Gruber, 2012), Spielberger (1983) STAI, and Rosenberg (1965) Self-Esteem Scale. Interviews were coded for valence of self-descriptions, presence and type of bullying, disclosure decisions, and challenges.
Results: No differences in responses based on disability status (ASD vs. OD) were observed. Most students reported having been bullied (75% ASD; 100% OD), with chronic, repeated bullying common (50% ASD; 83% OD). Bullying at college was reported by 57% of students with ASD and 60% with OD. Most students voluntarily disclosed diagnoses during the interview (58% ASD; 83% OD). Most reported academic (92% ASD; 67% OD) and non-academic (67% ASD; 67% OD) challenges. Students self-descriptions shifted from more negative to more positive from past to present to future, $F(2,34)=27.307$, $p<.001$. The magnitude of this shift was greater among chronically bullied students, $F(2,32)=6.164$, $p=.005$, who described their past-selves more negatively ($p=.013$) and present-selves more positively ($p=.040$) than their peers. Students who were chronically bullied were more likely to label their disability ($p=.013$). Bullying was not associated with self-reported symptoms, anxiety or self-esteem.
Conclusions: Students' experiences of chronic bullying impacted their perceptions of past and current selves. Findings suggest that negative perceptions of past selves who were chronically bullied give way to more positive self-perceptions when bullying becomes reduced in college. Students who were chronically bullied may label their disability to increase others' understanding. Bullying and other challenges were similar across college students with ASD and students with others disabilities, suggesting that a universal-design approach might benefit students with ASD and other disabilities.

183 **181.183** Positive and Negative Experiences of Mothers with Autism

***A. L. Pohl**, S. K. Crockford, C. Allison and S. Baron-Cohen, Autism Research Centre, University of Cambridge, Cambridge, United Kingdom*

Background: There is little awareness of parenthood as an identity and social role for adults with autism. The sensory, cognitive, and social aspects of autism impact individuals throughout the lifespan, but the experience of parenting in mothers with autism has not been addressed. We therefore sought to explore this, both to highlight areas of strength and to uncover areas of vulnerability.

Objectives: To explore the experiences of mothers with autism in the following areas: (1) pregnancy, childbirth and the postpartum period, (2) self-perception of parenting strengths and weaknesses, (3) communication with professionals in relation to one's child, (4) social experience of motherhood, including disclosing one's diagnosis of autism in a parenting context, and (5) interactions with social services and the family courts in the UK.

Methods: We used a community-based participatory research model, and recruited an advisory panel of mothers with autism. We co-developed and disseminated an anonymous, online survey for mothers with autism. We recruited 325 mothers with autism, and, for comparison, 91 mothers who did not have autism, but had a child with autism.

Results: Mothers with autism and comparison mothers were similar in age and marital status. There were differences in education (X^2=15.301, p<0.01), gender identity (X^2=9.354, p<0.01), and age at first birth (t=2.3482, p=0.02) between the groups. Mothers with autism were more likely to have experienced pre- (X^2=13.772, p<0.01) or postnatal (X^2=7.4339, p=0.02) depression. Mothers with autism reported greater difficulties in areas of parenting such as multitasking (X^2=43.417, p<0.001), coping with domestic responsibilities (X^2=30.355, p<0.001), and creating social opportunities for their child (X^2=7.8881, p<0.01). Communicating with professionals about their child was stressful for mothers with autism. Mothers with autism were more likely to report feeling misunderstood by professionals (X^2=18.356, p<0.001), greater anxiety (X^2=32.751, p<0.001) and selective mutism (X^2=39.679, p<0.001), and not knowing which details were appropriate to share with professionals (X^2=36.752, p<0.001). Mothers with autism were more likely to find motherhood an isolating experience (X^2=4.8558, p=0.03), worry about others judging their parenting (X^2=12.001, p<0.001), and feel unable to turn to others for support in parenting (X^2=14.717,p<0.001). Mothers with autism and mothers of children with autism were equally likely to have had contact with social services in the UK, with similar outcomes. Disturbingly, approximately 1 in 5 mothers of a child with autism, regardless of maternal diagnosis, were assessed by social services; of those, 1 in 6 had their child compulsorily placed for adoption. Finally, rates of allegations and investigations of suspected fabricated illness amongst children with autism and their siblings were two orders of magnitude higher than the known incidence the UK.

Conclusions: Mothers with autism would benefit from far more and better tailored support. Allegations of fabricated illness, and high rates of surveillance by social services suggest there may be discrimination towards mothers with autism. The stigma associated with autism may be a barrier to accessing services. Further research should

consider the mental health implications of being a mother with autism. There is a clear need for more and better autism awareness within the UK.

184 **181.184** Post-Diagnosis Family Experiences in a Pre-Elementary Age Population

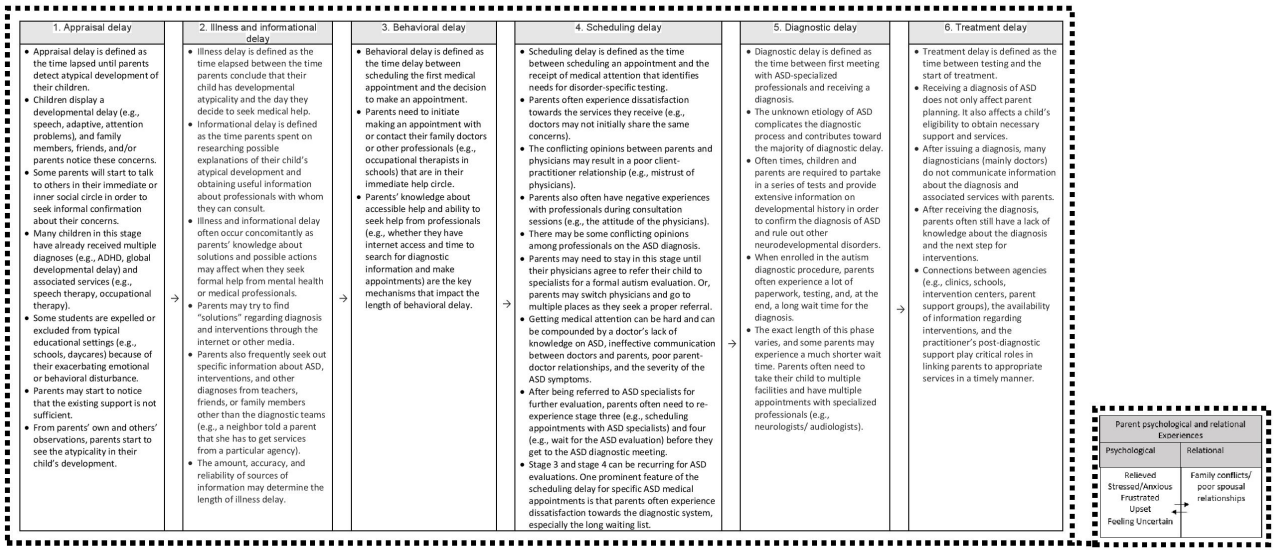
P. F. Turcotte[1], *L. J. Shea*[2], *G. Vivanti*[3] *and D. L. Robins*[4], *(1)A.J. Drexel Autism Institute, Cherry Hill, NJ, (2)A.J. Drexel Autism Institute, Philadelphia, PA, (3)Olga Tennison Autism Research Centre, Melbourne, Australia, (4)Drexel University, Philadelphia, PA*

Background: Recognizing autism spectrum disorder (ASD) in children as early as possible is critical to putting in place proper supports and referral services. After a diagnosis, coordinating those services and navigating complex service systems has been shown to impact child development as well as family life.
Objectives: The objectives of this study are twofold: 1) Examine associations among socio-economic variables, and post-ASD diagnosis access to services, and 2) Determine how families' workforce participation is impacted following an ASD diagnosis.
Methods: Survey data from a statewide ASD-specific needs assessment was used for this study. Respondents included 279 parent/caregivers with a child with ASD who was pre-elementary school age. The survey included detailed questions on family experience before, during and after an ASD diagnosis. Chi-square tests of significance were conducted to determine differing distributions among variables of interest.
Results: Most (82.7%) respondents were White/Caucasian. Average age of the child was 4.5 years old and 80.3% were male. Over half (60.1%) of parents were college educated with a diverse range of household incomes in the sample; 31.4% earned less than $40 thousand, 32.6% earned $40-$79 thousand, and 36% earned $80 thousand or more. Most (72%) children were referred to Early Intervention services after receiving a diagnosis of ASD. Minority children were referred to Early Intervention at a significantly higher proportion (87.5% compared to 68.7% of White/Caucasian children, p = .008). Less than half (48%) of children who received an ASD diagnosis had a referral for a follow up appointment with their physician. There were no significant differences across major demographic variables (including race/ethnicity, parental education, and family income) in terms of referral to follow up appointments. After the ASD diagnosis, most families (82.1%) decreased work hours or stopped working outside the home. Preliminary analysis shows no significant difference in workforce participation after an ASD diagnosis among demographic variables.
Conclusions: The period of time following an ASD diagnosis is critical and has ramifications for long-term outcomes in children. Often, the ASD service system is complex and difficult to navigate for parents with newly diagnosed children. Our sample shows interesting distributions of post-diagnosis experience across demographic characteristics. Of note, children from minority populations were referred to Early Intervention (either private or state-funded) at a higher rate than Caucasian children. More examination is needed to investigate why individuals from minority backgrounds are using Early Intervention at a higher rate, and if non-minority populations are seeking other avenues of support. Further examination is also needed to determine the full effect of an ASD diagnosis on workforce participation, as the majority of our study sample had their workforce participation reduced for the respondent or their partner, which may impact quality of life for the family.

185 **181.185** Prediagnostic and Diagnostic Stages of Autism Spectrum Disorders: A Parent Perspective

W. H. Wong[1], *Y. Yu*[2], *J. H. McGrew*[2] *and L. A. Ruble*[1], *(1)University of Kentucky, Lexington, KY, (2)Indiana University - Purdue University Indianapolis, Indianapolis, IN*

Background:
Caring for a child with autism spectrum disorder (ASD) is stressful and tends to be particularly high during transition points, such as receiving the initial ASD diagnosis (Evan, 2010). However, there is little research examining the diagnostic process comprehensively (Braiden et al., 2010). Additionally, the existing literature about the diagnostic process suffers from four main problems; most studies (1) were small in scale, (2) were conducted in countries other than the United States (e.g., Abbott, Bernard, & Forge, 2012), (3) were retrospective (see Brogan & Knussen ,2003), often occurring years after the initial diagnosis; therefore, introducing potential biases in recall, and (4) used either exclusively qualitative or quantitative methods, which poses limitations on the depth and breadth of understanding the diagnostic stages when compared to mixed method designs (see Abbott et al., 2013).
Objectives:
To develop a model that attempts to give a detailed account of the sequence of events, experiences, and actions associated with the ASD diagnosis. It is hoped that this model will provide additional guidance to offer timely support to parents and improve the diagnostic experience for families of children with ASD.
Methods:
A mixed methods cross sectional design was used. Eighty caregivers of children with ASD who received an initial diagnosis within the past six months completed a set of measures regarding their diagnostic experiences.
Results:
Main Quantitative Results
The caregiver was most frequently reported to be the first person to suspect a problem with their child (69.2 %). In most cases (87.2%), language delay was the initial cause for parents' concerns. The mean time between first concern and diagnosis was 28.72 months (SD=27.12), however, more than 10% of parents experienced a lapse longer than 4 years. Length of diagnostic lag was unrelated to ASD severity (r = -.06, p >.05). On average, parents reported consulting with 3.33 (SD=1.26) professionals before receiving an ASD diagnosis. Pediatricians (55.13%) and psychologists (41.02%) were most frequently consulted. However, across professionals, pediatricians and general physicians were reported to be most likely to neglect early ASD symptoms and least likely to refer parents to appropriate professionals.
Main Qualitative Results
Grounded theory was used to analyze the qualitative responses with regard to parents' experience during the prediagnostic and diagnostic process. Six core themes were identified: "heightened awareness," "initial search," "dissatisfaction with medical or associated processionals," "long process/delay," "feeling uninformed," "parent psychological and relational experiences," and "diagnosis goals." When participant responses were viewed as a whole, a set of commonly experienced steps or stages emerged that seemed to characterize the process of obtaining a diagnosis.
Conclusions:
The authors adapted the patients' health seeking model by Andersen and Cacioppo (1995) to understand the present data. A six-stage model (i.e., appraisal delay, illness and information delay, behavioral delay, scheduling delay, diagnostic delay, and treatment delay) was developed to capture and understand the prediagnostic and diagnostic experiences of children with ASD and their parents. See Graph 1 for the model. Implications and potential interventions based on the six-stage model will be discussed in the presentation.



186 **181.186** Predictors of Somatic Problems in Parents of Adolescents and Young Adults with Autism

M. Uljarevic[1]*, R. Y. Cai*[2] *and A. L. Richdale*[2]*, (1)Bundora Campus, La Trobe University, Melbourne, Australia, (2)Olga Tennison Autism Research Centre, Melbourne, Australia*

Background:
Parenting a child with autism is a situation of chronic stress for some parents. The negative effects of chronic stress on mental health of this group of parents is well established, however, little is known how chronic stress affects the somatic health in parents. The few studies that have looked at this issue have reported that parents experience high levels of health problems.
Studies have begun to identify pattern of individual and environmental differences that might make parents more susceptible to the negative psychological effects of chronic stress. However, factors that might put parents at increased risk for developing somatic problems are currently unknown.
It has been suggested that factors of intolerance of uncertainty, avoidant emotion regulation styles, lower mindfulness and social support increase the risk for both the mental and somatic health consequences of stressors because they can prolong stress-related affective and physiological activation, both in advance and following stressors. An additional factor that might be associated with somatic health problems in parents of children with autism is the presence of broader autism phenotype traits.
Objectives:
To identify factors associated with somatic problems in parents of individuals with autism.
Methods:
Fifty one parents of adolescents and young adults with autism (M_{age}= 50.19 years, SD_{age}= 5.78; 47 females) completed questionnaires assessing somatic health (COMPASS-31), anxiety (Cross-D), depression (PHQ-9), autistic traits (AQ), emotion regulation (ERQ), mindfulness (MAAS), social support (SSQ-6), and intolerance of uncertainty (IOU-12). This study forms part of the Australian Autism CRC longitudinal study of school leavers; recruitment is ongoing.
Results:
Variables significantly associated with the CASS-31 total score were entered into the hierarchical regression model (CROSS-D, r= .46, p= .001; PHQ-9, r= .47, p=.001; MAAS, r= -.54, p<.001; SSQ-6, r= -.55, p<.001; AQ, r= .28, p= .048; IOU-12, r= .33, p= .019). Parental traits were entered in the first step, with MAAS being independent significant predictor (t = 3.46, p = .001, β = .463) but AQ (t= .994, p = .326, β = .146) and IOU-12 (t= .423, p = .674, β = .065) not. MAAS stayed as an independent significant predictor (t= 2.92, p = .005, β = .369) after the SSQ-6 Satisfaction score was entered in the next step with SSQ also being unique predictor (t= 3.14, p = .003, β = .382). Finally, DSM-5 DAS and PHQ-9 were entered in the final step in order to control for the effects of anxiety and depression. The final model accounted for 35.5% of variance, with MAAS and SSQ-6 Satisfaction as unique predictors (t = 2.506, p = .016, β = .360 and t = 2.86, p = .007, β = .377 respectively) of CASS-31 total scores.
Conclusions:
Our study identified lower mindfulness and lower levels of social support as potential contributing factors to poor somatic health in parents of individuals with autism. Identifying such factors is a crucial first step in developing intervention programmes to provide support for parents.

187 **181.187** Problematic Mealtime Behaviors Identified in Chinese American Children with ASD

H. L. Gray *and H. M. Chiang, Teachers College Columbia University, New York, NY*

Background: Up to 89% of children with ASD have been reported to have some type of eating problems which can include limited food variety, food neophobia, rigid routines around mealtimes in the form of using the same utensils or dishes, food refusal, and difficulties with texture. Research is needed to better understand feeding difficulties in diverse population to improve intervention strategies and parent education programs tailored to particular culture and context.
Objectives: To assess parents' perceived mealtime behaviors of their children with ASD, particularly in Chinese American population resided in New York City.
Methods: Thirty one Chinese American parents who enrolled in a parent education program participated in the Brief Autism Mealtime Behavior Inventory (BAMBI) questionnaire. The BAMBI is a validated assessment tool with 18 items asking mealtime behaviors typically displayed in children with ASD. The questionnaire was provided both in English and Chinese languages to accommodate participants' needs. Response options were 5-point Likert-type answers (Never to almost every meal). In addition, parents were asked to identify whether or not each item was a problem for their family. Descriptive statistics and correlation coefficients were calculated, using SPSS statistical software. Higher scores represent more problematic mealtime behaviors.
Results: The following describes mean score for each mealtime behavior category: "prefers crunchy foods"=3.8 (SD 1.1), "unable to remain seated"=3.3 (SD 1.4), "eating only soft foods"=2.8 (SD 1.3), "limited variety"=2.8 (SD 1.3), "selective eating"=2.8 (SD 1.1), "inflexible mealtime"=2.6 (SD 1.4), "prepared in a particular way"=2.3 (SD1.2), "food refusal"=1.9 (SD 0.8), "aggressive behaviors"=1.3 (SD 0.5) on a 5-point scale. Top 5 behaviors identified as a problem by Chinese American parents were: (1) 54%, only prefers "crunchy" foods (e.g. snacks, crackers); (2) 48%, not willing to try new foods; (3) 46%, does not remain seated at the table until the meal is finished, (4) 44%, dislikes certain foods and won't eat them, and (5) 39%, does not accept or prefer a variety of foods. There was a significant association between food refusal and aggressive behaviors at mealtime (r=0.7; p<0.01).
Conclusions: To our knowledge, this is the first study examining Chinese American parents' perceived mealtime behaviors of their children with autism. Chinese Americans often eat differently than typical Americans do. Our findings may aid in developing appropriate intervention strategies and educational resources tailored to Chinese American population and have implications for other ethnic groups.

188 **181.188** Quality of Life in Families with a Transition Aged Young Adult on the Autism Spectrum from the Perspective of Adult Sisters

L. A. Crabtree[1] *and* ***B. B. Demchick***[2]*, (1)Towson University, Lutherville, MD, (2)Towson University, Towson, MD*

Background: Characteristics of Autism Spectrum Disorder (ASD) present unique challenges to families. Raising children with ASD is energy intensive and may necessitate a revision of familial roles and productivity. Transitioning to adulthood is particularly challenging for those with ASD and their families, as family members are often faced with increased caretaking demands (Graetz, 2010). This impacts family quality of life (FQOL), or the dynamic sense of well- being of the family. Research suggests that quality of life (QOL) of siblings is affected by a brother or sister with ASD, yet findings are inconsistent. Some studies suggest that typical siblings have restricted family interactions and reduced support; others find a high level of resilience. Discrepancies may be attributed to factors of severity of ASD, gender of the typical sibling, and age or number of siblings (Howlin et al., 2014).
Objectives: The purpose of this qualitative phenomenological study was to explore FQOL in families with a young adult severely impacted by autism from the perspective of adult sisters. Researchers planned to examine all siblings, however only sisters responded to requests for interviews, which may point to differences between brothers and sisters. Research questions were:
How do sisters describe their quality of life (past, present, and future)?
How do sisters describe experiences growing up?
How have services and supports for a sibling with ASD affected their family quality of life?
How have sisters' roles and occupations been impacted by a sibling with autism?
Methods: Participants were eleven sisters of young adults with ASD, recruited from families who had participated in previous phases of research on FQOL (Demchick, Eskow, & Crabtree, 2014). Sisters aged 18 -30, participated in a 1-2 hour semi-structured interview which was recorded and transcribed with permission and a second phone interview to confirm findings. Transcripts were coded by two investigators to ensure trustworthiness. Atlas.ti, was used to manage data. Important statements that provided an understanding of how the participants experienced the phenomenon were extracted from transcripts. Data were organized into meaningful clusters, and initial codes were formed. Researchers approached the data with an open attitude to allow meanings to emerge. Clusters of meaning were tied together into themes.
Results: Four themes were identified. 1) Characteristics of autism impact sisters' experiences and quality of life. 2) Limited supports restrict participation of those with ASD as well as that of the sisters. 3) A sibling with autism positively affects the sisters' personal attributes and occupations. 4) As parents age, all sisters plan to assume some caregiving responsibility for their sibling with ASD. Additionally, the sisters from families of more than two children reported that sisters assume far more responsibility for the sibling with ASD than brothers did.
Conclusions: Most sisters of individuals with ASD perceive their FQOL as positive, but suggested that more supports and services for themselves and their siblings with ASD, especially during puberty and the transition process, would benefit their overall participation and QOL. Results emphasize the importance of supports and services in meeting family needs.

189 **181.189** Reliability of Parent and Teacher Perspectives on Child Functioning in a Large Urban Sample of Children with ASD

K. S. Dickson[1], *A. C. Stahmer*[2], *S. R. Rieth*[3] *and J. Suhrheinrich*[4], *(1)Psychiatry, UCSD, San Diego, CA, (2)University of California at Davis MIND Institute, Sacramento, CA, (3)San Diego State University, San Diego, CA, (4)University of California San Diego, La Jolla, CA*

Background:
Cross-informant ratings are considered best clinical practice when assessing child functioning. However, data overwhelmingly support significant variability in ratings across informants. While the majority of this research has focused on typically developing children, recent work examining cross-rater agreement in ratings for children with ASD has found similar variability in ratings of functioning (Stratis & Lecavalier, 2014). The majority of this work has focused on emotional and behavioral problems; little work to date has examined parent/teacher ratings of children's functioning more broadly, especially within a large-scale, diverse sample.
Objectives:
The purpose of this study is to systematically evaluate agreement between parent and teacher ratings of child functioning using standardized rating scale assessments.
Methods:
Participants in the current sample were part of a large study examining the effectiveness of a naturalistic behavioral intervention in school settings. Participants included 289 children, 3-11yrs old (M = 4.08, SD =3.21) who were served for ASD in public school programs. Participant measures were collected in the beginning and end of the school year. Parents and teachers of participating children completed the Vineland Adaptive Behavior Scales- II (VABS) and Pervasive Developmental Disorder Behavioral Inventory (PDDBI) at each time point.
Results:
Cohen's kappa was used as a measurement of agreement between teachers and parents. Overall, data indicate only slight agreement between teacher and parent ratings across domains of each assessment, with Kappa's ranging from .03 to .10. On the PDDBI, there was agreement on 33.3% of domains at both the beginning and end of the school year. On the VABS, agreement was higher at the beginning (43.7%) compared to the end (37.5%) of the school year. Parent and teacher ratings were significantly reliable ($p < .04$) on 18.8% of VABS domains and 20% of PDDBI domains at both time points. When specifically considering these domains, three domains (PDDBI Expressive Language and Expressive Social Communication Abilities Composite and VABS Written) showed improved parent/teacher agreement from Fall to Spring. In contrast, three domains (PDDBI Semantic/Pragmatic Problems and VABS Play and Leisure skills and Fine Motor skills) showed declines in agreement from Fall to Spring. Potential moderating variables will be discussed.
Conclusions:
The reliability in parent and teacher ratings of various domains of children's functioning is highly variable. Data suggest only slight agreement between raters as well as an inconsistent pattern of change in agreement over time. Overall, these results support the larger literature demonstrating variability in cross-informant ratings of children's behavior. The significant variability in teacher and parents' ratings of functioning for children with ASD seen here warrants further exploration.

190 **181.190** Technology Use By Adolescents with Autism: It's Not Just for Playing Video Games and Watching Animated Movies

S. Hedges, *UNC Chapel Hill, Chapel Hill, NC*

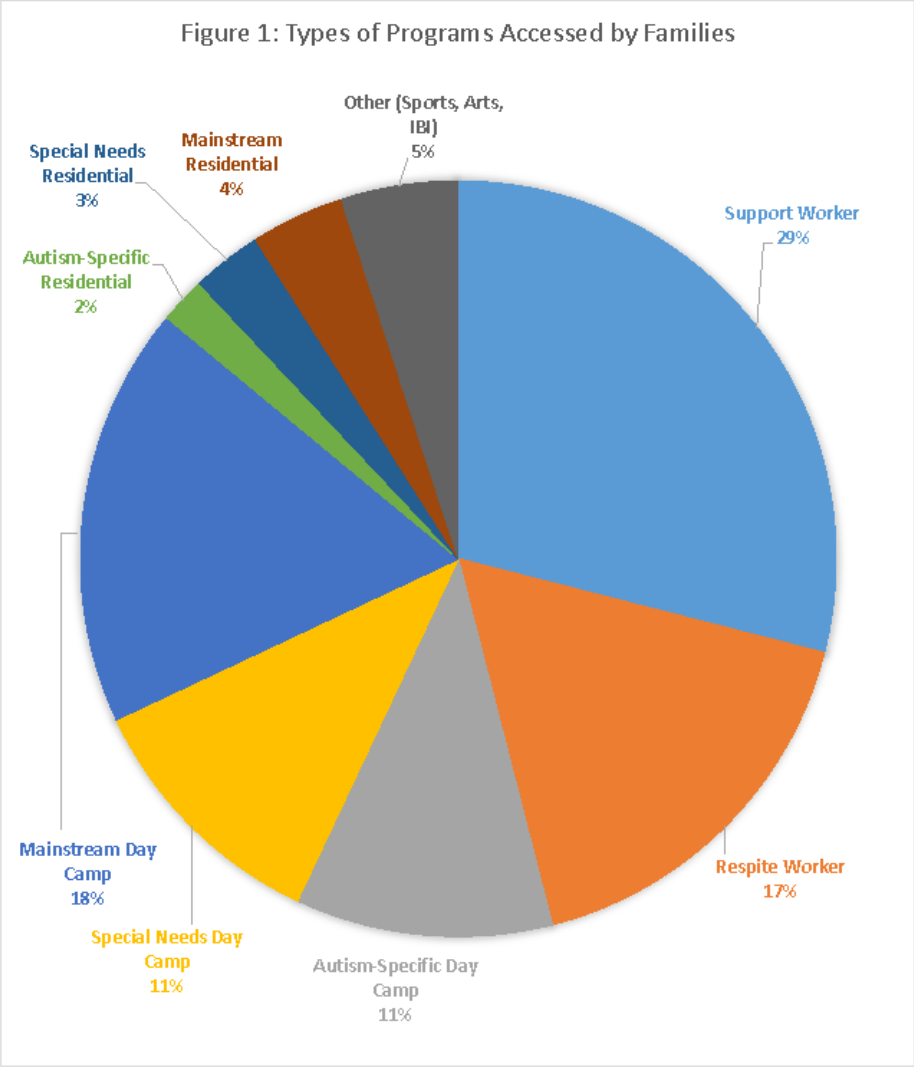
Background: New technologies have the potential to lead to novel, more efficient, and cost effective supports that may enhance quality of life for individuals with autism and their families. Research has shown that many individuals with autism have an affinity to screen-based technology and use it widely for recreation (e.g. to watch videos and play video games). However, the use of technology as a support by students with autism remains largely unexplored.
Objectives: To describe the forms of technology used by high school students with autism and for what purpose. To gain insights into student perceptions of the benefits of technology use as well as possible barriers to use in the school context.
Methods: Paper surveys were given to 174 high school students with autism across three states in the U.S. (North Carolina, Wisconsin, California). Follow-up qualitative interviews were conducted by email with 15 survey respondents to gain deeper insights into their perspectives.
Results: The majority of respondents (84%) bring internet capable technology with them to school each day and actively use technology to learn, stay organized, and to enhance their communication and social interactions. For example, they use technology to look things up on the internet (98%), to make presentations (88%), and to collaborate with other students on assignments (64%). But more than half indicated they are not permitted to use technology in all classes and 57% said that technology can be a distraction. Some students shared their strategies to reduce the distraction factor. The majority (82%) use technology to communicate with friends and roughly half indicated they use technology to socialize because it makes it easier to locate people with similar interests. Surprisingly, respondents prefered texting (69%) to email (64%) and the majority are active on a variety of social media websites. Not surprising, the majority (97%) believe they are good at using technology and 68% want to study a technology related subject in college. While only 30% had taken an online course, 55% of respondents said they would like to take one in the future. 78 participants wrote in specific apps and technology tools they use for support throughout the day including apps to help them handle stress and to sleep.
Conclusions: Many teens with autism are carrying powerful technology tools with them to school each day with the potential to ameliorate or bypass many of the deficits associated with autism. These tools are helping some of them to learn, stay organized, to communicate, and to find friends. Opportunities exist for researchers, practitioners and families to encourage and enhance technology use as a support tool.

191 **181.191** The Impact of March Break and Summer Program Funding on the Stress of Caregivers of Children with Autism

J. M. Bebko[1], *C. A. McMorris*[1], *B. L. Ncube*[1], *O. M. Jon*[2], *J. H. Schroeder*[1], *G. Kontosic*[3], *L. Verbeek*[3] *and M. Spoelstra*[3], *(1)York University, Toronto, ON, Canada, (2)McMaster University, Hamilton, ON, Canada, (3)Autism Ontario, Toronto, ON, Canada*

Background: Those raising children with Autism Spectrum Disorders (ASDs) face unique challenges, with the severity of symptomatology varying within a wide range of behavioral, communication and social skill levels. Consequently, research indicates that parents of children with ASDs report higher levels of stress than parents of those with other developmental disabilities or parents of typically developing children (Estes et al., 2009; Weiss et al., 2012). Support programming such as respite service are often cited as major factors that aid to reduce parental stress (Cowen, & Reed, 2002); however, the financial burdens placed on families seeking such services can be overwhelming. Autism Ontario is a service provider and family advocacy centre for individuals and families affected by ASD in Ontario, Canada. In addition to other services, Autism Ontario offers families the opportunity to apply for funding that can subsidize children to attend external programs during March and summer breaks.
Objectives: The goal of the present study was to examine the impact of funding for ASD support programming and its perceived effect on parental stress levels. Additionally, this study will explore how funding was utilized by families, what programs children participated in, what skills were obtained by children with ASD, and most importantly, how these factors relate to parent's levels of stress.
Methods: An online survey was circulated to parents who had applied for March or Summer Break program funding from 2007-2011. A total of 695 caregivers of children with

ASD completed the survey, 477 of whom indicated they had received either March or Summer break funding at least once during the 2007-2011 period. The survey obtained feedback related to basic demographic information, languages spoken by the families, years of Canadian residence, whether parents felt a reduction in stress, and how funding impacted their decision to enroll children in camps or seek respite help. Parents were also asked to describe the type of program in which their child participated (e.g., mainstream day or residential camps, autism-specific camps) as well as the length of time spent in each program. Respondents were asked if their child had made observable improvements in areas such as self-regulation, aggression, stereotypical behavior, improved communication, and social interaction.
Results: Support workers accounted for over 25% of funding expenditure with 50% of families placing their child in programs lasting 5-7days. Importantly, 31% of respondents stated they would not have been able to take advantage of support programs without subsidization. Approximately 78% of caregivers reported a significant decline in stress from their child's program participation. Finally, results revealed a wide-spread improvement for ASD children in social skills and increased interaction with others.
Conclusions: The current findings highlight that the funding provided by agencies, such as Autism Ontario, offer a critical financial opportunity to those families who would not otherwise be able to afford these support services. Access to supplemental programming, such as residential and day camps, is reported to have significantly benefitted families and their children with ASD, shown by an improvement in skills and significant reduction in parent's stress.



192 **181.192** The Influence of Ethnic Culture on Profiles of Stress and Coping in Caregivers of Children with Autism Spectrum Disorder

T. V. Williams[1], *K. Hartmann*[2] *and M. Urbano*[2], *(1)Virginia Consortium Program in Clinical Psychology, Norfolk, VA, (2)Eastern Virginia Medical School, Norfolk, VA*

Background: High parental stress is associated with parental depression, anxiety, and use of harsh parenting techniques. The impact of parental stress is magnified for a child with a diagnosis of ASD. African American families traditionally face additional stressors including structural racism, discrimination, fewer financial resources, and single parent homes. The literature suggests that African American families rely on more varied coping styles to manage the burden of additional stressors. Coping styles are likely influenced by individual acculturation to native culture versus the Euro-American majority culture in the United States.
Objectives: The present study intends to add to the literature by exploring African American caregivers' experiences when caring for a child with ASD in comparison to their

ethnic majority counterparts. This research compares the stress and coping profiles of three cultural groups: Caucasian caregivers, African American caregivers that are more acculturated with the majority culture, and African American caregivers that ascribe to more traditional African American cultural beliefs.
Methods: We are aiming to collect responses from a minimum of 100 caregivers of children with ASD. Data collection is ongoing with 41 completed participants at the time of abstract submission. Caregivers were asked to complete a series of questionnaires in an online survey. The measures include: a demographic questionnaire, a measure to confirm the presence of ASD symptomology (Autism Spectrum Rating Scale), five measures related to parental stress and coping (Parenting Stress Index, Autism Parenting Stress Index, The Proactive Coping Inventory, Coping Strategies Inventory, Brief RCOPE), and a measure of acculturation to African American culture (The African American Acculturation Scale- Revised). Participants completed the survey online and were provided with an electronic gift card for participation.
Results: Hierarchical Discriminant Function Analysis (DFA) will be used to predict group membership using variables of interest from the coping and stress measures. Demographic information will allow us to control for differences due to socioeconomic status. The initial DFA will determine if there are significant differences between the three racial groups on stress and coping variables. The DFA will also determine if the model reliably predicts membership to a given racial group based off of the predictor variables. The DFA will be followed up with canonical functions to determine which variables account for the biggest differences among the three groups.
Conclusions: We anticipate that of the three groups, Caucasian families will report experiencing the most stress, followed by highly acculturated African American families. In line with the literature suggesting that traditional African American families learn more coping styles because of additional exposure to stress, it is anticipated that less acculturated African American caregivers will report the most frequent use of a variety of coping behaviors. This study will supply mental health providers with a window into understanding how racial minority caregivers' perceptions and needs differ from that of racial majority populations, and how services may be best tailored to work within a caregivers' cultural framework.

193 **181.193** The Longitudinal Impact of Marital Adjustment and Social Support on Stress in Primary Caregivers of Children with ASD

Y. Yu *and J. H. McGrew, Indiana University - Purdue University Indianapolis, Indianapolis, IN*

Background: Caregivers of children with ASD report higher levels of stress and lower levels of marital adjustment (e.g., Benson & Kersh, 2011; Freeman et al., 2011; Risdal & Singer, 2004). Increased social support, a stress buffer, may moderate these impacts and has been consistently related to decreased negative outcomes for caregivers of children with ASD and their families (e.g., Stuart & McGrew, 2009). Social support can be both general and specific to the stressor. For example, received support from ASD providers and the ASD community has been associated with decreased stress in parents of children with ASD following diagnosis (Stuart & McGrew, 2009). Another critical social resource is the relationship with one's spouse or significant other. Both cross-sectional and longitudinal analyses have shown that marital adjustment can buffer stress of having a child with ASD (e.g., Kersh et al., 2006). Moreover, social support accumulates, that is, caregivers receive support from various resources (e.g., general social support from families and friends, contextual social support from the ASD providers and community, marital support), and these resources may compensate for each other or interact in their impact on caregiver outcomes.
Objectives: The current study examined the cross-sectional and longitudinal relationships among general and contextual social support, marital adjustment, and outcomes in primary caregivers of children with ASD shortly after receiving the diagnosis. Specifically, we examined whether there is a compensatory or additive mechanism among sources of social support in their impact on caregiver outcomes.
Methods: Primary caregivers of children diagnosed with ASD within the past six months (N = 79) were first recruited at baseline and again 12 months later (N = 65). Participants were assessed on caregiver outcomes using predictors within the double ABCX model (McCubbin & Patterson, 1983), e.g., life demands, social support, marital adjustment.
Results: At baseline, marital adjustment correlated with caregiver burden (r =-.56, p<.001), family burden (r =-.48, p<.001), and mental health-related quality of life (r = .25, p =.04). Multivariately, marital adjustment (*Beta* = -.26, p = .02) and general social support (*Beta* = -.46, p<.001) predicted baseline caregiver stress, R^2 = .59, F (6, 58) = 13.69, p<.001; life demands (*Beta* = .33, p = .005) and general social support (*Beta* = -.33, p = .012) predicted family burden, R^2 = .51, F (6, 58) = 10.19, p< .001. Longitudinally, controlling for baseline caregiver outcomes, as well as parent, family, and child factors at baseline and changes in those variables, the results showed that interactions between contextual social support from the ASD community and providers and marital adjustment (*Beta* =-.32, p = .024) predicted caregiver stress at follow-up, R^2 =.74, F (20, 58)= 8.38, p< .001.
Conclusions: An additive model was supported. When caregivers perceive low contextual social supports from the ASD community and ASD providers, the level of their marital adjustment does not impact their long term caregiver stress level; however, when they perceive high levels of contextual social support, better marital adjustment predicted decreased stress long term.

194 **181.194** The Relationship Between Pain and Problem Behavior in Predicting Parent Stress in Families of Children with Autism

C. E. Walsh[1] *and M. Tudor*[2]*, (1)University of Colorado Denver, Denver, CO, (2)Stony Brook University, East Setauket, NY*

Background: Studies have shown that children with ASD have increased severity and incidence of pain symptoms compared to typically developing children and children with other disorders (Herbert, 2005). Pain has also been shown to act as a setting event for problem behavior in children with autism spectrum disorder (ASD) and is one of the strongest predictors of parent stress. Parents of children with ASD who also experience physical illness tend to be more intensely involved in their caregiver role and are also more likely to experience stress (Krulik et al., 1999). Further, children with ASD may have difficulty communicating pain symptoms and are more likely to exhibit challenging behavior when sick (Carr & Blakeley-Smith, 2006). Currently, the relationship between child pain symptoms, problem behavior, and parent stress is unknown in parents of children with ASD; however, it is important to better understand this relationship in order to further address these issues in treatments for challenging behavior. **Objectives:** (1) To examine the relationship between pain symptoms, parent stress, and problem behavior; and (2) To determine the role of parenting style in the relationship between pain symptoms, problem behavior, and parent stress. **Methods:** Participants included 148 parents of children with ASD who were recruited from a Northeast local chapter of the Autism Society of America. Parents completed standardized self-report measures of pain symptoms, problem behavior, parent stress, and parent coping style They were compensated with a $20 Amazon.com gift card. **Results**: Multiple regression analyses indicated that child pain was significantly positively related to parent stress for those children with high problem behavior, r(99) = .403, p < .001, whereas it was not significantly related to parent stress for children with low problem behavior, r(33) = .04, p = .53. There was a significant interaction between pain symptoms and parent protectiveness to predict parent stress, t(128) = 2.62, p = .01 (β = .23). There was a significant, negative correlation between parent protectiveness and parent stress when child pain was low, r(99) = -.25, p = .05, and a significant, positive correlation when child pain was high, r(33) = .29, p = .02. **Conclusions:** Results showed that problem behavior was a moderating factor between pain and parent stress and there was a significant interaction between pain and problem behavior predicting stress. Pain could be functioning as a setting event such that when pain is present it might increase the likelihood that problem behavior will occur. An overprotective parenting style also moderated the relationship between pain and parent stress. This suggests that parents who respond to their child's pain by reducing demands or by increasing attention to the child's pain might be exacerbating the behavior problems and thus increasing parent stress. From a systems perspective it is important to acknowledge various factors that maintain a child's behavior and also produce parent stress. The novel model presented here indicates the importance of providing interventions that involve families with a main goal of increasing quality of life for the family.

195 **181.195** The Relationship Between the Behavioral Symptomology of Children with Autism Spectrum Disorder and Their Siblings' Psychological Functioning

E. A. Roth[1]*, G. M. Kuravackel*[2] *and D. Wohlfarth*[1]*, (1)School of Professional Psychology, Spalding University, Louisville, KY, (2)Pediatrics, University of Louisville School of Medicine, Louisville, KY*

Background: Some research has demonstrated that siblings of children with ASD are not at an increased risk of developing internalizing and externalizing behaviors (Dempsey et al., 2012; Macks & Reeve, 2007). Other research has shown detrimental effects on this population's behavior, psychological functioning, and quality of life (QOL) (Hastings, 2003; Ross & Cuskelly, 2006; Verte et al, 2003). Some researchers have found an increase in anxiety rates among this population (Orsmond & Seltzer, 2009; Pollard et al., 2013), while other researchers have not found similar results (Shivers et al., 2013). Previous research has assessed the relationship between the diagnosed child's behavioral symptomology and the participating family and sibling's psychological well-being (Hartley et al., 2012; Hastings, 2007; McStay et al., 2014; Freedman et al., 2012, Seltzer et al., 2009).
Objectives: The purpose of this study is to further investigate the psychological development of siblings of children with ASD. Little research has been conducted on siblings of children with ASD, and of the research that exists, conflicting evidence is present as to the psychological well-being of siblings of children with ASD. Of specific interest in this study will be the presence of anxiety symptoms and QOL. The relationship among the diagnosed child's behavioral symptomology and the participant's anxiety level, QOL, and psychological functioning will be the primary focus of this study. Additionally, this study will look at the relationship between multiple demographic characteristics in comparison to the presence of anxiety symptoms, QOL and psychological functioning. It is important to understand the significant relationship between any demographical variables and the presence of anxiety, psychological health, and QOL.
Methods: This specific poster presentation will look at the relationship between the child with ASD's behavioral symptomology (as measured by the Aberrant Behavior Checklist [ABC]) and the participant's psychological functioning (as measured by the Achenbach Child Behavior Checklist [CBCL]), anxiety (as measured by the Screen for Childhood Anxiety Related Emotional Disorders [SCARED]), and quality of life (as measured by the KINDL). Initial data collection has begun at a local Autism Center and will be completed, along with comprehensive analyses, prior to the IMFAR International Meeting.
Results: Multiple chi-square analyses will demonstrate relationships between the diagnosed child's behavioral symptomology and the participant's psychological functioning, specifically, anxiety and quality of life. Results are expected to continue to exhibit that the more serious a siblings' behavioral symptoms are, the more likely the participant will have increased anxiety and lower psychological functioning and quality of life.

Conclusions: The effects of a diagnosed child's behavioral symptomology is expected to have a detrimental effect on the participating sibling's psychological functioning, anxiety, and quality of life.

196 **181.196** The Role of Grandparents in the Identification of a Grandchild's Autism Spectrum Disorder and the Information Sources They Utilize

J. Hillman[1], *A. R. Marvin*[2], *J. K. Law*[3] *and C. Anderson*[4], *(1)Applied Psychology, Penn State Berks College, Reading, PA, (2)Kennedy Krieger Institute, Baltimore, MD, (3)Interactive Autism Network, Baltimore, MD, (4)Department of Interprofessional Health Studies, Towson University, Towson, MD*

Background: Early diagnosis and intervention is essential for children with Autism Spectrum Disorder (ASD). Although previous research suggests that grandparents often play a role in helping families cope with having a child with ASD, little is known about the role that grandparents may play in recognizing the condition itself. It also remains unclear what informational resources grandparents use to learn about ASD.
Objectives: The goal of the study was to examine the extent to which grandparents played a role in the recognition of a grandchild's ASD, and to ascertain factors associated with such recognition. A secondary goal was to identify what resources grandparents turned to for ASD information. Such knowledge may help foster early diagnosis and guide professionals in the development of educational materials.
Methods: Grandparents were recruited through web or email-based announcements from the Kennedy Krieger Institute's Interactive Autism Network (IAN) Research project, the Autism Speaks Foundation, the Grandparent Autism Network, and the American Association of Retired People (AARP). Participants participated anonymously in an online survey designed to be completed in approximately 30 minutes. Participants were required to live in the U.S. or its territories, and to have at least one grandchild with an ASD. The grandchild had to be the biological, adoptive, or stepchild of the respondent's biological or adopted son, stepson, daughter, or stepdaughter.
Results: A total of 1881 participants completed the online survey, including 1534 grandmothers (81.6%) and 347 grandfathers (18.4%), who also identified as maternal (63.4%) or paternal (35.6%) grandparents.
More than 75% of grandparents indicated that they had played a role in identifying their grandchild's ASD, with 27.5% "independently raised concerns about [their grandchild's] development" and 48.2% "supporting others who raised concerns." A binomial regression analysis (X^2=207.76, p<.001, Nagelkerke R^2=.18) revealed that middle-aged, working grandmothers who lived within 25 miles of their grandchild were significantly more likely to play a role in ASD identification; grandparental lineage (maternal vs. paternal), education level, and urbanicity were unrelated. The younger the age that grandparents reported that they first worried about their grandchild's development (x=2.08 years, sd=1.95), the younger the age that their grandchild first received an ASD diagnosis, (x=3.10 years, sd=2.12), r=.43, p<.001.
Grandparents turned to their son or daughter (80.7%), their son- or daughter-in-law (30.9%), autism therapy providers (e.g., speech, OT, ABA; 35.3%), school personnel (28.5%), medical professionals (20.7%), mental health providers (e.g., psychologists; 12.2%), and advocacy or government organizations such as Autism Speaks (72.5%), the Autism Society of America (24.2%), the Centers for Disease Control or National Institutes of Health (8.9%) for ASD information.
Conclusions: The majority of grandparents played a role in identifying their grandchild's ASD. More than one quarter were the first to raise concerns about a grandchild's development. Encouraging professionals to include grandparents in the diagnostic process, particularly middle-aged grandmothers who live within 25 miles of their grandchild, may offer benefits for the early detection of ASD. Professionals and organizations can also be encouraged to target materials specifically for grandparents.

197 **181.197** Understanding Health Care Disparities Among Families of Children with ASD: The Role of Advocacy, Empowerment, and Parent-Professional Relationships

K. A. Casagrande *and B. Ingersoll, Michigan State University, East Lansing, MI*

Background: Children with ASD have complex service needs due to a unique combination of core symptoms and comorbid conditions that affect child and family functioning. Consequently, these families utilize a greater number of services than families of children with other special healthcare needs. However, they also report more unmet service needs and less satisfaction with the services they receive. These disparities are even more pronounced in low-SES families. This may be due in part to the factors that support access to services, such as parental advocacy, parent empowerment, and parent-professional partnerships, which may differ across high and low SES families.
Objectives: This analysis will address two questions: 1) what might explain differences in service adequacy based on family SES; and 2) who is likely to advocate for services if their needs are not met.
Methods: Parents of children with ASD (n=248; M=9.9 years old) completed a 30-minute anonymous survey. The survey included a demographics questionnaire, services inventory, Autism Behavior Checklist, Family Empowerment Scale, Family-Professional Partnership Scale, and an advocacy questionnaire designed for this study. Recruitment utilized both online and in-person data collection strategies in an effort to maximize the diversity of the sample. Parent education (college degree vs. no college degree) was used as a proxy for SES.
Results: An independent samples t-test demonstrated that higher SES families (M=.48, SD=.29) were more likely to perceive their services as adequate than lower SES families (M=.35, SD=.22), t(246)=-3.70, p<.001. Parent empowerment, parent-professional partnerships, and parent advocacy were examined as potential mediators of this relationship. Controlling for child's age and level of severity, parent-professional partnership was a significant mediator of the effect between SES and service adequacy (Sobel test: z=2.81, se=.017, p<.005).
To examine potential predictors of parent advocacy, multiple regression was used. Child severity (β=-.157; p=.018), service adequacy (β=-.170; p=.017), and parent empowerment (β=.229; p=.001) were each independent predictors of parent advocacy. Controlling for child severity, a moderated regression found that service adequacy and parent empowerment interacted to predict parent advocacy, (ΔR^2=.013, $F\Delta$(1,243)=3.706, p=.055), such that parents who experienced a low level of service adequacy and high level of parent empowerment were most likely to advocate for their child.
Conclusions: As families have a finite amount of time, energy, and resources, it is important to understand how they can most effectively navigate the service system. Results suggest that parent-professional partnerships may be an important factor that explains some of the disparities in service adequacy for lower-SES families. Additionally, for those families who do not receive adequate services, empowerment may be an important component in making the decision to advocate. Strategies aimed at reducing disparities in service adequacy for lower-SES families of children with ASD should consider methods for improving parent-professional partnerships and increasing parent empowerment. It will be important to expand the study in order to determine if the trending results reach significance in a more diverse sample.

198 **181.198** Understanding Oral Care Challenges in Children with Autism Spectrum Disorder: A Mixed Methods Study

L. I. Stein[1], *B. F. Henwood*[2], *R. N. Bluthenthal*[3], *J. C. Polido*[4] *and S. A. Cermak*[1], *(1)Occupational Science & Occupational Therapy, University of Southern California, Los Angeles, CA, (2)Social Work, University of Southern California, Los Angeles, CA, (3)Preventive Medicine, University of Southern California, Los Angeles, CA, (4)Dentistry, Children's Hospital Los Angeles, Los Angeles, CA*

Background: It is well established that oral care is an important component of pediatric healthcare. However, children with autism spectrum disorder (ASD) and other developmental disabilities are at risk for poorer oral health and quality care.
Objectives: It is essential to identify and understand the barriers to quality oral care experienced by children with ASD and their caregivers. This mixed methods sequential explanatory study, the first on this topic to incorporate qualitative methods, will enable us to better understand how families of children with ASD experience oral care in the dental office.
Methods: Focusing on caregivers of children 5-10 years with ASD (n=106), quantitative methods using a 37-item survey were used to identify the types and degree of oral care challenges that affect children with ASD. Survey data were analyzed descriptively. Surveys were followed by qualitative methods to provide a more in-depth understanding of challenges. Two focus groups of parents of children with ASD 5-10 years lasting 2.5-3 hrs in duration each were conducted (n=9 participants total). Qualitative data were analyzed using a template coding approach based on the three domains of office-based oral care challenges covered in the survey.
Results: In the quantitative phase, parent respondents reported difficulties with access to care (37%) and that dentists had inadequate training to work with children with special healthcare needs (58%). Over 50% of parents reported that sensory sensitivities increased in the dental environment and made dental appointments challenging. They also reported that their child's uncooperative behaviors increased at the dental office (53%) and made it difficult for dentists to clean their child's teeth (64%) and that these behaviors led to the use of pharmacological methods (e.g., general anesthesia) to perform routine dental care (77% of those whose children had required drug interventions to perform routine care).
In the qualitative follow-up several related themes emerged. The first theme, *Difficult to Find the Right Dentist*, emphasized access challenges and included subthemes regarding dentist's refusals to treat their child, dentist misrepresentation to caregivers (e.g., dentist stating that they have experience/are comfortable working with children with ASD), difficulties with obtaining referrals to find an appropriate dentist, and the excessive cost of treatment. The second theme, *All the Sensory Devices Just Make Him So Uncomfortable,* focused on difficulties related to sensory sensitivities from stimuli of all modalities encountered during care. The third theme, *It Looked Like They Were Torturing Him,* delved into the use of restraint by a parent and/or dental professional during routine oral care and the complex perceptions of this practice. The last theme was *Drugs: A Mixed Bag*, which explored differing perspectives on the use of pharmacological methods such as nitrous oxide and general anesthesia to enable routine oral care.
Conclusions: These findings provide greater insight into the challenges experienced by children with ASD and their parents. This information has the potential to improve patient-centered care for this population by helping professionals identify priorities for efforts to address the oral health-related needs of this population.

Poster Session
182 - International and Cross-Cultural Perspectives

199 **182.199** Feeding Problems in Children with Autism Spectrum Disorders: Evidence from a Developing Country

P. Malhi[1], *L. Venkatesh*[2], *B. Bharti*[2] *and P. Singhi*[2], *(1)Post Graduate Institute of Medical Education and Research, Chandigarth, UT, India, (2)Pediatrics, Post Graduate of Institute of Medical Education and Research, Chandigarh, India*

Background:
Studies have documented that children with Autism Spectrum Disorders (ASDs) experience a range of eating and feeding difficulties including food selectivity and food refusal and these problems can lead to inadequate nutrition over time. Despite evidence to support feeding problems in children with ASDs, no study has examined eating behaviors of children with ASDs from India.
Objectives:
To examine the eating behaviors of children with ASDs and to compare it with an age and socio-economic matched group of typically developing children.
Methods:
Children with a diagnosis of Autistic Disorder (AD) and Pervasive Developmental Disorder Not Otherwise Specified (PDDNOS) aged 4 to 10 years were eligible for the study. The exclusion criteria included any neurological or systemic illness or current use of any drugs known to alter eating behaviors. A total of 63 ASD children (Mean= 6.1 years, SD=1.9) meeting criteria were recruited from the Department of Pediatrics of a tertiary care hospital in North India. The ASD sample included: Boys=90.4%, AD = 86%. An age and socio-economic status matched control group of typically developing children (N=50) was also recruited. Eating behaviors were evaluated using the Children's Eating Behavior Inventory (CEBI, Archer, Rosenbaum, & Streiner, 1991). It comprises of 40 items and assesses eating problems and mealtime behaviors. Responses are scored on a five point rating scale (ranging from never to always) to measure the frequency of eating behaviors and whether each behavior presents a problem. A list of common foods, specific to the Indian diet, including proteins, starches, dairy, fruits, and vegetables was prepared to measure food selectivity. In addition, height and weight was measured and Body Mass Index (BMI) computed. The study was approved by the ethics committee of the Institute.
Results:
The ASD group had significantly higher total scores on the CESI (t= 3.2, P=.002) and more feeding problems (t =3.7, P=.001) as compared to the control group. Eating problems of the ASD children included not chewing food or feeding self as expected for age, not enjoying eating, taking a long time to eat, eating inadequate amounts of food, and meal times being prolonged and stressful for the family. The height, weight, and the BMI, however, did not differ for the two groups of children. As compared to typical controls, children with ASD ate fewer foods (57.8 vs. 51.0, P=.001), particularly fruits, vegetables, and meat products. Feeding difficulties of the ASD children did not differ by socio-economic status or education of the mother. However, severity of ASD was related to eating problems and children with severe autism, as measured by the Childhood Autism Rating Scale (CARS) had significantly higher total CESI scores (t= 2.2, P=.030).
Conclusions:
Children with ASD are at a high risk for eating problems and this may be associated with long term nutrient inadequacies. Clinicians should routinely screen ASD children for eating difficulties and initiate appropriate interventions.

200 **182.200** Implementation of the Latin American Autism Spectrum Network Caregiver Needs Survey

A. Rattazzi[1], *C. S. Paula*[2,3], *R. A. Garcia*[4], *G. Garrido*[5], *C. Montiel-Nava*[6], *D. Valdez*[7,8], *A. Rosoli*[9], *S. H. Cukier*[1], *G. Rodrigues da Cunha*[3,10], *M. Irarrazaval*[4,11], *M. Rodriguez*[12] *and V. Besio*[13], *(1)PANAACEA, Buenos Aires, Argentina, (2)Department of Psychiatry, Federal University of Sao Paulo, Sao Paulo, Brazil, (3)Mackenzie Presbyterian University, Sao Paulo, Brazil, (4)Universidad de Chile, Santiago, Chile, (5)School of Medicine- Child Psychiatry Clinic, Universidad de la República, Montevideo, Uruguay, (6)La Universidad del Zulia, Maracaibo, Venezuela, (7)FLACSO, Buenos Aires, Argentina, (8)UBA, Buenos Aires, Argentina, (9)OEI, Santo Domingo, Dominican Republic, (10)Federal University of Sao Paulo, Sao Paulo, Brazil, (11)Millennium Institute for Research in Depression and Personality, Santiago, Chile, (12)Hospital Británico, Montevideo, Uruguay, (13)Universidad de la República, Montevideo, Uruguay*

Background: ASD knowledge, services and research infrastructure in Latin America are limited and unevenly distributed. In 2015, researchers from Argentina, Brazil, Chile, Uruguay, Venezuela and Dominican Republic constituted the Latin American Autism Spectrum Network (Red Espectro Autista Latinoamerica – REAL) in order to conduct international research collaborations related to ASD. The first project undertaken by REAL was the translation, adaptation and implementation of the AS Caregiver Needs Survey. The AS Caregiver Needs Survey was developed by Autism Speaks to assess the needs of families affected by autism in partner countries of its Global Autism Public Health Initiative. It is intended for parents or primary caregivers of individuals with a professional diagnosis of autism spectrum disorder. After translation, adaptation, back translation and pilot testing of the survey, REAL researchers reached a final version by consensus, taking into account caregiver suggestions collected during the pilot phase.
Objectives: To provide a comprehensive picture of the major needs and challenges faced by families affected by ASD in REAL countries with the purpose of successfully enhancing awareness, improving services, and developing long-term policy solutions related to ASD.
Methods: The Caregiver Needs Survey will be broadly disseminated via social networks in REAL countries during a period of 4 months (November 2015-February 2016) so that caregivers can complete it online, either assisted by a clinician or not. The survey solicits information about family demographics, affected individual characteristics, service encounters and parent/caregiver perceptions, including stigma. It is estimated that more than 3000 surveys will be completed in total. After the collection of completed surveys, REAL researchers will proceed to data cleaning and data analysis, and will draft a country and regional report.
Results: A summary of the results from the Caregiver Needs Survey in each REAL country will be presented, and regional similarities and differences will be analyzed.
Conclusions: The assessment of needs and challenges faced by families affected by ASD in different Latin American countries is essential for the identification of knowledge gaps, service needs, and stigma. It is also important in the development of culturally relevant strategies for raising autism awareness, guiding the implementation of successful and improved ASD clinical and educational services at the national and regional levels and setting priorities for future national and regional research collaborative efforts. In this era of globalization, REAL is an attempt to generate a collaborative workforce in order to readily identify the best ways to approach issues related to ASD in Latin America.

201 **182.201** Validation of the Arabic Version of the Social Communication Questionnaire (SCQ)

M. Aldosari[1], *F. Alshaban*[2], *M. Ouda*[3], *S. F. Elhag*[2], *H. F. Alshammari*[2], *A. Alsaleh*[4] *and E. Fombonne*[5], *(1)Center for Pediatric Neurology, Cleveland Clinic Foundation, Cleveland, OH, (2)Neurological Disorders Research Center, Qatar Biomedical Research Institute, Doha, Qatar, (3)National Guard Health Affairs, Riyadh, Saudi Arabia, (4)King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia, (5)Oregon Health & Science University, Portland, OR*

Background:
There is a scarcity of validated autism screening and diagnostic tools for Arabic-speaking individuals which presents a major challenge to clinicians as well as researchers in many countries around the world.
Objectives:
The objective of the study is to evaluate the sensitivity and specificity of the Arabic Version of SCQ.
Methods:
As part of the first country-wide Autism Prevalence Study that is ongoing in Qatar, we translated the Social Communication Questionnaire (SCQ) to Arabic and worked with Western Psychological Services (WPS) to have the back-translation reviewed by author-assigned reviewer. Multiple review cycles were needed prior to agreeing on the final version. The ASD sample was recruited from the Shafalah Autism Center in Qatar (N=35) and form 10 Autism Centers and classes in Saudi Arabia (N=97). The control sample were recruited from 8 schools in Qatar (N=778 recruited by mailing SCQ forms to the families) and 10 schools in Saudi Arabia (N=247 recruited by distributing forms to schools by two of the authors). The study was carried between February and September 2015. We evaluated the sensitivity and specificity of the Arabic SCQ using the published cut-off value of 15.
Results:
The pilot sample included 1060 (132 ASD and 928 Control). We are continuing to recruit more children. The boy to girl ratio was 2.14:1 (92/42; 68.2% male) in the ASD group. In the control group, the corresponding values were 0.60:1 (346/579; 37.3% male). The mean SCQ total score was significantly higher in cases as compared to controls (20.79 (SD=6.4) vs 7.26 (SD=5.0); p<.0001). As expected, the variability was larger in cases than in controls as illustrated by the standard deviations. A total of 184 children (109 cases, 75 controls) had scores equal or above the cut-off of 15; the remaining 23 cases (17.4% of the cases) had scores below the cut-off. An ROC analysis was performed to examine the overall performance of the SCQ. The area under the curve showed excellent discrimination between cases and controls (AUC=0.937; 95%CI: .915-.959). For the established cut-off of 15, sensitivity and specificity were of .826 and 0.919, respectively. Adjacent values for the cut-off were associated with slightly lower overall performance as defined by the sum of the sensitivity and 1-specificity (Yougen index).
Conclusions:
The findings from this study validates the use of the Arabic SCQ as screening instrument with the original published cut-off values.

202 **182.202** An International Review of Autism Knowledge Assessment Measures

A. J. Harrison[1], *M. M. Slane*[1], *L. Hoang*[2] *and J. M. Campbell*[3], *(1)University of Georgia, Athens, GA, (2)Skidmore College, Saratoga Springs, NY, (3)University of Kentucky, Lexington, KY*

Background:
Low-levels of knowledge about ASD symptoms, etiology and treatment can profoundly increase the amount of burden experienced by families with children diagnosed with ASD. Lower ASD knowledge often results in the proliferation of stigmas and misconceptions that disadvantage families impacted by ASD (Khan et al., 2012). ASD-specific knowledge deficits also play a key role in current disparities in the timing and quality of ASD services throughout the United States and globally, particularly in low- and middle-income countries.
Objectives: A primary goal of this review was to examine global use of ASD knowledge measures published in peer-reviewed journals and assess measure adherence to psychometric standards guidelines that define "well-established assessment" practices (Cohen et al., 2008).
Methods:
The present study conducted a systematic review of Western and International literature to examine quantitative measures used to specifically assess ASD knowledge published in. This review identified 39 unique ASD knowledge measures across 52 studies.
Results:
Peer-reviewed research reveals the construct of ASD knowledge has been examined in 18 different countries around the world, 50% (n = 26) were conducted in North America, 15% (n = 8) in the Eastern Mediterranean region, 13% (n = 7) in Europe, 10% (n = 5) in the Western Pacific region, 8% (n = 4) in Africa, and 4% (n = 2) in Southeast Asia. Measures used in each study were evaluated in terms of psychometric strength. Of the 52 studies reviewed, only 7.7% were rated as using a measure with strong psychometric support compared to 46.2% that were rated as using a measure with no reported psychometric support. Most measures examined did not meet the definition for a "well-established assessment" as most researchers developed independent surveys for their specific study. As evidence of this, among the 39 measures examining ASD knowledge, only four meet this best practice assessment standard (Stone, 1987; Bakare et al., 2008, Ross & Cuskelly, 2006; Segall, 2008). Additionally, we examined subdomains of ASD of knowledge assessed. Of 39 different measures, 46.2% (n = 18) examined specific subdomains of ASD knowledge through the use of subscales, such as diagnosis and symptoms, etiology, and treatment (e.g., Bakare et al., 2009; Furnham & Buck, 2003; Heidgerken et al., 2005; Koyama et al., 2009; Kuhn & Carter, 2006; Segall & Campbell, 2012; Shaukat et al., 2014).
Conclusions:
While demonstrating the international relevance of examining the construct of ASD knowledge, this review reveals important concerns about psychometric quality of ASD knowledge measures currently utilized and a lack of measurement consistency in the field. Without defensible utility, inferences made from existing ASD knowledge instruments may counterproductively misguide efforts to study ASD knowledge and related constructs. Based on these findings, we present recommendations for the development of a cross-culturally valid and psychometrically sound measure of ASD knowledge is discussed. Progress toward a more psychometrically sound measure of ASD knowledge is imperative if we are to accurately assess the nature and extent of knowledge disparities and develop successful methods for reducing the impact of low ASD literacy on families.

203 **182.203** Procedures and Compliance of a Video Modeling Intervention for Parents of Children with ASD

C. S. Paula[1,2], *J. J. Mari*[3], *D. Bordini*[4], *D. Brunoni*[5], *S. C. Caetano*[6], *H. Brentani*[7], *T. Ribeiro*[7], *M. C. C. Martone*[8], *G. Rodrigues da Cunha*[9] *and L. Bagaiolo*[6], *(1)Mackenzie Presbyterian University, Sao Paulo, Brazil, (2)Department of Psychiatry, Federal University of Sao Paulo, Sao Paulo, Brazil, (3)Psychiatry, Federal University of São Paulo, São Paulo, Brazil, (4)Departament of Psychiatry, Federal University of São Paulo (UNIFESP), Sao Paulo, Brazil, (5)Development Disorders Program, Mackenzie University, São Paulo, Brazil, (6)Department of Psychiatry, Federal University of São Paulo (UNIFESP), São Paulo, Brazil, (7)Department of Psychiatry, University of São Paulo (USP), São Paulo, Brazil, (8)Universidade Federal de Sao Carlos, São Carlos, Brazil, (9)Federal University of Sao Paulo, Sao Paulo, Brazil*

Background:
Video modeling using ABA techniques is one of the most promising procedures to improve social skills in the ASD population. This method requires less time for training/implementation than live modeling, which can enable its use on a large scale. These aspects are particularly relevant in low-middle-income countries like Brazil, where there is a lack of specialized, trained professionals. However, there are a few studies using video modeling specifically for ASD parental training and most of the clinical trials focus on high-functioning ASD.
Objectives:
(1) to describe a low-cost video modeling parental training intervention based on ABA to improve eye contact, joint attention and decrease disruptive behaviors among children with ASD and (2) to assess the compliance of these participants.
Methods:
Study Design: descriptive study of a clinical trial. **Site**: three specialized health units for children with ASD in São Paulo-Brazil. **Sample**: 66 parents of children with ASD aged 3-6 and with IQ lower than 70, randomized into two groups: 36 families as the intervention group and 36 families as the control group (receiving treatment as usual). *Inclusion criteria*: children having (1) an ASD diagnosis according to the Brazilian version of the ADI-R and a clinical evaluation based on DSM-V, and (2) IQ 50-70 assessed by the SON-R 2½-7, a non-verbal standardized instrument validated in Brazil. **Intervention Model:** the primary outcome of the intervention was to assess the impact of video modeling training on eye contact, joint attention, and disruptive behaviors. The intervention was carried out during 22 weekly sessions. **Assessments**: a package of standardized instruments to assess participants before and after the intervention. To evaluate children: ADI-R; SON-R 2½-7; Autism Behavior Checklist–ABC; Vineland Adaptive Behavior Scales; Eye-tracking tasks; Structured Observation for Autism Screening-OERA; Child Behavior Checklist-CBCL and SNAP-IV Rating Scale. To evaluate parents: Hamilton Depression Rating Scale, Zarit Burden Interview and Adult Self-Report Scale- ASRS-18.
Results:
One of the main results of the study was the development of 15 standardized videos, with varied themes for parents to use on a daily basis with their ASD children. The main themes were related to: (i) management of disruptive behaviors, (ii) prompting hierarchy, (iii) preference assessment, and (iv) acquisition/improvement of eye contact and joint attention.
Compliance with the full intervention program varied from good (75-100% frequency) to reasonable (50-74% frequency) in 70.6% of the participants from the intervention group, distributed as follows: good compliance 32.4% of the group (11 families) and reasonable compliance 38.2% of the group (13 families). 29.4% of the sample (10 families) did not achieve good/reasonable compliance, distributed as follows: 5.9% (2 families) low compliance (25-49% frequency), and 23.5% (8 families) no compliance (0-25%).
Conclusions:
The video modeling parental training model seems promising, feasible, and an inexpensive way to offer assistance to children with ASD and low IQ. After proving its efficacy, this model can be replicated in bigger samples and populations with a lack of access to treatment services, making a major impact on ASD treatment in Brazil and potentially in other Portuguese speaking countries.

204 **182.204** Behavioral Treatment and Educational Intervention Received By Children with Autism in Ethiopia

W. Zeleke *and M. Chitiyo, Duquesne University, Pittsburgh, PA*

Background: Autism is one of the childhood disorders that has received a lot of attention in most developed countries. There is a clear imbalance of knowledge about autism spectrum disorders and its intervention worldwide. Most of what we know about the epidemiology, diagnosis, and treatment of autism is based on research conducted in developed countries. A few studies conducted in various African countries report that the awareness of autism in Africa is beginning to improve and parents of children are striving to find service for their children with autism. That is certainly the case in Ethiopia too. However, our knowledge about the current practice on autism intervention and how children with ASD and their parents received service in Ethiopia is limited due to lack of scientific studies.
Objectives: The Autism treatment and service providers' confidence survey was developed mostly based on the work of Green etal (2006) to identify strategies used in behavioral treatment and education of children with ASD in Ethiopia and to measure the level of confidence that the service providers have in providing the service for children with ASD
Methods: Using convenience/ purposive sampling, 102 service providers (teachers, nurse, psychologist, social worker, special need educators and therapeutic care worker) completed the survey. Descriptive statistics and t-test used to analyze the results.
Results: Skill based intervention such as *self help skills, play, using rewards, art therapy, music, sand/clay therapy, and ABA* was the most frequently used intervention, followed by Interrelationship based (*modeling, direct instruction, social skills, social stories, experiential activity*) intervention and intervention focused on Language and Communication base treatment. Absence of pre-service and in-service training on autism found to be the common problem that the participants reported. Sixty five percent of the participants also rated their confidence on understanding and treating autism spectrum disorder low.
Conclusions: Result highlighted clear implication for pre-service and in-service training and the need for continued research to document the intervention strategies use in autism center in Ethiopia

205 **182.205** Ignoring the Odds: The RISE in Autistic Spectrum Disorder in Libyan Children and EARLY TV Viewing "Libyan Vision"

ABSTRACT WITHDRAWN

Background: There is a strong belief among most Libyan's newly married couples that early TV viewing can be responsible for Autism in children. Anecdotal and clinical reports indicate that early use of television can be a clinically significant problem to the extent that it may lead to impairment of communication and socialization. However, this phenomenon has not been examined thoroughly in Arabic population.

It's estimated that approximately 7 out of every 1000 Libyan children has an autism spectrum disorder, according to Zeglam and etal's study. Children with autism seem to be particularly drawn to certain channels and programs on satellite TV.
Objectives: to examine the prevalence of ADS in Tripoli, Libya and correlates of early TV viewing among a large nationally representative sample of children with ASD.
Methods:
This was a large hospital-based study. The study's two-stage sampling involved first studying the prevalence of ASD; and then All the families of children with ASD attended between Jan.2015 and Jun.2015 (267 children) weighted to be nationally representative of children with ASD were asked two specific questions related to TV watching. All children enrolled in this category did met full DSM-V criteria for an ASD. We compared these children with those who are normal and attends mainstream nurseries.
We examined two dependent measures of TV use. A measure of duration of exposure and a measure of age exposure. Children were identified as having an ASD through screening of all children referred to the Neurodevelopment Clinic of Al-Khadra Teaching Hospital (NDC-KH), Tripoli, Libya between June 2011 and June 2015 with the diagnosis of speech and language disorders or behavioral difficulties. Children were reviewed, scored and classified by a clinician (AZ) as having ASD if they displayed behavioral abnormalities consistent with DSM-IV & V for diagnosing ASD.
Results: Total number of children seen in all Pediatric clinics were 321251.Children diagnosed with ASD were 2170 which gives the prevalence of 7:1000.
Using Mann-Whitney test we found that 15% of infants and toddlers watched TV on an average of 2 - 4 hours a day while 46% watched TV for more than four hours (p-value < 0.001). 34% & 33% of infants and toddlers were put in front TV in the first six months and between six and 12 months of age respectively. Only 10% of children watched TV after first 12 months of age (p-value< 0.001).
Infants under age of 12 months watched an average of about 4 hours of TV a day.
Conclusions: Consistent with our expectations, we found a very high rate of use of TV among children with ASD. Our findings conclusively demonstrate that early exposure to TV can account for the rise in prevalence of ASD in Libya over the last five years. The current study is the first to examine the prevalence and correlates of TV use among a large nationally representative sample of children with ASD in Libya and probably in Africa. Our study has provided support that early TV viewing might be associated with autism.

206 **182.206** Pattern of Behavioural Deficits Among Nigerian Children with Autism

A. T. Olagunju[1], *Y. O. Oshodi*[2], *M. A. Oyelohunnu*[3], *E. A. Campbell*[3], *B. Fadipe*[3], *C. S. Umeh*[4], *O. F. Aina*[4], *W. A. Oyibo*[5], *A. E. Lamikanra*[6], *A. Lesi*[7] *and J. D. Adeyemi*[4], *(1)Department of Psychiatry, College of Medicine, University of Lagos, Lagos, Nigeria, (2)Department of psychiatry,, College of medicine, university of Lagos., Lagos, Nigeria, (3)Department of Psychiatry, Lagos University Teaching Hospital, Lagos, Nigeria, (4)Department of Psychiatry, College of Medicine, University of Lagos, Lagos, Nigeria, (5)Department of Medical Microbiology and Parasitology, College of Medicine, University of Lagos, Lagos, Nigeria, (6)Wuhan Polytechnic University, Frisco, TX, (7)Department of Pediatrics, College of Medicine, University of Lagos, Lagos, Nigeria*

Background: Beyond diagnosis of autism spectrum disorder (ASD), interventions are best if need-tailored and predicated on what is known about specific behavioural deficits.
Objectives: This study is set to profile behavioural and emotional problems among children with ASD in a resource restricted setting.
Methods: The study participants were made up of 100 children with ASD and their caregivers recruited during the annual autism project done in 2014 and 2015. This autism program is anchored through the collaborative partnership among College of Medicine, University of Lagos; Guaranty Trust Bank and Blazing Trail International, USA. A designed questionnaire was used to collect socio-demographic, clinical and psychosocial characteristics of the participants. Following screening with the Modified Checklist for Autism in Toddlers (M-CHAT) and Childhood Autism Spectrum Test (CAST), clinical diagnosis of ASD was done based on DSM-V criteria. Subsequently, the Strengths and Difficulties Questionnaire (SDQ) was used to profile behavioural and emotional problems across multiple dimensions among the participants.
Results: The mean ages of the children, their mothers and fathers were 7.7(±5.7), 38.9 (±6.7) and 43.7 (±7.2) years respectively. Majority of the children (74%) were males and more than four-fifths of their mothers (87%) and fathers (81%) had tertiary education. Close to two-thirds (63%) of the children with ASD reported various degrees of difficulties as shown by overall SDQ score that ranged from high (39%) to raised (24%) difficulties. The domain score on peer problems showed the worse level of deficits, with up to 80% reporting more than average difficulties, while 67%, 36% and 17% of participants reported considerable behavioural difficulties with respect to hyperactivity, prosocial and emotional issues respectively. All participants indicated this encounter to be their index evaluation despite 80.5% of them having had the behavioural problems for more than one year.
Conclusions:
Our study observed varying degrees of difficulties across the behavioural dimensions of SDQ among children with ASD, with worse deficits reported on domains capturing "externalized symptoms". Given the array of "unattended'' behavioural problems profiled among children with ASD, there is need for sustained resources including research, training and intervention to address these behavioural challenges.

207 **182.207** Translation and Cultural Appropriateness of the ADOS-2 in Afrikaans

ABSTRACT WITHDRAWN

Background: A key need in diagnostic practice for autism spectrum disorder (ASD) in South Africa is to generate acceptable and valid diagnostic tools in the official languages of the country. The Autism Diagnostic Observation Schedule-2 (ADOS-2) is one of the "gold standard" diagnostic aids for ASD and it is increasingly used in South Africa. However, its use is limited to English-speakers, as it has not been translated into any of South Africa's other 10 official languages. Moreover, the cultural appropriateness of this tool for the local cultures of South Africa, or the implications of low socio-economic status has not been explored.
Objectives: Given that approximately 50% of the population of the Western Cape province of South Africa speak Afrikaans as primary language, we wanted to focus on the Afrikaans ADOS-2. The primary objective was to determine the cultural appropriateness of the tool for Afrikaans-speakers in low to middle income communities. Three components associated with method bias were examined 1) the language used in the Afrikaans-translated ADOS-2, 2) the social interactions and activities in the ADOS-2, and 3) the ADOS-2 materials.
Methods: A mixed method and qualitative thematic approach was used to analyse the data collected through interviews and questionnaires. The ADOS-2 was translated into Afrikaans and we assessed its cultural appropriateness for the 'coloured' (mixed ancestry) population from low to middle socio-economic backgrounds residing in the Western Cape. An ethnographic investigation of play, social interaction, and social activities was conducted in a community sample (n = 40) and the Afrikaans ADOS-2 was pre-piloted in a clinical sample (n = 7). The ethnographic component was included given that there was no existing literature for this socio-cultural group. Community sample participants were interviewed and asked questions pertaining to what games their children played, what materials they played with, and whom they played with (on own, with peers, with adults). ADOS-2 materials were shown to community and clinical sample participants, who were asked to comment on their children's familiarity with the materials.
Results: The findings highlighted numerous unique aspects of the vernacular of Afrikaans spoken by this population ("Kaaps") including the dialect spoken and use of code-switching (rapid switching between Afrikaans and English). The ethnographic exploration of play (on own, with peers, with adults) indicated that the social interaction expectations in an ADOS-2 assessment between child participant and examiner and adults seemed culturally appropriate and that most of the ADOS-2 materials and activities were familiar and appropriate. The materials raising the most concern included the frog toy (fear-inducing) and the PinArt (unfamiliarity). Gender stereotypes associated with play materials were also noted frequently.
Conclusions: With appropriate cultural and clinical sensitivity during administration, we found the Afrikaans ADOS-2 to be useful and culturally appropriate for Afrikaans-speaking, coloured individuals from low socioeconomic backgrounds in the Western Cape. We recommend a similar parallel process when translating the ADOS-2 into other languages spoken in South Africa, as well as a similar ethnographic exploration in other communities where little is known about play, social interaction, and social activities.

208 **182.208** Prevalence and Capacity Building in Brazil

C. S. Paula[1], *D. Bordini*[2] *and R. Lowenthal*[3], *(1)Developmental Disorder Program, Mackenzie Presbyterian University, Sao Paulo, Brazil, (2)Departament of Psychiatry, Federal University of São Paulo (UNIFESP), Sao Paulo, Brazil, (3)Ambulatorio de Autismo Marcos T Mercadante, CAISM, Santa Casa de São Paulo, Sao Paulo, Brazil*

Background: In Brazil, a single study reporting ASD prevalence in the childhood has estimated a rate of 0.3%, which is probably an underestimate due to methodological limitations. This research also showed that most of the positive cases had no previous diagnosis of ASD, and it is known that early identification is one of the main predictors of functional outcome and social adaptation in patients with ASD.
Objectives: (1) to present results from a recent prevalence study conducted in four Brazilian regions; (2) to evaluate the impact of a pilot training program on ASD identification offered to professionals from the Public Health system.
Methods: Study 1 **-** *Design*: Multicenter cross-sectional-study. *Sample/Settings*: 1,715 students (aged 6-16) from 2nd-6th grade enrolled in elementary public school, from four towns from four out of five Brazilian regions, were randomly selected. *Instruments*: (i) screening ASD: subscale of the K-SADS-PL; (iii) Estimated IQ: two subtests (Vocabulary and Blocks) of the WISC-III; (iii) Service use: structured questionnaire developed by our research team.
Study 2 **–** *Participants/training program*: the training program offered to 20 primary care providers (most pediatricians) consisted of five three-hour weekly training sessions comprising two hours of lectures and one-hour case discussion. The main themes delivered by ASD experts were: epidemiology; ASD symptoms and early signs; and evidence-based treatments. The main objective of the training was to improve detection of suspected cases of ASD and to refer them to the single local specialized unit. *Assessments*: (1) to measure the knowledge acquisition, a structured questionnaire comprising of 13 multiple-choice questions and vignettes of clinical ASD cases was developed by our research team (applied before and immediately after the training). (2) to identify changes in the clinical practice, we compared data on the amount and

profile of suspected ASD cases referred for these professionals to the specialized unit, four months before and after the conclusion of the training.
Results: Study 1**:** the estimated prevalence rate was 1%. Among the positive cases, (a) 62.5 % were male; (b) 12% had average/normal IQ; and (c) only 56.3% had been seen by a health specialist (psychologist/neurologist/psychiatrist) in the previous year, and 37.5% had received specialized educational support in the same period.
Study 2: health providers significantly improved their ASD knowledge after training in comparison with pre-training [mean score 6.73 vs 9.18 ($p<0.01$)]. Clinical practice also changed: they had referred 6 times as many suspected cases of ASD to a specialized mental health service four months after the training program in comparison with the previous four months.
Conclusions: The prevalence of ASD identified in this study is in accordance with international rates. Only a small proportion of youth with ASD had been seen by a health/educational specialist in the previous year. The pilot training-model presented seems a promising, feasible and inexpensive way to improve early identification of ASD in the primary care system.

209 **182.209** Self-Descriptions By Individuals with Autism Spectrum Disorder in New Delhi and Los Angeles: The Power of Cultural Context

ABSTRACT WITHDRAWN

Background:
Most research on ASD to date has focused on the immediate social skills, rather than the broader cultural skills, of individuals with ASD. Cross-cultural research has shown that cognitive and emotional patterns may differ significantly across cultural contexts. For instance, decades of research have shown that individuals in Western cultures have overall more autonomous, and more abstract, self-concepts, compared with individuals in non-Western cultures, who have more social and specific self-concepts (Markus and Kitayama, 1991; Rhee et al. 1995). It is unclear whether individuals with ASD, who have impairments in self- and other-understanding, will acquire the relevant cultural patterns regarding self- and other-concepts; or whether their social impairments will extend to broader cultural impairments. Here we present the first test, to our knowledge, of self- and other-concepts in a cross-cultural sample of individuals with ASD in Los Angeles, USA, and New Delhi, India.
Objectives:
To determine whether self-descriptions by Americans with ASD are more autonomous and abstract, and less social and specific, than those of Indians with ASD, as would be predicted from their cultural context (Rhee et al., 1995).
Methods:
Thirty-two high-functioning youth with ASD (6 females; *M*=12.4), and 30 age-, gender- and IQ-matched typically developing (TD) controls were interviewed in Los Angeles. Twelve high-functioning adults with ASD (2 females; *M*=25.1) and 12 TD adults, matched for age, gender, language preference and income, were in interviewed in New Delhi. Participants were asked to describe themselves in as many ways possible, starting with "I am…". Transcripts were parsed into phrases and coded by 2 coders blind to location and diagnosis according to 28 sub-categories (e.g., traits, evaluations, emotional states), categorized as social/autonomous and abstract/specific based on Rhee et al. (1995).
Results:
Participants with ASD provided marginally fewer relevant responses, compared with TD participants, across both cultures ($F(1,94)=3.02$, $p=.086$). Individuals in Los Angeles were significantly more likely to self-describe in autonomous ($F(1,85)=9.33$, $p<.01$) and abstract ($F(1,85)=51.5$, $p<.001$) ways, compared with individuals in New Delhi. We found no significant effect of Group, nor interaction effect, for either axis of interest: social/autonomous and specific/abstract.
Conclusions:
Our findings demonstrate that, despite their difficulties with self- and social-understanding, individuals with ASD *are* sensitive to their cultural contexts. Indeed, group differences between TD and ASD individuals appeared insignificant compared with the significant cross-cultural differences in self-description between individuals in New Delhi and Los Angeles. Care was taken to match ASD and TD individuals in each culture on relevant characteristics; though our cross-cultural comparison is limited in that American participants were youth, and Indian participants were adults. Our findings have important social implications: demonstrating that (a) individuals with autism *can* acquire cultural schemas from their surroundings; and that (b) relatively speaking, ASD and TD individuals in each local culture share a much more similar self-concept than do individuals from different cultures.

210 **182.210** The Profile and IMPACT of ASD and Other Neurodevelopmental Disorders: Comparison and Predictors from India

***B. Koshy**, M. Manoharan, R. Roshan, L. Samuel and R. Beulah, Developmental Paediatrics, Christian Medical College, Vellore, Vellore, India*

Background:
Autism spectrum disorders (ASD) and other neurodevelopmental disorders (NDD) impact families adversely. Published studies state that families of children with ASD report a higher impact than those with other NDD. There is a paucity of data evaluating these concepts in the Low Middle Income Countries (LMIC).
Objectives:

1. To compare the profiles and impact on families of children with ASD and those with other NDD
2. To understand the predictors for the impact on families of children with either disorder

Methods:
All families who were welcomed to an inpatient residential facility attached to the Developmental Paediatrics Unit in a tertiary care centre in India for detailed assessment and interventions from January 2015 to September 2015 were included in the analysis. The child was diagnosed by a multidisciplinary team of paediatricians, psychologists and therapists. The ASD diagnosis was confirmed by DSM-V and Childhood Autism Rating Scale (CARS). The Revised Impact on Family questionnaire was administered to all families to assess the impact.
Results:
196 children, 114 NDD and 82 ASD were included in this study. The distribution of age and developmental delay were similar in both groups. The ASD group had significantly more proportion of males (p=.00). Mother's education was higher for the ASD group than the NDD group (p=.05); both groups significantly better than the national average (p=.00). Professional occupation for fathers was reported significantly higher for the ASD group than the NDD group (p=.01); both groups significantly better than the national average (p=.00).
Both families of children with ASD and other NDD reported high impact on the family. There was no significant difference between the reported impact of ASD and NDD (37 and 37.75 respectively; p=.99). None of the usual factors including age, gender, associated developmental delay, mother's education, father's occupation and associated sleep problems predicted the impact on family. The severity of autism also did not predict the impact model for families of children with ASD.
Conclusions:
Families who actively sought help for both ASD and NDD belonged to a better socio-economic class compared to the average Indian demographic profile. Both ASD and NDD have high impact on families. Further studies need to evaluate the care seeking pattern of families as well as alternate models for impact on family for developmental disorders including ASD in the Low and Middle Income countries.

211 **182.211** Communication and Interaction in Autism Research - Perspectives from Volunteers and Scientists

***J. J. Finnemann**[1,2] and K. Plaisted Grant[1], (1)Department of Psychology, University of Cambridge, Cambridge, United Kingdom, (2)Brain Mapping Unit, Department of Psychiatry, University of Cambridge, Cambridge, United Kingdom*

Background:
Recent years have seen an increased awareness of the cultural and ethical challenges in autism research and the unease within the autism community with regard to the perceived attitudes of scientists conducting research into ASC (Pellicano & Stears, 2011). A large-scale study on the landscape of autism research pointed out that the autism community is not satisfied with the distribution of funding for different areas of research and furthermore that there is a discrepancy between researchers' perceived engagement with the autism community and the experience of autistic people themselves (Pellicano et al., 2014).
Objectives:
This study aims to achieve a better understanding of the dynamics that underlie the apparent 'rift' between autism researchers and individuals with ASC with a particular focus on the communication and interaction between researchers and study volunteers.
Methods:
Individuals with ASC and autism researchers were invited to fill in a mixed-methods survey covering the following topics: involvement in autism research, ethical concerns about autism research, relevance & impact of autism research, communication of research results, media representation of autism, misconceptions in autism research, community engagement in autism research and the idea of neurodiversity.
The questionnaire was piloted with a small sample of ASC participants (N=16) in 2011 and feedback about the issues covered and the format of the survey was obtained.
To date, 100 individuals with ASC and 65 autism researchers have completed the survey; data collection is on-going until mid-2016.
Quantitative data is analysed with the appropriate chi-square and regression analyses whilst a grounded theory approach is used to elaborate on data trends and code the answers to open-ended comments.
Results:

The level of concern about ethics in autism research was similar in both groups (χ^2=1.56, p=0.21), but the areas of concern differed between the groups with the exception of the search for a cure which was mentioned by both groups. In addition to these concerns, individuals with autism were on average less optimistic about the potential of research to improve the lives of people with autism (χ^2=12.20, p=0.0005) and the majority (58%) was not satisfied with the way research was communicated to them. However most respondents would still like to be more involved in research (84%). At the same time researchers stressed that they would like to see more translational goals in research and improved communication between participants and scientists, but notably significantly more ASD participants felt that there is a divide between the scientific and the autism community (χ^2=8.898, p=0.003).

Conclusions:

The survey illustrates that while researchers and individuals with autism agree about certain aspects concerning the quality, purpose and ethical challenges of research, there are also still areas of disconnect and dissatisfaction. While one has to recognise a certain diversity of opinion, the emerging themes of this survey suggest that culturally sensitive research approaches and meaningful community involvement could improve the relevance of the research that is conducted. It remains to be seen what format best supports a mutual transfer of expertise between researchers and research participants to address these disparities.

212 **182.212** Social Desirability, Collectivism/Individualism and Stigma Towards Individuals with Autism Spectrum Disorders (ASD) in Japanese and American College Students

F. Someki[1], *M. Torii*[2] *and K. Gillespie-Lynch*[3], *(1)College of Staten Island, Staten Island, NY, (2)Kobe University, Kobe, Japan, (3)City University of New York, College of Staten Island, Staten Island, NY*

Background:

Stigma associated with ASD is apparent around the world (e.g., Dachez et al., 2015; Jones & Harwood, 2009; Bie & Tang, 2015). Recent cross-cultural research revealed that stigma towards ASD is higher in Japan and Lebanon than it is in the U.S. (Obeid et al., 2015; Someki et al., 2015). In Lebanon, where autism services and research are scarce, higher stigma co-occurs with reduced knowledge relative to the U.S. (Obeid et al., 2015). However, stigma is also heightened in Japan, which has a relatively long history of autism research (Volkmar et al., 2007). Therefore, knowledge differences are unlikely to be the only factor underlying cross-cultural differences in stigma.

Both Lebanon and Japan are more collectivistic than the U.S. (Matsumoto et al., 2008). Collectivism is more common in relatively homogeneous cultures like Japan while individualism occurs more in heterogeneous cultures like the U.S. (Triandis, 1993; Hofstede, 1980). Individualistic societies may be more tolerant of differences (Triandis, 1993), which might lessen stigma towards ASD. Social desirability may also influence self-reports of stigma. Individuals who value social desirability are guided by the desire for social approval, which is more important in collectivistic societies. Being female and greater ASD knowledge were significantly associated with reduced stigma towards ASD in the U.S. but not Lebanon (Obeid et al., 2015). In the current study, we examine if ASD knowledge, individualism-collectivism, social desirability and gender underlie heightened stigma in Japan relative to the US.

Objectives:

1) Compare stigma associated with and knowledge about ASD among Japanese and American college students; and 2) Examine if gender, ASD knowledge, social desirability and collectivism-individualism underlie cross-cultural differences in stigma.

Methods:

A total of 391 American college students (234 women, 157 men) and 165 Japanese students (41 women, 124 men) completed an online survey consisting of a demographic questionnaire, Social Distance Scale (assessing stigma; Gillespie-Lynch et al., 2015), Adapted Autism Awareness Scale (assessing knowledge; Gillespie-Lynch et al., 2015), Social Desirability Scale (Reynolds, 1982) and Vertical-Horizontal Individualism-Collectivism scale (Triandis & Gelfand, 1998).

Results:

American students reported less stigma towards ASD, $F(1,549) = 104.43$, $p < .001$, than Japanese students. However, there was no difference across countries in overall ASD knowledge, $F(1,549) = .005$, $p = .94$.

A regression analysis revealed that being Japanese ($\beta = -.31$; $p<.001$), being male ($\beta = -.01$; $p=.045$), less ASD Knowledge ($\beta = -.33$; $p<.001$), less social desirability ($\beta = .10$; $p=.008$), and higher individualism relative to collectivism ($\beta = .15$; $p<.001$) were associated with greater stigma towards ASD.

Conclusions:

Despite comparable overall ASD knowledge, Japanese college students exhibited greater stigma towards ASD than American students. Cultural and individual factors contributed to stigma but did not account for cross-cultural differences in stigma. Therefore, cultural differences between Japan and the U.S. that were not assessed in the current study (such as possible effects of people with ASD on productivity) likely contribute to stigma towards ASD.

213 **182.213** Environmental Factors in Autism Spectrum Disorder: A Case Control Study from Tunisia

N. Gaddour, *T. Brahim, S. Missaoui, R. Ben Moussa and L. Gaha, University of Monastir, Monastir, Tunisia*

Background: Incidence of Autism Spectrum Disorder (ASD) is increasing dramatically. Although, ASD has a high genetic basis, the role of environmental factors is undeniable.

Objectives: to investigate environmental factors that may interfere with ASD physiopathology

Methods:

A case-control study was conducted from July 2014 to August 2015, at the Child and Adolescent Psychiatry Unit at the University Hospital of Monastir. We included all outpatients diagnosed with ASD seen during their routine follow-up. A control group was chosen randomly in 4 different kindergarten of the region of Monastir. Each group included 200 children, with a sex ratio M/F of 4.2 and a mean age of 3.3 years. ASD was diagnosed according to DSM-IV criteria (including autistic disorder, Asperger's disorder and PDD-NOS) by certified Child and Adolescent Psychiatrists and the Childhood Autism Rating Scale (CARS). We excluded children with neurological or genetic comorbidities. In the control group, we excluded children with abnormal m-CHAT or abnormal psycho-emotional development.

Environmental factors were assessed by a structured questionnaire eliciting obstetric, family and social factors. One-way ANOVA test was used for statistical analysis.

Results:

Statistically significant differences were found for the use of ovulation induction by the mother, and for the proportion of first borns, both factors being more prevalent in ASD group. Partner violence and use of physical punishment were also significantly more reported in ASD group.

No statistical difference was found for the following factors:

- Age of the mother or the father,
- In vitro fertilization and twin pregnancy,
- Mother depression during pregnancy and the use of antidepressant medication during pregnancy
- Work of the mother and duration of maternal leave
- Breastfeeding duration
- Presence of multiple attachment figures

Conclusions:

Some environmental factors may be associated with autism in a way that needs to be further assessed.

214 **182.214** Analysis of Support Devices for Inclusive Education of Students with ASD in the City of Buenos Aires, Argentina

D. Valdez[1,2] *and L. Sueiro*[1], *(1)FLACSO, Buenos Aires, Argentina, (2)UBA. Universidad de Buenos Aires., Buenos Aires, Argentina*

Background:

In Argentina the UN Convention on the Rights of Persons with Disabilities (CRPD) has constitutional status. In practice, this has meant a series of changes in public policies regarding educational inclusion of students with ASD. Historically the families of children with ASD, nucleated in different organizations, have raised claims against policies of exclusion and segregation, calling for support for inclusive education of their children.

Objectives:

The aim of our research is to investigate and analyze current support devices for inclusive education for students with ASD in the Educational System of the City of Buenos Aires offers, considering the public and private sectors in primary and secondary levels. What are its scope and limitations. What are the views of stakeholders protagonists of these formats in the local educational community, teachers and families. What human and material resources they are involved in these processes of inclusion. That is, what transformations and transitions are presented today from the proposals of support devices for learning in mainstream schools and special school. And finally, what future prospects can be drawn from in-depth analysis of the current situation.

Methods:

Participants: 177 students with ASD, through surveys completed by teachers and families.

We have developed two types of surveys: "S" ("School") and "F" ("Family"), which have been distributed in schools and among families.

"S" Survey consists of 30 questions and was given to different school actors (teachers, administrators, supervisors, support teachers) both in mainstream and special schools.

Survey "F" consists of 21 questions and was distributed among relatives of students with ASD of the City of Buenos Aires.

Both surveys share 14 questions, while the remaining questions are specific to each type of survey.

Surveys were self-administered by each participant and their distribution was done in two ways: virtual and in person, according to the possibilities of the participants. After the collection of completed surveys, will proceed to data cleaning and data analysis, considering the different variables and the interaction between these.
Results:
Among the barriers to educational inclusion respondents note the lack of inclusive education policies and projects; prejudice, fear or lack of inclusive values in the educational community and the lack of training of teachers.
The analysis and interpretation of further results is in progress and will be added later.
Conclusions:
Expected from a current state of the situation with regard to supporting devices for the inclusion in the educational system of the City of Buenos Aires, with voices of the actors, directors, teachers and families of students with ASD. In a second phase will be interviewed students with ASD.
This will help provide educational services and support devices increasingly tailored to the needs of people with ASD learning. We believe that our research, the first in the area covering entire education system of the City of Buenos Aires, may contribute to the design of inclusive public policies in education, in order to improve the quality of life and possibilities of autonomy and self-determination of people with ASD.

215 **182.215** The Education Program Changed Knowledge and Stigma Associated with Autism Spectrum Disorder in Japanese High School Students

M. Torii[1] *and F. Someki*[2]*, (1)Kobe University, Kobe, Japan, (2)College of Staten Island, Staten Island, NY*

Background: Autism spectrum disorders (ASD) is often misunderstood in Japan (Koyama et al., 2008), and stigma associated with ASD in Japanese college students was higher than their American counterparts (Someki et al., 2015). Furthermore, even though factors such as gender (i.e., females report less stigma than males) are known to affect stigma associated with ASD in the U.S. (e.g., Tipton & Blacher, 2013), the same tendency was not observed in Japan (e.g., Someki et al., 2015). In contrast, accurate knowledge about positive outcomes of people with ASD contributed to less social distance (i.e., less stigma) in Japanese high school students (Torii et al., 2015). These findings suggest that, in different cultures, different factors impact on stigma towards people with ASD.
Objectives: The purpose of this study was to 1) examine the effectiveness of the education program to increase knowledge and decrease stigma (i.e., less social distance) associated with ASD in Japanese high school students, and 2) examine the relations between stigma and knowledge about ASD, previous direct experiences with ASD, previous learning experiences about ASD, and previous exposure to ASD information in mass media.
Methods: A total of 1,111 high school students (453 males, 649 females) in an urban city in Japan participated in the study. Each participant filled out the pre- and post-test with 32 items: 3 demographic information items (e.g., age, gender), 6 items on previous direct experiences with people with ASD, 9 items on knowledge about ASD, 7 items on life style, and 7 items on social distance towards people with ASD (i.e., stigma measure: Bogardus, 1933). For the intervention, the first author, an expert in ASD, gave a lecture to the participants about these disabilities.
Results: The ASD knowledge mean scores significantly decreased (i.e., gain in ASD knowledge) from the pre-test (M= 2.55, SD= 0.55) to the post-test (M= 2.06, SD= 0.68), t (1,050) = 25.60, p< .01. Further, the social distance mean scores also decreased (i.e., less stigma) from the pre-test (M= 2.36, SD= 0.64) to the post-test (M= 2.12, SD= .64), t (1,076) = 16.35, p< .01. In terms of the relation between stigma and other factors, more accurate knowledge about ASD was strongly correlated with less social distance (i.e., less stigma: Z = .449, p< .01). Additionally, previous experiences interacting with students with ASD, Z =.109, p< .01, learning experiences about ASD in the classroom, Z = .101, p< .01, and previous exposure to ASD information through mass media, Z = .125, p< .01, were all positively related to lesser social distance (i.e., more experiences were related to less stigma).
Conclusions: The ASD education program was proven to be effective for increasing accurate knowledge on ASD as well as lowering stigma associated with ASD in Japanese high school students. Further, more accurate knowledge on ASD as well as previous direct interactions with students with ASD, opportunities to learn about these disabilities, and exposure to information about these disabilities were all correlated with lesser stigma associated with ASD.

216 **182.216** A Profile of Children with Autism in Ethiopia from the Perspective of Parents

W. Zeleke *and M. Chitiyo, Duquesne University, Pittsburgh, PA*

Background: One of the important aspects of autism that could be helpful to researchers in developing relevant interventions for children ASD in Africa is understanding the specific characteristics of ASD in the region. Unfortunately, there are still many unanswered questions on characteristics of ASD in Africa. For example, current research suggests that the stereotypic repetitive behaviors and activities characteristic of ASD are uncommon in Africa (Mankoski et al., 2006). But that research is not conclusive; it will be important to ascertain this difference in terms of specific behaviors. Also, even though Khan and Hombarume (1996) reported autistic typical behaviors among their sample of participants, the sample comprised of children with intellectual disabilities, which could confound the outcome. It is these lingering uncertainties that make the characterization of ASD in Africa unclear.
Objectives: This study aimed to investigate the characteristics of ASD in Ethiopia and to establish a profile of children with ASD in order to promote a better and clearer understanding of the disorder in Ethiopia. It is anticipated that such an effort could enhance better understanding of the disorder and promote better treatment outcomes among the African population
Methods: Survey questionnaires and Focus Group Discussion (FGD) were used to collect data from 85 parents of children with ASD. Descriptive and inferential statistics were run to analyze the data.
Results:
The majority of research participants (85%) reported that even though they noticed their child disability as early as two years old, the average age when their child see a professional for diagnosis was five years old. Parents' reason for seeking help from professional for their child with ASD found to be related to cultural, social, economic and educational factors. Diagnoses for the children was conducted by either a physician or pediatrician (n=55), either a psychologist or counsellor (n=18), or a psychiatrist (n=12). The symptoms leading to the diagnoses included behavioral (n=38), language/communication (n=26), social skills (n=2), or health (n=10). While most did not indicate the types of therapy that the children were receiving, a few indicated their children were receiving speech therapy (n=2) and behavioral therapy (n=21). Some of the children had been receiving therapy for as long as 12 years; 24 indicated that they had noticed change as a result of the therapy while 21 indicated not seeing any change; 20 did not respond.
Conclusions: Parents' awareness of autism is important for early dedication of ASD. It is also noted that cultural context may significance affect the age of identification of the symptoms, seeking intervention, and parents' understanding of the characteristics of autism.

217 **182.217** Age of First Diagnosis in Asian Children at a Regional Autism Clinic

M. Lambha[1]*, J. Mendelson*[2]*, J. Hamel*[3]*, N. Bhuiyan*[4]*, C. Hall*[4] *and D. R. Ussery*[5]*, (1)Marcus Autism Center/Children's Healthcare of Atlanta, Atlanta, GA, (2)Marcus Autism Center, Children's Healthcare of Atlanta, Emory University School of Medicine, Atlanta, GA and The University of North Carolina at Greensboro, Greensboro, NC, (3)Clinical Assessment and Diagnostics, Marcus Autism Center/Children's Healthcare of Atlanta, Atlanta, GA, (4)Marcus Autism Center, Children's Healthcare of Atlanta, and Emory University School of Medicine, Atlanta, GA, (5)Marcus Autism Center, Atlanta, GA*

Background: Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by deficits in social communication, social interaction and restricted, repetitive patterns of behavior/interests (American Psychiatric Association, 2013). ASD diagnoses can be made as early as two years of age (Charman & Baird, 2002), allowing for earlier intervention, which leads to improved outcomes (Dawson, Rogers, & Munson, 2010; Eapen, Crncec, & Walkter, 2013; Reichow, 2012). While prevalence rates of autism has increased and the age of diagnosis has decreased among US children, ethnic differences exist in age of diagnosis (CDC, 2014). Studies have begun to investigate ethnic differences in age of first diagnosis, which has resulted in mixed findings for Asians. Specifically, some research has found that the age of first diagnosis is older in Asians as compared to other ethnicities in the US (Mandell, et al, 2009). In contrast, other research suggests that no significant difference exists between these groups (Windham, et al., 2011).
Objectives: This study examined the age of first diagnosis of Asian children at a regional autism clinic as compared to the ADDM Network's (CDC, 2014) national and state samples (comprised of Caucasian, Hispanic, Asian, and African American children). Further, a comparison was made between the Asian sample and the overall clinic sample. It was hypothesized that the age of first diagnosis for the Asian clinic sample would be significantly older as compared to the age of first diagnosis for the ADDM Network (nationally and regionally) and the overall clinic sample.
Methods: Data from the clinical sample of 59 Asian children (aged 23 to 128 months) who were diagnosed with ASD a regional autism clinic was used. Data from record review included information regarding age (M=55.85 months) and gender (male N = 49; female N = 10). Data from this sample were compared to the ADDM Network's reported national and state mean age of diagnosis using one-sample T-tests.
Results: This sample of Asian children (n=59) did not differ significantly from national norms (CDC, 2014) in terms of age of first diagnosis (53 months), nor did they differ significantly from the overall clinic sample (56 months). However, the age of diagnosis was significantly older than the average for their region as reported by the CDC (2014) (49 months; t=2.22; p<.05), mirroring results from previous work. Further analyses will be conducted to examine possible relations between IQ and region of origin, with age of diagnosis.
Conclusions: Asian children receive a first time ASD diagnosis at an older age within a regional autism clinic when compared to the overall state sample of children. Factors contributing to this may include cultural and/or family influences. This is concerning because important intervention services are implemented later in development and may have less optimal outcomes (Reichow, 2012). However, the findings are not consistent with the national sample and the regional autism clinic, where the age of diagnosis is similar for both samples. This finding shows that compared to the national sample, Asian children from the clinic are being diagnosed at a similar age.

218 **182.218** Barriers to Diagnosis and Treatment of Autism Spectrum Disorder in Latino and White Non-Latino Families

*K. Zuckerman[1], O. J. Lindly[2], N. M. Reyes[3], **A. E. Chavez**[1], K. Macias[4], A. Folan[3], K. Smith[5] and A. M. Reynolds[3], (1)Oregon Health & Science University, Portland, OR, (2)Oregon State University, Portland, OR, (3)University of Colorado - Denver, Aurora, CO, (4)UCEDD Children's Hospital Los Angeles, University of Southern California, Los Angeles, CA, (5)Children's Hospital Los Angeles, Pasadena, CA*

Background: Latino children are diagnosed with autism spectrum disorder (ASD) less often and at older ages than white non-Latino children. Early ASD diagnosis is associated with improved child functioning and better family outcomes. Little is known about barriers families experience to ASD diagnosis, how these barriers differ according to ethnicity and family language, and whether diagnostic barriers relate to subsequent ASD treatment use.
Objectives: To compare barriers to ASD diagnosis and rates of ASD-related service use among Latino and white non-Latino families.
Methods: We surveyed a random sample of parents of Latino and white non-Latino children with ASD seen at academic autism specialty clinics in California, Colorado, and Oregon. Study population included families of children age 2-10 with ASD diagnosis verified by DSM-4-TR or DSM-5 criteria and administration of the Autism Diagnostic Observational Schedule (ADOS). Parents completed a mixed-mode survey in English or Spanish. Survey assessed experience of 15 possible barriers to ASD diagnosis as well as hours of current therapy use. Bivariate and multivariate analyses compared frequency of specific barriers to ASD diagnostic care, total number of barriers, and rates of therapy service use among Latino families with limited English proficiency [L-LEP], Latino families with English proficiency [L-EP], and white non-Latino [WNL] families. Race/ethnicity were per parent report. English proficiency was defined as parent report of speaking English less than “very well.”
Results: 357 families (L-LEP: n=94, L-EP: n=95, WNL: n=168) completed the survey. Families experienced a median of 8 barriers, with L-LEP families experiencing the most barriers (Adjusted Incidence Rate Ratio 1.15 [1.05-1.27] compared to WNL). The most frequent barriers experienced overall were "Diagnostic process stressful for family" (74.9% of families) and "Parent lacked knowledge about ASD" (71.4% of families). On multivariate analysis, the following barriers were more frequent among L-LEP families compared to WNL families: “Parent was afraid to ask for help due to legal problems (Adjusted Odds Ratio [AOR] 13.00, 95% Confidence Interval [5.18-32.62]), “Parent lacked knowledge about ASD” (AOR 3.12 [1.37-7.13]), “Diagnostic process stressful for family (AOR 2.90 [1.37-7.13]), and “Difficult to trust providers” (AOR 2.71 [1.55-4.76]). L-EP and WNL families reported similar barriers, except “Diagnostic process was stressful,” which was less frequent among L-EP compared to WNL (AOR 0.51 [0.29-0.90]). In analyses of service use, experiencing more barriers was significantly associated with currently using <1 hour per week of services per week (AOR 0.40 [0.29-0.54]). L-LEP families were likely than WNL families to receive <1 hour/week of therapy compared to children in WNL families (AOR 3.84 [1.57-9.40]). There were no differences in therapy hours between L-EP and WNL families.
Conclusions: English proficiency is an important marker of barriers to ASD diagnosis and treatment among Latinos with ASD. Children in L-LEP families experienced more frequent and different types of barriers to ASD diagnosis than children in L-EP and WNL families. Improving family knowledge about ASD and trust in providers and the health system may help L-LEP families access earlier diagnosis and treatment.

219 **182.219** Differences in Neuropsychological and Behavioral Profiles of White and Asian Children with Autism Spectrum Disorder (ASD)

***C. Luong-Tran**[1], L. Kenworthy[2], C. Rothwell[3,4], A. B. Ratto[5], L. Mohamed[6], R. E. Shafran[7] and L. G. Anthony[8], (1)Neuropsychology, Center for Autism Spectrum Disorders, Children's National, Rockville, MD, (2)Children's Research Institute, Children's National Medical Center, Rockville, MD, (3)Catholic University of America, Washington, DC, (4)Center for Autism Spectrum Disorders, Children's National Medical Center, Rockville, MD, (5)Children's National Medical Center, Silver Spring, MD, (6)Yale Child Study Center, New Haven, CT, (7)Department of Psychology, Columbia University, New York, NY, (8)Children's National Medical Center, Rockville, MD*

Background: Asian-American children are less likely to be identified with Autism Spectrum Disorder (ASD) relative to White children (CDC, 2014). Understanding the impact of cultural differences on symptom presentation, as well as symptom identification, is important for closing this gap and for guiding appropriate treatment planning. Although researchers have found that cultural factors can account for differences in the neuropsychological profiles of typically developing racial minorities relative to their White peers (e.g., Ardila, Rosselli, Matute & Guajardo, 2005; Kelkar, Hough & Fang, 2013; see also Ponton & Corona-LoMonaco, 2007), no known research studies have compared neuropsychological outcomes of Asian and White children with ASD.
Objectives: This study aims to address the gap in cross-cultural ASD research by comparing executive function (EF) and behavioral profiles of Asian-American and White-American children with ASD.
Methods: Data from participants evaluated at an outpatient neuropsychology clinic between 2014-2015 were drawn from an IRB-approved clinical database. 19 Asian and 19 Caucasian children with ASD were matched by age (*M*=7.97, *SD*=3.80), gender (89.5% male), and nonverbal IQ (*M*=101.53, *SD*=22.35). Parents and teachers completed the ADHD Rating Scale, Behavior Rating Inventory of Executive Function (BRIEF) and Child Behavior Checklist (CBCL). Performance tests included various Wechsler intelligence scales, the Differential Ability Scales, Second Edition (DAS-II), the Test of Everyday Attention for Children (TEA-Ch), and the Tower of London (TOL).
Results: Independent samples t-tests indicated that teachers of students with ASD reported more problems with inattention ($t(21)=-2.961$, $p<.01$) and hyperactivity ($t(21)=-2.729$, $p<.01$) in White children than in Asian children on the ADHD Rating Scale. Parents of Asian children endorsed fewer problems with inhibition, shifting, emotional control, and planning/organization on the BRIEF, while parents of White children rated them to have clinically significant deficits in the same areas. Similarly, teacher responses to the BRIEF identified fewer problems with planning/organization in Asian students. No differences were found on performance tests of EF. Teachers and parents reported greater concerns for aggression and externalizing behaviors in White children on behavioral checklists. Parents of Asian children additionally reported significantly less concerns for internalizing behaviors.
Conclusions: There are clear differences in parent/teacher reports of executive dysfunction and behavioral problems between Asian and White children, while performance test results are similar between groups. In general, White children are perceived to have more (and clinically significant) difficulties in behavior regulation relative to Asian children. This could be related to referral bias, differences in cultural perception/attribution of problems, or cultural differences in the manifestation of problems. This could also represent problems in the cultural sensitivity of parent/teacher report tools. Further research and analysis is needed to confirm these findings.

220 **182.220** Factors Underlying Cross-Cultural and Gender Differences in Stigma Towards ASD: Insights from an Online Training for College Students in Lebanon and the United States

***K. Gillespie-Lynch**[1], N. Najjar Daou[2], M. J. Sanchez Ruiz[3], R. Obeid[4], P. J. Brooks[5], S. K. Kapp[6], F. Someki[5], N. Silton[7] and R. A. Habib[3], (1)CUNY Graduate Center, Brooklyn, NY, (2)American University of Beirut, Beirut, Lebanon, (3)LAU, Beirut, Lebanon, (4)CUNY Graduate Center, New York, NY, (5)College of Staten Island, Staten Island, NY, (6)University of California, Los Angeles, Los Angeles, CA, (7)Marymount Manhattan College, Manhattan, NY*

Background:
In previous work, we documented that stigma towards ASD was heightened in more collectivistic countries (Lebanon and Japan) than in the US. Collectivism has been positively associated with mental health stigma in the UK (Papadopoulos et al., 2013). In our prior work, stigma was higher among males than females in the US; such gender differences were less apparent in Lebanon and Japan. This pattern may arise from individualism-collectivism as gender differences in personality are heightened in more individualistic countries (Costa et al., 2001). Higher quality contact with individuals with ASD is associated with increased acceptance (Gardiner & Iarocci, 2013). We hypothesized that individualism-collectivism, quality of contact, and personality differences might underlie cross-cultural and gender differences in stigma towards ASD.
Objectives:
Examine (1) factors contributing to differences in ASD stigma in Lebanon and the US, and (2) factors that contribute to reductions in stigma following training.
Methods:
College students in Lebanon (N=672) and the US (N=563) completed an online survey, which included pre-tests (assessing ASD knowledge and stigma), an ASD training, which included a manipulation of contact, post-tests, and assessments of individualism-collectivism, social desirability, openness to experience, trait emotional intelligence, autism symptoms, and quality of contact with individuals with ASD. Participants were randomly assigned to one of three “contact” conditions, varying the alleged creator of the training (an autism researcher or a nonverbal or verbal person with autism).
Results:
Due to large numbers of comparisons, $\alpha=.001$. An initial regression analysis with country and gender as predictors of baseline stigma replicated findings of higher stigma in Lebanon, and among men (ps<.001). When the following predictors were included, lower ASD knowledge, lower quality of contact, less openness, lower collectivism, and being male were associated with heightened stigma (ps <.001). Country (p=.009), individualism (p=.013) and social desirability (p=.022) were marginally associated with stigma. Emotional intelligence and symptoms were unrelated to stigma.
Following training, participants reported less stigma (p<.001), with the magnitude of the reduction positively associated with quality of contact (p<.001) and marginally associated with knowledge (p=.004), emotional intelligence (p=.013) and openness (p=.039). The manipulation of contact, social desirability, and symptoms were unrelated to stigma reductions.
Conclusions:
Counter to our hypothesis, greater collectivism was associated with less stigma. The measure of individualism-collectivism used has a vertical dimension (acceptance of inequality) and a horizontal dimension (viewing people as equal) that intersects with the dimension of individualism-collectivism. Greater acceptance of inequality was associated with higher stigma in the current sample. Greater quality of contact and ASD knowledge were associated with lower stigma; both were low in Lebanon where autism resources are scarce. Prior contact predicted the degree to which stigma was reduced with training, which suggests that interventions should include direct contact with people on the spectrum. Our manipulation of “contact” (via the alleged creator of training materials) lacked actual engagement and was ineffective. Findings suggest that equalizing experiences (such as contact) and personality characteristics that contribute to such experiences (such as openness) may reduce stigma towards ASD.

221 **182.221** Factors Effecting the Age at Diagnosis of Autism Spectrum Disorders in the Kingdom of Saudi Arabia

F. Alnemary[1], *F. Alnemary*[1], *H. M. Al Dhalaan*[2], *G. Simon-Cereijido*[3] *and A. Hernandez*[4], *(1)UCLA, Los Angeles, CA, (2)King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia, (3)Communication Disorders, Cal State LA, Los Angeles, CA, (4)Applied & Advanced Studies in Education, California State University Los Angeles, Los Angeles, CA*

Background:
Providing the autism spectrum disorders (ASD) diagnosis early in childhood warrants access to early intervention programs, yet many children are not diagnosed until later in life. While extensive buddy of research is available about factors affecting the age at ASD diagnosis in the western countries, little attention has been directed toward this area of research in Middle Eastern countries.
Objectives:
This study attempted to bridge the gap by identifying these factors among children with ASD in the Kingdom of Saudi Arabia (KSA).
Methods:
Regarding access to and use of services, survey data were collected from 205 caregivers of children with ASD in the KSA or of Saudi citizenships in other counties and were younger than 21 years. Multivariate regression analysis was utilized to characterize the associations of clinical and demographics predictors with the age at diagnosis.
Results: The median age at diagnosis was 3.0 years and was strongly predicted by residing outside the KSA followed by the having no comorbidity, engaging in challenging behavior in first two years, not responding to name in the first two years, and the child age.
Conclusions:
Establishing public laws to ensure access to early developmental screening and comprehensive diagnostic evaluation along with utilizing video-conferencing to provide diagnostic services have the potential to ameliorate disparities in the age at diagnosis in the KSA.

222 **182.222** Study of Changes in Caregiving-Related Parental Stress after Parent Training in Evidence-Based Techniques

M. Diamond[1], *L. Keenan*[2] *and M. Habash*[3], *(1)A Global Voice for Autism, Minneapolis, MN, (2)A Global Voice for Autism, Abu Dhabi, United Arab Emirates, (3)A Global Voice for Autism, Ottawa, ON, Canada*

Background: Families affected by autism in the West Bank experience significant political, socioeconomic and cultural barriers when attempting to access evidence-based autism services. Studies have shown that mothers of children with autism in communities with access to resources experience stress similar to that of a combat soldier. For families who live in communities without resources, this stress is even greater. The lack of professionals qualified to diagnose autism and to provide intervention for children on the spectrum increases parental stress and leads families to feel isolated in raising their children with autism. This study measures changes in parental stress before and after teaching parents evidence-based techniques for supporting their children with autism at home and in the community.
Objectives: To assess changes in parental stress, as related to caregiving for a child with autism prior to and following training in evidence-based intervention techniques.
Methods: A total of twenty-four families (n=24) of children who have been diagnosed with autism spectrum disorders in Jenin and Ramallah Palestine participated in this study, with sixteen families from Jenin and eight families from Ramallah. Primary caregivers answered questions about their own stress and comfort managing their child's behaviors at home and in the community prior to and after taking part in a 12-week parent-training program. Quantitative and qualitative data were collected and analyzed.
Results: Results across the Jenin and Ramallah groups suggested that teaching parents how to utilize evidence-based practices to teach their children with autism new skills significantly decreases parental stress as related to caregiving for children with autism. Furthermore, we observed that teaching parents that they are not at fault for their child's autism is a significant factor in reducing parental stress.
Conclusions: Parent training can benefit parents in conflict-affected communities by teaching them strategies to support their children at home and in the community. Teaching parents that they are not the cause of their child's autism also decreases stress for these caregivers.

223 **182.223** Factor Structure and Psychometric Properties of an Arabic Version of the Autism Knowledge Questionnaire

F. Alnemary[1] *and A. Hernandez*[2], *(1)UCLA, Los Angeles, CA, (2)Applied & Advanced Studies in Education, California State University Los Angeles, Los Angeles, CA*

Background:
The Autism Knowledge Questionnaire (AKQ) was originally developed by Stone (1987) and then modified by Schwart and Drager (2008). The updated version included 20-items that aimed to assess professionals and parents knowledge about etiology, diagnosis, and specific features of autism spectrum disorder (ASD). A four point Likert-type scale (1- Strongly agree, 2- Agree, 3- Disagree, 4-Strongly disagree) is used to respond to the items. Previous research has demonstrated the reliability and validity of this measure in Western countries (e.g., United State; Heidgerken, Geffken, Modi & Frakey, 2005). Yet, no attempt has been made to validate this instrument in Arab world countries.
Objectives:
The purpose of this study was to adopt and examine the psychometric properties of the AKQ among parents of children with ASD in the Kingdom of Saudi Arabia (KSA).
Methods:
A total of 205 caregivers, mostly fathers (61%), of children with ASD and were younger than 21 (M = 8.0; 3.5 SD) years completed an online survey including the AKQ (*See table 1 for sample characteristics*). Exploratry factor anaylsis was used. The Principal Axis Factoring extraction method was selected due to the skewedness of data while Promax rotation method was used as factors were correlated (Costello & Osborne, 2005). The scree plot with the exclusion of the inflexion point's criterion was used to determine the number of factors (Field, 2013).
Results:
Of the 20 items, only 12 items underlie four factors. These factors included: Criteria Necessary To Be Diagnosed With Autism (CN), Descriptive Features (DF), Cognitive Features (CF), and Social Communication Features (SCF). Regarding reliability, Cronbach's alphas for the CN, DF, CF and SCF were 0.67, 0.48, 0.50, and 0.52, respectively. The Cronbach's alphas of these subscales were deemed sufficient, as the instrument is in an early stage of investigation (Field, 2013).
Conclusions:
The AKQ was adopted into Arabic and resulted in excluding some items. However, the modified questionnaire is more suitable to examine parents' knowledge of ASD in the Arab world.

224 **182.224** Study of Changes in Autism Sibling Behavior and Attitudes after Participation in Sibling Support

M. Diamond[1], *L. Keenan*[2] *and M. Habash*[3], *(1)A Global Voice for Autism, Minneapolis, MN, (2)A Global Voice for Autism, Abu Dhabi, United Arab Emirates, (3)A Global Voice for Autism, Ottawa, ON, Canada*

Background: Due to the autism stigma in the Middle East, many family members of children with autism do not talk about their family member's diagnosis outside of the home. Because of this, many siblings of children with autism have never shared their sibling's diagnosis with anyone else and have a limited understanding of autism and how to interact with their sibling. This study measures increases in sibling confidence, understanding of autism and desire to support siblings with autism after participation in a sibling support program.
Objectives: To assess changes in sibling confidence, understanding of autism and desire to support their siblings with autism before and after participating in a sibling support program.
Methods: A total of thirty-three siblings (n=33), between the ages of six and fourteen, of children who have been diagnosed with autism spectrum disorders from Jenin and Ramallah Palestine participated in this study, with 9 siblings from Ramallah and 24 siblings from Jenin. The siblings answered questions verbally at the beginning and end of sibling support sessions and their responses were recorded in writing. Quantitative and qualitative data were collected and analyzed.
Results: Results across the Jenin and Ramallah groups suggested that meeting other siblings of children with autism and learning about their siblings' diagnoses had a substantial impact on participating siblings' desire to support their siblings with autism. Discussions that occurred between siblings also suggest the value of siblings with autism developing relationships with other children with similar experiences. Autism stigma and a desire to hide the autism label from siblings were identified as primary factors preventing social interactions between siblings of children with autism.
Conclusions: Siblings can benefit from sibling support through the formation of friendships with other children with similar experiences, and through increased self-confidence in supporting their siblings with autism. Reducing autism stigma will increase social acceptability of talking about autism diagnoses in Palestine and will facilitate the formation of relationships between siblings of children with autism.

225 **182.225** Study of Effects of Parent Training on Parental Activation in Conflict-Affected Communities in Palestine

M. Diamond[1], *L. Keenan*[2] *and M. Habash*[3], *(1)A Global Voice for Autism, Minneapolis, MN, (2)A Global Voice for Autism, Abu Dhabi, United Arab Emirates, (3)A Global Voice for Autism, Ottawa, ON, Canada*

Background: In spite of frequent autism diagnoses, few services exist to support children with autism and their families in the West Bank, Palestine. Due to the lack of evidence-based programs to support children with autism, many families rely on professionals with little training that use methods with no evidence-based backing and see

few results. These parents develop feelings of hopelessness and believe that nothing will help their children with autism acquire skills. This study investigates the impact of parent training on parental activation in the support of their children with autism in Ramallah, Palestine.
Objectives: To assess changes in parental activation in Palestinian mothers after participation in a 12-week parent training program about evidence-based practices.
Methods: A total of eight families (n=8) of children who have been diagnoses with autism spectrum disorders in Ramallah, Palestine participated in this study. The primary caregiving parent completed Insignia Health's Patient Activation Measure as well as an assessment of parental confidence as related to their child's care in Arabic prior to participating in a 12-week parent-training program. Caregivers and their children with autism then participated in a 12-week parent-training program that included both didactic and theoretical training components. At the end of the program, primary caregivers completed the Patient Activation Measure and parental confidence measure again and changes in activation levels were calculated.
Results: Results suggested that parent training resulted in increased parental confidence in supporting their child's needs as well increased parental activation and ownership over the care of their child with autism. In the six months following the program, we found that parents with higher activation levels at the end of the program had a greater retention rate in the program's follow-up components while there was attrition from caregivers with lower activation scores.
Conclusions: Parent training can increase parental activation by showing parents in conflict-affected communities that they can take ownership of their child with autism's care. Furthermore, parents with higher activation levels are more likely to follow through with support programs for their children with autism and to prioritize their child's needs.

226 **182.226** Development and Adaptation of a Parent-Mediated Behavioral Intervention for Children with Autism Spectrum Disorder in Rural Bangladesh

J. M. Blake[1], *E. Rubenstein*[2], *P. C. Tsai*[3], *H. Rahman*[4], *S. R. Rieth*[5], *J. Chan*[6], *A. Hasmot*[4], *S. Mehra*[1], *A. A. M. Hanif*[4] *and L. C. Lee*[3], *(1)Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (2)Department of Epidemiology, University of North Carolina, Chapel Hill, NC, (3)Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (4)Johns Hopkins University Bangladesh, Gaibandha, Bangladesh, (5)San Diego State University, San Diego, CA, (6)University of California, San Diego, San Diego, CA*

Background: Timely access to behavioral intervention services has been shown to promote positive outcomes for children with Autism Spectrum Disorder (ASD). However, for many children living in low and middle income countries (LMICs), ASD services are rarely available or affordable. In rural northwestern Bangladesh, the lack of existing infrastructure is coupled with low literacy rates, extreme poverty, a dispersed population, limited resources, and inconsistent schooling for children. The combination of these factors makes it extremely difficult to establish clinic or school based ASD intervention programs. Little is known about adapting and implementing interventions and services in such rural communities, but in-home parent-mediated interventions are likely a feasible, low cost, and sustainable approach to address the needs of children with ASD in LMICs.
Objectives: We aim to describe the process of developing and adapting a sustainable parent-mediated ASD intervention for a community in rural Bangladesh and highlight the challenges and barriers to cultural adaptation and implementation.
Methods: In rural northwestern Bangladesh, researchers from the US and Bangladesh have been conducting research as part of a maternal and child health project called JiVitA aimed at improving pregnancy, birth, and child growth and development outcomes. Recently, a community based ASD study aimed to screen and test for ASD and examine risk factors in the study population. The current work builds on this recently completed study. The intervention was developed based on Pivotal Response Training (PRT) techniques and positive behavior support tools. Study investigators worked with US based PRT experts to familiarize themselves in these techniques and develop strategies and educational materials that could be used in a low resource and low literacy community. Study investigators then spent two months in the JiVitA study area to better understand the community's culture and needs. While there, investigators trained a JiVitA master's level child developmental psychologist in this intervention and used his expertise to further culturally adapt the materials. Field implementation is scheduled for winter 2015 and will include two half-day group sessions for parents followed by three individual in-home coaching sessions delivered by the project trained psychologist under the supervision of the study investigators.
Results: Through developing and adapting this intervention, we have gained insight into implementing ASD interventions in a rural Bangladeshi setting where community plays a key role in family dynamics with the broader community oftentimes acting as one family unit. Persons with disabilities (and their families) are often stigmatized within the community. Interventions need to be structured to avoid excess attention to the family or provide a lesser version of the intervention to the whole community. Furthermore, the relationship between parent and child is inconsistent across cultures. Any intervention needs to carefully consider the culturally appropriate role of the interventionist when supporting families of children with ASD.
Conclusions: Developing and adapting ASD behavioral interventions in a LMIC requires careful consideration of an area's knowledge about ASD, approach to parenting, acceptance of disability, cultural child behavior norms, and interaction between the family and community. Further results and findings will be discussed.

227 **182.227** Challenges to Autism Diagnosis and Service Delivery in the Gaza Strip

M. Habash[1] *and I. Habash*[2], *(1)A Global Voice for Autism, Ottawa, ON, Canada, (2)O.B.C, Ottawa, ON, Canada*

Background: The majority of the population in the Gaza Strip still live in refugee camps. The region has suffered major political and economic challenges for many year. Those facts have made the efforts to conduct autism prevalence studies in the Gaza Strip very challenging. Furthermore, organizations and institutions working in the autism domain have not been able to improve the diagnosis or the delivery of services to those who need such services. In particular, cultural and economic barriers have impacted the population of the refugee camps more that those who live in the cities, leading to less chances of children with autism being diagnosed or receiving any form of services.
Objectives: The purpose of this paper is to investigate the challenges facing families of children with autism dwelling the refugee camps in the Gaza Strip and to determine opportunities to provide better access to services for those families.
Methods: Quantitative and qualitative data is collected for this study through volunteer participants and institutions working in the region. A survey has been developed to be using during interviews with families of children suspected to have autism spectrum disorders as identified by public health workers or a professional. The study also utilizes autism prevalence data that was recently published.
Results: This is an ongoing study expected to complete in February 2016. Results will be available upon completion of the study.
Conclusions: The results from this study are expected to highlight the challenges and barriers to accessing services for diagnosis and interventions for families living in the refugee camps in the Gaza Strip, and compare those results to services received by people living outside the refugee camps.

228 **182.228** Engaging Low-Income Latino Families in a Community-Based Executive Function Intervention for Children with ASD or ADHD

J. Safer-Lichtenstein[1], *A. B. Ratto*[2], *M. Biel*[1], *L. Kenworthy*[3], *L. G. Anthony*[4] *and B. J. Anthony*[5], *(1)Georgetown University, Washington, DC, (2)Children's National Medical Center, Silver Spring, MD, (3)Children's Research Institute, Children's National Medical Center, Rockville, MD, (4)Children's National Medical Center, Rockville, MD, (5)Georgetown University, Catonsville, MD*

Background:
Low-income Latino families face critical disparities in access to and involvement in diagnostic and treatment services for autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD). The factors that contribute to this problem are both socioeconomic, including lack of financial resources to pay for services, and cultural, such as lack familiarity with research and medical systems. The handful of prior studies that have investigated the application of treatments for neurodevelopmental disorders with ethnic minority children have indicated that cultural adaptations are likely needed for the successful implemention, although the types of adaptations needed is unclear.
Objectives:
This study made use of Diffusion of Innovation (DOI) theory, which provides a framework for understanding how individuals and groups adopt new behaviors, in this case participation in treatment research, to identify the methodological considerations and adaptations made to research procedures in order to effectively recruit and engage low-income Latino families. Information was collected during the implementation of a PCORI-funded, comparative effectiveness study of two community-based executive function interventions for children with ADHD or ASD.
Methods:
Changes in procedures and measures were crafted based on initial consultation with stakeholders, as well as experiences during implementation of different components of the study: 1) initial contact with parents made by school personnel during the process of identifying potential participants in the study; 2) consultation with a stakeholder advisory board of community advocates, practitioners, and parents; 3) translation of materials and measures by multiple bilingual members of the research team; 4) parent trainings during which families received information on their child's intervention and support strategies to use at home; and 5) contact between parents and a Latina Family Navigator to offer support and answer questions about the program.
Results:
Methodological adaptations to the research protocol were made to more effectively engage Latino families, leading to important lessons regarding their involvement in research process and community based treatment. Within the DOI framework, these adaptations were related first to increasing *awareness* of the link between the intervention and family needs by providing information on the child's problems and how the intervention addresses them. Adaptations were also linked to three key characteristics of the interventions and research protocols that DOI research has identified as influential in determining adoption of innovations: (1) incorporating the role of family in influencing decisions related to engagement, including perceptions of diagnosis and treatment and forming relationships with trusted community members and organizations enhanced *compatibility* with the needs and existing values of families; (2) scheduling logistics, language and educational barriers, financial strain and time constraints were addressed to reduce the *complexity* or the level of difficulty of requirements and procedures; and (3) providing information to establish the *relative advantage* of the interventions over other options.

Conclusions:
The strategies utilized in this study and pragmatic adaptations made over the course of the trial highlight the need for a thoughtful and flexible approach to working with low-income, Latino families in community-based research.

229 **182.229** Autism on the Screen: Shaping Public Knowledge of Autism

A. Nordahl-Hansen[1], *M. Tøndevold*[2] *and S. Fletcher-Watson*[3], *(1)University of Oslo, Oslo, Oslo, Norway, (2)Institute of Special Need Education, faculty of Education, Oslo, Norway, (3)University of Edinburgh, Edinburgh, United Kingdom*

Background:
The film *Rainman* (1988) was a breakthrough in depicting characters with autism spectrum disorders (ASD). In representations since that time, the character's diagnosis may be clearly stated, as in *Rainman*, or diagnostic speculations may stem from the general public (as in the character of *Sheldon Cooper* in *Big Bang Theory*). Despite increases in estimated prevalence of ASD diagnosis globally, most people do not have substantial direct personal experience of the condition. Therefore, it is likely that depictions of characters with ASD on screen have substantial influence on public attitudes towards and knowledge of ASD.
Objectives:
To investigate how characters with ASD are portrayed on screen when assessed against diagnostic criteria. Sub-topics include: a) whether evidence suggests that those characters not explicitly labelled as having an ASD diagnosis would receive a diagnosis in real life; and b) whether specific characteristics associated with ASD (e.g. savant skills) are over-represented on screen.
Methods:
Clinical best estimate evaluations of n=10 characters from film and television were made using DSM-5 and ICD-10 diagnostic criteria. Two raters agreed an evaluation method in partnership drawing on evidence from two characters, and subsequent ratings were performed independently. Raters have at least 15 years' expertise working with autism including work in diagnostic services.
Results:
Characters demonstrated an almost perfect match to diagnostic criteria from both DSM-5 and ICD-10. Thus representations of ASD on screen are not misleading, but could be described as archetypal. The prevalence of savant-like skills is much higher than in the true population. Characters on screen who are not explicitly labelled with a diagnosis do display the full complement of traits employed in diagnosis, but not to an extent that these impact negatively on daily living, and thus real life diagnosis would not necessarily be sought or warranted in these cases.
Conclusions:
Representations of ASD on screen cannot be described as inaccurate, apart from an over-representation of savant skills. In contrast, on-screen characters with ASD present with every associated trait. Narrative imperatives may drive the over-representation of savant skills on screen. This may also explain why characters in long-standing TV series seem to be immune to many of the difficult consequences of autism.
Characters with ASD in television and film play a role in shaping knowledge and awareness of ASD in society. In an ideal world screen representations would not only be diagnostically accurate but also do justice to the obstacles faced by people on the spectrum, while illustrating how people with ASD can achieve great things in a supportive environment. There are examples of both of these representations in our sample, but it is impossible to represent in an individual character the heterogeneity of the autism spectrum. This may contribute to the frequent objections raised by the autism and Autistic communities to characters with ASD on screen. Therefore a goal for the community might be to encourage larger numbers of incidental characters with ASD on screen in order to present a more nuanced picture of the multiple facets of the condition.

Poster Session
183 - Interventions Pharmacologic
11:30 AM - 1:30 PM - Hall A

230 **183.230** Brief Outcomes in Autism Tool (BOAT): Use of a Novel Outcomes Tool to Improve Medication Management in Persons with Autism Spectrum Disorders

E. Pedapati[1], *R. Shaffer*[2], *E. Fox*[3], *L. K. Wink*[4], *R. Ittenbach*[5], *J. S. Anixt*[6], *M. Sorter*[3], *I. A. Badran*[7] *and C. Erickson*[8], *(1)INSAR Cincinnati Children's Hospital Medical Center, Anderson, OH, (2)Cincinnati Children's Hospital Medical Center, Harrison, OH, (3)Division of Psychiatry, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (4)Child and Adolescent Psychiatry, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (5)Division of Biostatistics and Epidemiology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (6)Division of Developmental and Behavioral Pediatrics, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (7)Cincinnati Children's Hospital Medical Center, Mariemont, OH, (8)Cincinnati Children's Hospital Medical Center, Cincinnati, OH*

Background: Many persons with autism spectrum disorders (ASD) suffer from behavioral problems that lead caregivers to seek treatment. The use of medication as an intervention has been climbing rapidly, with recent estimates reporting that the majority of persons, including children, with ASD are treated with at least one psychotropic medication. There is a pressing need to have robust measures that assess not only the impact of medications on symptoms, but also concurrently measure key aspects of pharmacotherapy itself.
Objectives: We sought to develop an instrument to quantify behavioral changes and assess the quality of pharmacotherapy that could be easily and quickly be completed by caregivers in an outpatient setting, both at an initial encounter and for repeated measures. The goal of this scale is to provide valid and reliable caregiver reported measures to guide clinical decision making, especially of the use of pharmacotherapy in ASD.
Methods: We report on a novel ASD-specific 16-item care-giver assessed outcome measure, the Brief Outcomes in Autism Tool for Medications (BOAT-M) that measures clinically relevant dimensions related to pharmacotherapy in youth with ASD including acute symptom burden, overall caregiver perception of medication benefit, medication compliance, effect of medication changes, and non-specific and ASD-specific chronic symptom burden. We describe the design and creation of this measure, including the analysis of a preliminary data set to support the validity and responsiveness of the BOAT-M. The Clinical Global Severity (CGI-S) and Improvement (CGI-I) scale served as a standard to assess the clinical utility of the BOAT-M.
Results: A retrospective chart review of the BOAT form of 253 persons treated over a 3 month period at an outpatient academic child psychiatry practice specializing in developmental disabilities. Two-hundred and fifty three subjects were included in this analysis with basic demographic characteristics and chronic symptom burden presented in Table 1. The summation BOAT-M score (Figure 1) was significantly correlated with the CGI-S for all subjects ($n=233$; $r=0.403$; $p < 0.01$) and ASD subjects ($n=143$; $r=0.374$; $p<0.01$). Normality was confirmed with examination of a Q-Q plot. A higher chronic symptom severity subscale score (SS) was present between ASD and typically developing persons (TDC) ($t=3.5740$; $p < 0.001$). Subscales and clinical measures are reported in Table 2.
Conclusions: The BOAT-M is a 16 item, rapid, self-administered behavioral measure directed toward caregivers with children with developmental disabilities that is divided into 5 scored subscales and 1 summation score. The subscales are Behavioral Severity (BS), Mediation Compliance (CC), Medication Benefit (MB), Medication Change (MC), and Symptom Severity (SS). Initial psychometric properties indicate the summation score is highly correlated to a standardized clinical measure. In addition, chronic symptom burden can be delineated from acute behavioral symptoms. Future directions will investigate changes between multiple visits and sensitivity to treatment response.

	All (n=253)	Autism (n=145)	DD (n=82)	TDC (n=26)
Measure	**Mean (SD)/%**	**Mean (SD)/%**	**Mean (SD)/%**	**Mean (SD)/%**
Age (years)	12.9 (5.9)	13.6 (5.9)	12.2 (6.1)	11.5 (4.1)
Gender (male)	77.9%	80.6%	71.9%	80.7%
Seizures	Incomplete 2.0 %			
Never	156 (75.9%)	116 (80.0%)	56 (68.3%)	20 (77.0%)
Yes, past only	26 (10.4%)	16 (11.0%)	8 (9.8%)	2 (7.7%)
Yes, current	30 (11.9%)	11 (7.6%)	17 (20.7%)	2 (7.7%)
Unsure / Incomplete	5 (1.9%)	2 (1.4%)	1 (1.2%)	2 (7.7%)
Constipation	Incomplete 1.6%			
Never	118 (46.6%)	67 (46.2%)	36 (43.9%)	15 (57.7%)
Present	131 (51.8%)	76 (52.4%)	45 (54.9%)	10 (38.5%)
Insomnia	Incomplete 1.2%			
Never	96 (37.9%)	56 (38.6%)	30 (36.6%)	10 (38.5%)
Present	151 (59.7%)	85 (58.6%)	50 (61.0%)	16 (61.5%)
Self-Injury	Incomplete 1.2%			
Never	119 (47.0%)	66 (45.5%)	39 (47.6%)	14 (53.9%)
Present	127 (50.2%)	76 (52.4%)	40 (48.8%)	11 (53.85%)
Aggression	Incomplete 2.0 %			
Never	56 (22.1%)	27 (45.5%)	19 (47.6%)	10 (53.9%)
Present	192 (75.89%)	115 (79.3%)	61 (74.4%)	16 (61.5%)

Table 1: Medication profiles and associated data of psychiatric inpatients including frequency, descriptive statistics (mean, standard deviation (SD)), and hypothesis testing for overall sample and subsamples based on Autistic Diagnostic Observation Schedule (ADOS) classification.

	All Subjects	Autism	DD	TDC
Subscale	**Mean (SD)[range]**			
BS	n=241 5.4 (2.3) [0,10]	n=149 5.3 (2.3) [0,10]	n=79 5.4 (2.4) [1,10]	n=13 5.5 (2.4) [2,10]
SS	n=227 8.2 (3.0) [1,16]	n=138 8.7 (2.9) [1,16]	n=78 7.8 (2.9) 1,14]	n=11 5.5 (2.2) [2,8]
MB	n=231 2.6 (2.2) [0,8]	n=144 2.5 (2.2)[0,8]	n=74 2.8 (2.2)[0,8]	n=13 2.9 (2.1) [0,6]
MC	n=131 3.1 (2.0) [0,6]	n=82 3.0 (2.1) [0,6]	n=43 3.2 (1.9) [0,6]	n=6 3.7 (2.1) [1,6]
BOAT-M	n=229 13.6 (4.4) [2,23]	n=142 13.9 (4.4) [2,23]	n=74 13.2 (4.5) [2,22]	n=13 12.5 (4.4) [5,21]
CGI-S	n=234 4.1 (0.7) [3,7]	n=143 4.2 (0.7) [3-6]	n=80 4.1 (0.7) [3,7]	n=11 3.5 (0.52) [3,4]
CGI-I	n=233 2.2 (1.4) [0,6]	n=142 2.2 (1.4) [0,5]	n=80 2.1 (1.4) [0,6]	n=11 1.8 (0.9) [1,3]

Table 2: Descriptive statistics of Brief Outcomes in Autism Tool (BOAT) subscales. Acute Behavioral Scale, BS; Chronic Severity Scale, SS; Medication Benefit Scale, MB; Medication Change Improvement Scale, MC; Total BOAT score, BOAT-M; Clinical Global Severity, CGI-S; Clinical Global Improvement, CGI-I.

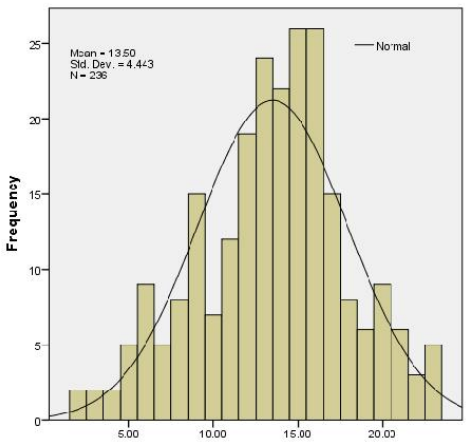


Figure 1: Bell-shaped curve

231 **183.231** Improvement of Daily Living Skills in Adolescents and Adults with Fragile X Syndrome Following MDX (Metadoxine Extended Release) Administration

E. Berry-Kravis[1], *J. Rubin*[2], *E. Harary*[3] *and Y. Daniely*[3], *(1)Pediatrics; Biochemistry; Neurological Sciences, Rush University Medical Center, Chicago, IL, (2)Alcobra Pharma, Plymouth Meeting, PA, (3)Alcobra, Ltd, Tel Aviv, Israel*

Background: Fragile X Syndrome (FXS) is a rare genetic disorder characterized by Intellectual Disability and/or Learning Disability in association with a constellation of neuro-behavioral problems, including Autism Spectrum Disorder (ASD), Attention Deficit Hyperactivity Disorder (ADHD), anxiety, and repetitive behaviors. Metadoxine (pyridoxol L-2-pyrrolidone-5-carboxylate) is an ion-pair salt of pyridoxine (vitamin B6) and 2-pyrrolidone-5-carboxylate (PCA, also known as L-PGA) that has been used outside of the US in an immediate-release form for more than 30 years to treat acute alcohol intoxication, alcohol withdrawal syndrome, and chronic alcoholic liver disease. Metadoxine extended release (MDX) is a dual-release formulation of metadoxine, demonstrated to be a modulator of GABAergic transmission with a monoamine-independent mechanism of action, and which reverses phenotypes in the mouse model of FXS. In a phase 2, 6-week, randomized, multi-center, double-blind, parallel, flexed- and fixed-dose trial of MDX compared with placebo in adolescents and adults with FXS, the ADHD-RS IV, the primary outcome failed to show improvement, while the Vineland II Daily Living Scale (DLS), a secondary outcome, was significantly improved on MDX versus placebo.
Objectives: To fully characterize the effects of MDX on the Vineland-II DLS in FXS.
Methods: Subjects enrolled in the study were males and females with molecular diagnosis of FXS, (≥200 CGG repeats, in *FMR1*) 14 to 55 years, with a score ≥12 on the inattentive subscale of the ADHD RS-IV. Improvements in the group assigned to MDX, in comparison with the placebo group, with a secondary efficacy assessment, the Vineland Adaptive Behavior Scale, Expanded Interview Form, Second Edition (Vineland-II) DLS were characterized in detail by using item analysis and correlating results with other outcomes.

Results: 62 subjects were randomized (MDX 30; placebo 32). The primary analysis, the MMRM LS mean change from baseline to week6/early termination in the ITT population was significant on the DLS domain standard score (p=0.04) and the community subdomain v-scale score (p=0.004), and was not significant for the personal and domestic subdomain v-scale scores. These results were strengthened when the ITT population was limited in a post-hoc analysis to subjects with normalized IQ from 40-85 and ages 14-40.
Analysis of individual items in the DLS domain demonstrated significant effects ($p<0.05$) for several questions such as: seeks medical help in emergencies, plans and/or organized daily work, and carries out multi-step tasks. For most of these items, the MDX placebo difference in the mean change from baseline to week 6/ET was 0.5 to 1, demonstrating a categorical improvement. Items from objective secondary measures in the trial directly assessing the subject (KiTAP Distractibility and Go/No-Go computerized tests, and RBANS-List Learning), produced supportive correlations ($r>0.25$, $p<0.05$) with improvements on the DLS domain.
Conclusions: MDX demonstrated a statistically significant effect on the Vineland-II DLS domain in FXS. Item analyses suggested clinically meaningful changes in areas related to daily living skills, and correlations with other objective outcomes strengthened the effect.

232 **183.232** Medication Knowledge, Attitudes, and Readiness for Transition to Healthcare Self-Management in ASD

L. B. Silverman[1], *K. M. Brown*[2], *M. A. Steingraeber*[2], *J. Aldrich*[1], *T. Smith*[1], *D. Harris*[3] *and L. P. Shone*[3], *(1)Division of Neurodevelopmental and Behavioral Pediatrics, University of Rochester Medical Center, Rochester, NY, (2)University of Rochester, Rochester, NY, (3)American Academy of Pediatrics, Elk Grove Village, IL*

Background: An estimated 30 to 60 percent of individuals with autism spectrum disorder (ASD) take at least one psychotropic medication. Despite widespread use, little is known about child and caregiver knowledge of medication regimens, attitudes towards taking medications, and perceived readiness for medication self-management. Addressing these questions has significant implications for adherence and treatment outcomes.
Objectives: To quantify medication knowledge, attitudes, and perceived readiness for transition to healthcare self-management in adolescents with ASD and their parents.
Methods: Participants were 22 high-functioning adolescents with ASD between 14 and 17, and 22 of their parents. Both groups completed an hour-long interview and electronic survey addressing these topics. Medication knowledge was quantified via survey questions asking for a list of current medications, and reasons for each medication. Medication attitudes were measured using a modified version of the South Hampton ADHD Medication Behaviour and Attitudes Scale (SAMBA; Harpur et al., 2008). Participants indicated the extent to which they agreed with statements about medication use, via a 32-item, 5-point Likert scale (1=strongly disagree, 5=strongly agree). Mean subscale scores were calculated, quantifying perceived costs and benefits of medication, patient stigma, and resistance to treatment. Readiness for healthcare self-management was measured via the Transition Readiness Assessment Questionnaire (TRAQ; Sawicki et al., 2011). Participants indicated their skill level related to healthcare self-management, via a 20-item, 5-point Likert scale (1=No-I don't know how, 5=Yes-I always do this when I need to). Mean subscale scores were calculated, quantifying ability to manage medications, keep appointments, track health issues, and talk with providers.
Results: The mean number of medications taken by adolescents was 2.68 ((1.94); per parent report) and 1.33 ((1.20) per child report). A reason for taking every medication was provided by 100% of parents, and only 65% of adolescents. Mean SAMBA scores in both groups indicated a perceived low to moderate cost of medication use (child: 1.94 (.69); parent: 1.40 (.50)), resistance to the medication regimen (child: 1.82 (.63); parent: 1.73 (.54)), and stigmatization (child: 1.89 (.83); parent: 1.51 (.66)), while the benefits of medication were rated as moderate to high (child: 3.79 (.71); parent: 3.93 (.82)). Mean TRAQ subscale scores indicated very limited readiness for healthcare self-management: medication self-management (child: 1.49 (.84); parent: 1.05 (.83)), appointment keeping (child: 0.69 (.80); parent: 0.18 (.29)), healthcare tracking (child: 1.01 (1.06); parent: 0.45 (.66)), and talking to providers (child: 2.25 (1.13); parent: 1.89 (.65)). Intraclass correlations demonstrated a significant positive relationship between child and parent scores on the SAMBA's medication benefits subscale ($r=.56$, $p=.04$) and the TRAQ's medication management subscale ($r=.72$, $p=.004$); all other correlations between child and parent scores were non-significant.
Conclusions: These findings suggest that individuals with ASD and their parents regard medication as beneficial, but parents and adolescents agree that adolescents have limited knowledge about their medications and feel unprepared to manage their own healthcare. These findings emphasize the need for enhanced education around healthcare self-management in transition planning for adolescents with ASD.

233 **183.233** Mental Comorbidities and Use of Psychotropic Medications in Patients with Autism Spectrum Disorder in the United States

R. C. Ong[1], ***R. Houghton***[1], *A. Surinach*[2] *and F. Bolognani*[1], *(1)F. Hoffmann-La Roche, Basel, Switzerland, (2)Genesis Research, Hoboken, NJ*

Background:
Patients with autism spectrum disorder (ASD) are known to have a range of social, communication, behavioral, sensory and motor difficulties. Other mental disorders are common among patients with ASD. Psychotropic medications may be used to treat these comorbidities.
Objectives:
The objectives of this study were to investigate among patients with ASD the frequencies of concurrent mental diagnoses and use of psychotropic medications, and to investigate factors associated with psychotropic medication use.
Methods:
This retrospective observational study utilized administrative claims data based on multiple commercial health plans in the United States (MarketScan® Commercial Database). ASD patients of all ages were identified by having at least two ASD diagnoses (ICD-9-CM code of 299.0x, 299.8x, or 299.9x) in the database between 2000 and 2013, and having at least one of the ASD diagnoses given during the year 2013, i.e. the year of interest for this analysis. A total of 38,071 ASD patients were identified. Mental disorders of interest included epilepsy, sleep disturbances, attention-deficit disorder (ADD), anxiety disorder, depression, bipolar disorder, schizophrenia, and conduct disorder. Any prescription filled for any psychotropic drug class was investigated, with classes of interest being antidepressants, stimulants, antipsychotics/tranquilizers, anticonvulsants, anxiolytics/sedatives/hypnotics, and hypotensive agents (limited to clonidine and guanfacine).
Results: The age in the cohort ranged from 3 to 65 years. Among the ASD patients identified, more than half (56%) had a claim for a concurrent mental disorder of interest, with ADD (33%), anxiety disorder (20%), and conduct disorder (11%) being the most common conditions. Most of the patients (63%) had a filled prescription for a psychotropic drug, with antidepressants (32%) being the most common drug class, followed by stimulants (29%) and antipsychotics/ tranquilizers (26%). Among all mental conditions investigated, patients with bipolar disorder in addition to their ASD diagnosis were most often given psychotropic medications (95%). The proportion of patients who received psychotropic medications increased with age. More than one-fifth (21%) of patients aged 2-4 were diagnosed with additional mental conditions, but only 12% of patients in this age group received psychotropic medications. Although psychotropic medication use was common in patients with comorbid mental conditions (83%), many patients (36%) without those conditions also received psychotropic medication. Results from adjusted multivariate logistic regression indicated that the likelihood of patients receiving psychotropic medication increased with patient age and the presence of any of the mental conditions of interest.
Limitations:
Diagnosis of ASD or any of the comorbidities of interest was based on claims data. Reasons for initiating treatment with psychotropic medications cannot be assessed.
Conclusions:
Mental comorbidities and psychotropic medication use were common in ASD patients in the United States. Interestingly, psychotropic medication was prescribed in patients without concurrent mental conditions, suggesting a broader use of this class of drugs. Finally, the use of psychotropic medication is less likely in childhood.

234 **183.234** Oxytocin-Based Pharmacotherapy for Autism Spectrum Disorders: Investigating the Immediate and Long-Term Effects from a Neural and Behavioral Perspective

S. Bernaerts[1], *J. Prinsen*[1], *C. Dillen*[2], *E. Berra*[1], *S. Brams*[1], *N. Wenderoth*[1,3] *and* ***K. Alaerts***[1], *(1)University of Leuven - KU Leuven, Leuven, Belgium, (2)Child and Adolescent Psychiatry, KU Leuven, Leuven, Belgium, (3)ETH Zurich, Zurich, Switzerland*

Background:
Autism spectrum disorders (ASD) are characterized by impairments in social communication and interaction. To date, no pharmacological treatments exists targeting the core symptoms of ASD. The past years, the pharmacological use of a neuropeptide, called oxytocin (OT), has gained increasing interest from the research community to explore its potential for elevating the core social deficits in ASD. In the brain, OT acts as a neurotransmitter where it is considered to form a mediator of prosocial behavior by increasing social salience, social motivation, and social awareness.
Objectives:
With this study, we aim to evaluate both immediate (single-dose) and long-term (multiple dose) effects of OT administration in adult male patients with ASD in a double-blind randomized placebo-controlled trial. Both neural and behavioral measures are assessed.
Methods:
A multi-modal neuroimaging approach is adopted to assess neural effects (i) at baseline; (ii) after a single-dose (24 IU) of nasal spray administration (OT or placebo); (iii) after 4 weeks of daily nasal spray administration; and (iv) one month post-trial to assess potential retention effects. Behavioral changes are assessed using emotion processing tasks and questionnaires assessing social responsiveness, attachment, mood state, and quality of life. Sixteen male patients with ASD (8 OT/ 8 placebo) are currently enrolled in the study and recruitment is still ongoing. All patients are characterized using IQ and ADOS-scales and thoroughly screened for adverse indications for participation in fMRI research.
Results:
To date, we only have preliminary data available assessing changes in functional connectivity based on resting-state fMRI scans. Resting-state fMRI is a technique for measuring spontaneous fluctuations in low-frequency brain activity while participants are at rest in the scanner (not performing an explicit task). An exploratory analysis was

conducted to assess changes in whole-brain functional connectivity after a single-dose (immediate effect) or after 4-weeks of daily nasal spray administration (long-term effect). Retention data (one month post-trial) are not yet available.
Changes in whole-brain network connectivity were identified for several regions of the social brain (e.g. fusiform gyrus, orbito-frontal cortex, frontal operculum, insula). Interestingly, changes in network connectivity of these regions were evident both immediately after a single dose of OT, as well as after 4-weeks of daily OT administration. After long-term OT administration (not after a single-dose) connectivity changes were additionally identified for the thalamus and middle/superior temporal gyri. These preliminary results are in agreement with results of a recent voxel-based meta-analysis of 11 task-based fMRI studies exploring single-dose effects of OT in neurotypical individuals (Wigton et al., 2015). This study similarly identified the insula, temporal lobes, thalamus and (pre/orbito) frontal cortex as the most implicated regions.
Conclusions:
Our highly preliminary results provide first indications that OT can induce changes in network connectivity of the social brain in patients with ASD. Further research is however necessary to explore whether these neural changes can be replicated in larger samples; whether and how they are paralleled by behavioral changes and whether the effects will outlast the time of intervention.

235 **183.235** Pattern of Use of Psychotropic Medication in Patients with Autism Spectrum Disorder in the United States

R. C. Ong[1], *R. Houghton*[1], *A. Surinach*[2] *and F. Bolognani*[1], *(1)F. Hoffmann-La Roche, Basel, Switzerland, (2)Genesis Research, Hoboken, NJ*

Background: Patients with autism spectrum disorder (ASD) have a range of social, communication, behavioral, sensory and motor difficulties, and, additionally, often have other mental conditions. The use of multiple psychotropic medications in ASD patients, singly or in combination, has been reported in previous studies.
Objectives: The objectives of this study were to investigate the pattern of use of psychotropic medications in terms of length of treatment (LOT) as well as factors associated with psychotropic medication polypharmacy among commercially insured patients with ASD in the United States.
Methods: This retrospective observational study utilized administrative claims data based on multiple commercial health plans in the United States (MarketScan® Commercial Database). ASD patients of all ages were identified by having at least two ASD diagnoses (ICD-9-CM code of 299.0x, 299.8x, or 299.9x) in the database between 2000 and 2013, and having at least one of the ASD diagnoses during the year of 2013, i.e. the year of the interest for this analysis. A total of 38,071 ASD patients were identified. Polypharmacy was defined as the concurrent use of two or more psychotropic medications in at least two drug classes for 30 consecutive days or longer. LOT was defined for each medication class as the sum of supply days for medications in the class; a day supplied with multiple drugs within the same class was counted as one day. Psychotropic drug classes of interest were antidepressants, stimulants, antipsychotics/tranquilizers, anticonvulsants, anxiolytics/sedatives/hypnotics, and hypotensive agents (limited to clonidine and guanfacine). Mental disorders of interest included epilepsy, sleep disturbances, attention-deficit disorder (ADD), anxiety disorder, depression, bipolar disorder, schizophrenia, and conduct disorder.
Results: The age in the cohort ranged from 3 to 65 years. For most of the drug classes investigated, patients were given medications for >200 days on average in 2013, regardless of the presence of concomitant mental conditions. However, for anxiolytics/sedatives/hypnotics, LOT was shorter (<100 days). Among patients who received psychotropic medications, mean and median LOT increased with age. Of all ASD patients, 35% had psychotropic polypharmacy. Polypharmacy was rare among patients <5 years of age (2%), but was 49% for patients aged 18 years and older. Although polypharmacy was common among patients with mental comorbidities (49%), many patients (17%) with none of the conditions of interest had polypharmacy. Polypharmacy was most commonly observed among patients with bipolar disorder (82%), followed by patients with schizophrenia (76%) and depression (62%). Adjusted multivariate logistic regression indicated that patients who were older, and those who had a claim for any of the mental conditions of interest, were more likely to have received psychotropic polypharmacy.
Limitations: Diagnosis of ASD or any of the comorbidities of interest was based on claims data. Reasons for initiating treatment with psychotropic medications cannot be assessed.
Conclusions: Our study showed that psychotropic polypharmacy was associated with older age and comorbid mental conditions. Almost a fifth of ASD patients without mental comorbidities received polypharmacy, despite limited evidence supporting the safety and effectiveness of these combinations.

236 **183.236** Predicting Response to Pregnenolone Treatment of Irritability in Autism Spectrum Disorder – Preliminary Neurosteroid Metabolomic Analysis

L. K. Fung*, W. Sun, R. A. Libove, S. Tanaka, J. M. Phillips, J. Rajadas and A. Y. Hardan, Stanford University, Stanford, CA*

Background: Pregnenolone (PREG) is the precursor of endogenous pharmacologically active neurosteroids. When orally administered in humans, PREG is converted to multiple metabolites, including allopregnanolone (a $GABA_A$ receptor agonist). We recently reported the results of an open-label trial of PREG in the treatment of adults with autism spectrum disorder (ASD). We found that PREG reduced the levels of irritability and associated aggressive behaviors as measured by the Aberrant Behavior Checklist – Irritability subscale (ABC-I). PREG was also found to be well-tolerated by the study participants.
Objectives: To explore the associations between response to PREG and plasma concentrations of metabolites of PREG before and after 12-week trial of oral PREG.
Methods: PREG was initiated at 50mg twice daily in weeks 1 and 2, then increased by 50mg twice daily every 2 weeks to a final dose of 250mg twice daily which was maintained from weeks 9 to 12. Primary outcome measure was the ABC-I. Response was defined as change of ABC-I of 7 or greater. Concentrations of PREG and its metabolites in plasma samples were quantified by liquid chromatography-mass spectrometry. Analytes measured include PREG, PREG sulfate, progesterone, allopregnanolone, dehydroepiandrosterone (DHEA), DHEA sulfate, testosterone, estradiol, and cortisol. Levels of sex hormone binding globulin (SHBG) in the plasma samples were determined by an enzyme-linked immunosorbent assay (ELISA). Free levels of testosterone were calculated from total testosterone concentration, SHBG concentration, and published values of albumin concentration and association constants of albumin and SHBG. Two-tailed student t-tests were performed to compare metabolite concentrations between responders and non-responders. Regression analyses were also performed to determine the strengths of correlations between the change in ABC-I and the levels of metabolites.
Results: Twelve individuals with ASD (mean age 22.5) participated in this open-label study. PREG yielded improvement in the primary measure, ABC-I [17.4±7.4 at baseline; 11.2±7.0 at 12 weeks (p=0.028)]. Six participants were found to be responders to PREG treatment, while the rest of the six participants did not reach the responder criteria. Mean baseline PREG plasma concentration in the responder group (1.5±0.4ng/mL) was found to be lower (p=0.039) than the non-responder group (2.2±0.7ng/mL). Furthermore, week 12 total testosterone plasma concentration in the responder group (1.8±1.3ng/mL) was found to be lower (p = 0.0097) than the non-responder group (3.8±0.7ng/mL); week 12 free testosterone plasma concentration in the responder group (6.4±4.8pg/mL) was found to be lower (p = 0.0054) than the non-responder group (14.4±2.7pg/mL). Finally, correlation analyses revealed a negative correlation between the reduction of ABC-I and week 12 total testosterone level (coefficient of determination $R^2 = 0.40$).
Conclusions: Preliminary analysis found that baseline PREG and 12-week testosterone (both free and total) levels were associated with reduction of ABC-I. These findings suggest that effectiveness of PREG might be related to testosterone blood levels and additional research is needed to replicate these findings in a controlled trial.

237 **183.237** Psychotropic Medication Trends Among Children and Youth Diagnosed with Autism Spectrum Disorder in a Specialized Paediatric Clinic

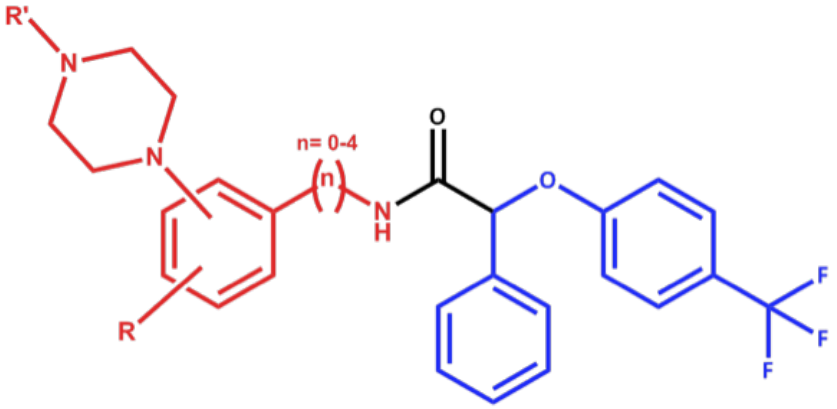
L. A. Siapno[1], *A. Dupuis*[2] *and S. Smile*[3], *(1)Developmental Paediatrics, Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada, (2)The Hospital for Sick Children, Toronto, ON, Canada, (3)Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada*

Background:
Psychotropic medications are primarily directed towards treating comorbid symptoms, rather than core symptoms of autism spectrum disorder (ASD) in children. The rate of polypharmacy among children with ASD ranges from 10-20%. There is a paucity of studies examining psychotropic medication use over time among children with ASD.
Objectives:
This study examined if there is an effect of an ASD diagnosis on the number and change in the number of medication classes at two time points (year 1 and year 5) compared to baseline (time of initial consult).
Methods:
Medical records of children seen in a Psychopharmacology Clinic in a tertiary hospital setting in Toronto, Canada during 2006 and 2013 were reviewed. Cases were divided into two groups, namely i) ASD and ii) non-ASD. The variation on the number and types of psychotropic medication classes based on psychiatric, medical diagnosis and behavioural symptomatology was examined.
Results:
Three hundred and five medical records were included in the review. Eighty three percent (254/305) of cases had a diagnosis of ASD and 16.7% (51/305) non-ASD. The majority of cases (76%) were referred for irritability and aggression. A greater number of cases with ASD (45.2%) were on one psychotropic medication class and 23.6% were on two psychotropic medication classes at their initial consult. Antipsychotics were the most commonly prescribed medication class. Cases were more likely to be prescribed more psychotropic medications than taken off at the initial consult. The number of subjects who went on or off psychotropic medication was similar between groups with the ASD group slightly more likely to increase medications. An increased number of psychotropic medication classes were 2 to 3 three times more likely to occur than a decrease in the number of classes at the first year consult.
Conclusions:
Among children with ASD, prescribing trends remain relatively stable with one to two classes of psychotropic agents. There is no effect of an ASD diagnosis in the number and change pf medication classes over time.

238 **183.238** SAR of Phenoxyacetic Acid Analogs As Synergistic Dual Activity Serotonergic Ligands for Potential Use in ASD

L. Tran[1], *O. M. Ghoneim*[1] *and A. A. Khalil*[2], *(1)University of Saint Joseph School of Pharmacy, Hartford, CT, (2)Qatar University-College of Pharmacy, Doha, Qatar*

Background:
Repetitive/stereotypic behaviors are one of Autism Spectrum Disorder's (ASD) main domains and include persistent preoccupation with an object, phrase, or body movement that hampers educational or social interventions, and creates disturbance in the life of individuals and their caregivers. Currently, Selective Serotonin Reuptake Inhibitors (SSRIs) are used as first-line treatment for Obsessive-Compulsive Disorder and have been successfully used to treat repetitive behaviors in ASD individuals. SSRIs inhibit serotonin (5-HT) reuptake by blocking the serotonin transporter on the presynaptic neuron, as a way to increase synaptic serotonin. Another pathway to increase serotonin levels is to manipulate serotonin autoreceptors such as 5-HT_{1A}, 5-HT_{1B}, and 5-HT_{1D} receptors by regulating the synthesis of serotonin in the synapse based on demand. Accordingly, high 5-HT level in the synaptic cleft (enhanced by SSRIs) will stimulate the autoreceptors to decrease 5-HT synthesis and therefore counteract SSRIs. As a result, the 4-6 week delay in the therapeutic effect of SSRIs may be attributed to the time needed for the 5-HT autoreceptor to be desensitized. Co-administration of SSRIs with 5-HT autoreceptor antagonists is advantageous over SSRIs alone with respect to the magnitude of extracellular brain 5-HT levels produced. Encouraged by this fact, our laboratory has been investigating the combination of 5-HT uptake inhibition and autoreceptor antagonism in one molecule to act as synergistic dual-activity serotonergic ligand.
The design of the dual functional ligand comprises of structural features responsible for serotonin reuptake inhibition derived from fluoxetine (blue side; Figure 1) tethered to structural features responsible for autoreceptor inhibition from the non-selective autoreceptor antagonist GR-127935 (red side; Figure 1). Two compounds that provide proof of our pharmacologic concept include, OG-103 and JDO-106 as *in vitro* dual functional serotonergic ligands. Both compounds achieved 90-100% inhibition of 5-HT uptake when tested at 10 µM concentrations, which indicates activity from the blue side. However, their effect on 5-HT autoreceptor antagonism varied, indicating improvements can be made to the autoreceptor inhibition component.
Objectives:
Establish a structure activity relationship (SAR) of these fluoxetine-derived compounds called the LG-series, to achieve lead compound(s) that can effectively inhibit 5-HT uptake and antagonize 5-HT autoreceptors concomitantly.
Methods:
We used a four-step synthetic scheme. Briefly, a Williamson ether synthesis of trifluoromethylphenol and methyl-bromophenylacetate provided the ester core, followed by hydrolysis to yield the substituted phenoxyacetic acid. Coupling the acid with varying amines/anilines resulted in the wide varieties within the LG-series.
Results:
Eleven final compounds were synthesized in our laboratory from the LG-series encompassing amines/aniline of diverse steric and electronic characteristics. The biological screening of the LG-series was conducted at Eurofins/CEREP, Inc. The synthetic scheme, reaction conditions, and the effect of the various amines on the inhibition of the 5-HT uptake and serotonin autoreceptors will be presented.
Conclusions:
Our findings suggest that phenoxyacetic acid analogs can be used as a potential new class of agents with synergistic dual activity serotonergic ligands for repetitive behaviors modulation in ASD.



239 **183.239** The Influence of Sensory Integration on Behavior, Cognition and Mood in Autistic Children: A Pilot Study

C. Gouws*, Biokinetics and Sport Science, University of Zululand, Richardsbay, South Africa*

Background: The spectrum of treatment for autism is still poorly understood. Autism is typically characterized by developmental disruptions in social-emotional behaviour and communication. This condition/ disorder can be divided into three different types; depending on the severity of autism, of which each is treated differently. Sensory integration can be used to improve an autiistic child's problem areas, and is also applied to maintain the senses.
Objective: The importance of this pilot-study was to determine if a change in the behaviour, cognition and mood exists/occurs after undertaking/participating ina sensory integration intervention programme. Additionally, the study was designed to determine the time frame for the effects of a sensory integration intervention programme to be observed, as well as which test elicited the highest improvement in sensory integration in autistic children.
Method: Eleven males and one female of all ethnic groups, between the ages of 2 and 7 years, were initially recruited from special needs schools in the Richards Bay area of Northern KwaZulu-Natal, South Africa. Participants were tested using *the Sensory Processing Disorder Checklist* for the baseline measurments and the *Short Sensory Profile Checklist* was used for the pre/post-testing .
Results: A powerful, positive correlation was observed between pre-and post-testing for behavior, mood, cognition (r = .761). Paired t-tests demonstrated no significant changes in each class between baseline and post-test tactile sensitivity, taste/ smell sensitivity, underesponsive sensations, auditory filtering, low energy/ weak and visual/ auditory sensitivity. Movement sensitivity demonstrated a significant increase in the post-test ().
Conclusion: In conclusion, the effects of a sensory integration intervention programme positively influences an autistic child's movement sensitivity, which assists with mood control, cognition and overall behaviour.

Oral Session - 11A
185 - Genetic Mouse Models of Syndromal Autism Spectrum Disorder
1:45 PM - 2:35 PM - Hall B

1:45 **185.001** Initial Characterization of a New Loss-of-Function Mouse Model of the Autism Susceptibility Gene Chd8

J. L. Silverman[1], *M. C. Pride*[1], *I. Zdilar*[2], *A. L. Gompers*[2], *K. Zarbalis*[3], *J. N. Crawley*[1], *A. Visel*[4], *D. Dickel*[4], *L. A. Pennacchio*[4] *and A. S. Nord*[2], *(1)Psychiatry and Behavioral Sciences, MIND Institute, Sacramento, CA, (2)Center for Neuroscience, Davis, CA, (3)Department of Pathology and Laboratory Medicine, Shriners Hospitals for Children, Northern California, Sacramento, CA, (4)Lawrence Berkeley National Laboratory, Berkley, CA*

Background: Autism spectrum disorder (ASD) is a heterogeneous disease in which prominent efforts are being made to define subtypes with genetics and behavior. Recent successes using genetic based subtype identification have identified the chromodomain helicase DNA-binding protein 8 (*CHD8*) as a likely candidate for a specific subtype of ASD (Bernier et al., 2014, O'Roak et al., 2012, Talkowski et al., 2012 and Neale et al., 2012). *CHD8*, located on 14q11.2, binds to β-catenin and has major chromatin remodeling functions (Thompson et al., 2008). However, in vivo studies of the functional and phenotypic consequences of heterozygous mutation are lacking. To evaluate biological and behavioral consequences of *Chd8* mutations, we used targeted genomic engineering, to generate a mouse line harboring a loss-of-function mutation in *Chd8*.
Objectives: The present experiments in *Chd8* mice were designed to: 1) validate our genetic engineering of mice heterozygous for the *Chd8* mutation, 2) begin a behavioral characterization of phenotypes of high relevance to ASD, and 3) demonstrate the power of integrated genomic, neuroanatomical, and behavioral approaches towards revealing the effects of heterozygous *Chd8* mutation using a novel preclinical model of ASD.
Methods: Genetic engineering via the Cas9/CRISPR system was employed to generate one of the first *Chd8* mutant mouse lines. Briefly, synthetic guide RNA was injected along with Cas9 mRNA to mouse oocytes, and F0s carrying mutations were genotyped and bred to expand lines that harbored a mutation. We selected a line that harbors a

short deletion in the fifth exon of *Chd8* causing a frameshift resulting in a predicted loss-of-function allele. A battery of behavioral assays relevant to ASD, as well as numerous control assays to detect confounds in physical health or ability to evaluate complex behaviors were conducted as previously described (Crawley et al., 2007; Silverman et al., 2010, 2012). This inventory focused on domains that are affected in ASD, such as sociability, social communication, repetitive behavior, cognition, sensorimotor function and anxiety-like behaviors.
Results: Consistent with an earlier study, *Chd8* mutations are associated with early embryonic lethality in homozygous carriers, with no homozygous mice observed in the first five litters examined. In preliminary studies comparing mRNA generated via deep RNA sequencing performed on forebrains of heterozygous and wildtype littermates at different embryonic and postnatal ages, we have identified *Chd8* haploinsufficiency and associated changes of gene expression. Female mice with the *Chd8* haploinsufficient mutations exhibited motor deficits, anxiety-like behavior on the elevated plus-maze, and learning and memory deficits on both cued and contextual fear conditioning compared to wildtype control mice. Mutant males exhibited a trend toward anxiety-like behavior on another anxiety-related task, light↔dark transitions. Lower acoustic startle responses were also noted in the *Chd8* mutant males compared to wildtype littermate control mice.
Conclusions: We discovered important clinically relevant behavioral phenotypes in our novel *Chd8* mutant model of ASD. These preliminary studies also observed substantial sex differences in behavioral phenotypes, analogous to the clinic ASD literature. Our findings highlight the need to further examine this unique *Chd8* mouse model with extensive pathophysiology and behavioral phenotyping efforts.

1:57 **185.002** Total Brain Volume Increase and Selective White Matter Loss in the Hgsnat(-/-) and Sgsh (-/-) Mouse Models Related to Sanfillipo Syndrome

J. P. Lerch[1], *R. Yuen*[2], *A. Creighton*[3], *L. Spencer Noakes*[1], *B. J. Nieman*[1], *L. Nutter*[3], *S. W. Scherer*[2] *and J. Ellegood*[1], *(1)Mouse Imaging Centre, Hospital for Sick Children, Toronto, ON, Canada, (2)Centre for Applied Genomics (TCAG), Hospital for Sick Children, Toronto, ON, Canada, (3)Canadian Mouse Mutant Repository, Toronto Centre for Phenogenomics, Toronto, ON, Canada*

Background: Sanfillippo syndrome (SFS) is a rare autosomal recessive lysosomal storage disease, also known as mucopolysaccharidosis (MPS) III. There are four different types, A-D, all of which are indistinguishable in the clinic. *HGSNAT* (heparan-α-glucosaminide N-acetyltransferase) and its mutations are associated with SFS type C and the *SGSH*(N-sulfoglucosamine sulfohydrolase) and its mutations are associated with SFS type A. In a recent report (Rumsey et al. 2014) it was determined that 13 of 21 children diagnosed with SFS type A also met the criteria for autism diagnosis.
Objectives: To provide a first screen of two novel homozygote knockout mouse lines – C57BL/6N-*Hgsnat*^{em4Tcp} and C57BL/6N-*Sgsh*^{em3Tcp}.
Methods:
Mouse lines were generated using Cas9, to introduce frameshift indels in the coding regions of their respective genes. In total, 39 fixed mouse brains were examined. 16 of which were WT (C57BL6/N), 11 *Hgsnat*(-/-) mice, and 13 *Sgsh*(-/-) mice. The mice were P60 ± 2 days and equally distributed between both sexes. We used whole brain MRI to provide an indication if – and where – mutations in these genes affect the brain.
MRI Acquisition – A multi-channel 7.0 Tesla MRI scanner was used to acquire anatomical images of the brain. A T2-weighted, 3-D fast spin-echo sequence was used (restricting sampling to a circular region in the two phase encode dimensions). This sequence yielded an image with 40 µm isotropic voxels (3D pixel) in ~14 h.
Data Analysis – To visualize and compare any differences the images are registered together. The goal of the registration is to model how the deformation fields relate to genotype (Lerch et al., 2008). Volume differences are then calculated either in individual voxels or for 159 different segmented brain regions in each groups (Dorr et al. 2008, Ullmann et al. 2013, and Steadman et al. 2014). Multiple comparisons were controlled for using the False Discovery Rate (FDR) (Genovese et al., 2002).
Results:
For both the *Hgsnat*(-/-) and *Sgsh*(-/-) mice the total brain volumes were significantly larger than the WT mice (450 mm^3 ± 7 for *Hgsnat*, and 450 ± 11 for *Sgsh* versus 432 ± 14 for the WT, FDRs <1%); therefore, relative volumes were examined to account for these differences. 14 regions were found to be significantly different in the *Hgsnat*(-/-) brains, and 27 regions were found to be different in the *Sgsh*(-/-) brains. Since mutations in both genes are implicated in SFS, it is not surprising that the same 14 regions affected in *Hgsnat* null mice were also affected in *Sgsh* null mice albeit to a greater extent. Analysis of the images voxelwise shows a similar pattern of differences in both models, but with the Sgsh(-/-) mice showing a stronger phenotype (Figure 1). Interestingly, despite a total brain volume increase, the white matter is decreased in both models, with the anterior commissure, cingulum bundle, corpus callosum, internal capsule all found to be smaller.
Conclusions: These two SFS models show very similar characteristics with decreased volume in several white matter tracts despite an overall increase in total brain volume.

2:09 **185.003** Mechanisms Underlying Sensitive Periods for Treatment of Cerebellar Mediated Autistic Behavior

J. Ellegood[1], *Y. Chu*[2], *J. P. Lerch*[1], *W. Regehr*[3], *M. Sahin*[4] *and* ***P. Tsai***[5], *(1)Mouse Imaging Centre, Hospital for Sick Children, Toronto, ON, Canada, (2)Neurobiology, Harvard Medical School, Cambridge, MA, (3)Neuroscience, Harvard Medical School, Boston, MA, (4)Department of Neurology, Boston Children's Hospital, Boston, MA, (5)6000 Harry Hines Blvd, University of Texas Southwestern Medical Center, Dallas, TX*

Background:
Autism Spectrum Disorders (ASDs) are prevalent neurodevelopmental disorders marked by social impairments, repetitive behaviors, and cognitive inflexibility. Despite a prevalence exceeding 1%, underlying mechanisms are poorly understood while targeted therapies and their guiding parameters are needed. Recent evidence has implicated the cerebellum in ASD pathogenesis, and we have recently demonstrated that cerebellar dysfunction is sufficient to generate autistic-like behaviors in a mouse model of Tuberous Sclerosis Complex (TSC).
Objectives:
The developmental windows during which behavioral dysregulation emerges and the time windows of treatment efficacy for ASD and the underlying circuit and cellular mechanisms remain poorly understood. In this study, we sought to delineate these sensitive periods for treatment of ASD behaviors and to examine the underlying cellular, physiologic, and circuit based mechanisms.
Methods:
In this study, we utilize the mechanistic target of rapamycin (mTOR) specific inhibitor rapamycin in a cerebellar Tsc1 mouse model of monogenic ASD, performing behavioral analysis, electrophysiologic studies, anatomic characterization, and MRI based structural connectivity.
Results:
Using these methods, we define distinct treatment sensitive periods for autistic-like – motor, social, and repetitive/restricted – behaviors, periods that extend into adulthood for social and motor behaviors. Moreover, we identified anatomic, cellular, and electrophysiologic parameters that underlie behavioral rescue. Lastly, using volumetric MRI and structural covariance measures, we identified patterns of connectivity between cerebellar and cortical regions implicated in clinical ASD that are disrupted in mutant mice. We further demonstrate that alterations in clinically relevant connectivity respond to rapamycin therapy, consistent with demonstrated behavioral rescue.
Conclusions:
These findings, thus, not only define treatment parameters but also provide a mechanistic and structural basis for targeted, behavioral rescue in ASD.

2:21 **185.004** Social Encounters Reveal Brain Region-Specific Gene Expression Changes in Shank3 Null Mice

A. Anacker[1], *T. D. Rogers*[2] *and J. Veenstra-Vander Weele*[3], *(1)Columbia University, New York, NY, (2)Vanderbilt University Medical Center, Nashville, TN, (3)New York State Psychiatric Institute / Columbia University, New York, NY*

Background: Deletions or mutations in *SHANK3* lead to Phelan-McDermid syndrome (P-MS), one of the most common known genetic causes of autism spectrum disorder (ASD). Mice with disruptions in *Shank3* show deficits in social behavior and may provide a window into the networks and circuits underlying P-MS specifically and perhaps ASD more broadly.
Objectives: The goal of the present study was to examine the transcriptional response to a social stimulus in specific brain regions.
Methods: Adult male mice with a deletion in exons 13-16 of the *Shank3* gene, or their wildtype littermates, were exposed to a social or non-social stimulus for 30 minutes. Ten hours later, tissue was extracted from the prefrontal cortex, medial amygdala and lateral amygdala for RNA sequencing analysis (Illumina HiSeq 2000). Count-based differential expression analysis was performed (edgeR_3.4.2) for the following comparisons: 1) mutant vs wildtype in nonsocial condition, 2) mutant vs wildtype in social condition, 3) social vs nonsocial in wildtype, 4) social vs nonsocial in mutant, and 5) the interaction across genotypes and conditions. Analyses of the differentially expressed genes in each comparison ($p<0.05$) were performed using WebGestalt for Gene Ontology, KEGG, and Wikipathway analyses, and using Ingenuity Pathway Analysis for Canonical Pathway, Disease and Function, and Network analyses. Differentially expressed genes were also compared to genes implicated in ASD, as collected in the SFARI Genes database.
Results: Genes implicated in ASD were significantly enriched among differentially expressed genes in all brain regions, particularly in the mutant versus wildtype comparisons in the non-social condition ($p\leq0.0001$), as well as in the interaction analysis across genotypes and conditions ($p<0.03$). Pathway analyses revealed that genes involved in neuronal signaling and development were differentially expressed in nearly all comparisons, across all brain regions examined. Genes relevant for behavior, developmental and neurological disorders were also enriched. The axonal guidance signaling pathway was one of the most consistently significant canonical pathways identified as having enriched gene networks, particularly in mutant vs wildtype comparisons (p ranging from 0.00359 to <0.0001).
Conclusions: These findings indicate that the *Shank3* null mouse model has changes in gene expression relevant to ASD, indicated by the prevalence of autism-associated genes, as well as the consistent enrichment of pathways relevant for neuronal signaling and development. Future studies may elucidate the role of specific networks in the social deficits observed in *Shank3* null mice.

Oral Session - 11B

186 - Integrated Approaches and Insight from Related Disorders

2:40 PM - 3:30 PM - Hall B

2:40 **186.001** Genome Wide Association Studies of Empathizing and Systemizing

V. Warrier[1], *R. Toro*[2], *P. Smith*[3], *B. Chakrabarti*[4], *N. Litterman*[5], *T. Bourgeron*[6] *and S. Baron-Cohen*[3], *(1)University of Cambridge, Cambridge, England, United Kingdom, (2)Institut Pasteur, Paris, France, (3)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (4)School of Psychology & Clinical Language Sciences, University of Reading, Reading, United Kingdom, (5)23andMe, Mountain View, CA, (6)Institute Pasteur, Paris, France*

Background: Autism Spectrum Conditions (autism) are neurodevelopmental and are characterized by difficulties in social interaction and communication alongside unusually repetitive and stereotyped behaviours, unusually narrow interests, and resistance to unexpected change. Several lines of evidence suggest that, on average, individuals with autism have preserved systemizing abilities but are impaired in select domains of empathy. The genetic architecture of these traits have not been investigated. We investigated the heritability of these two traits and the genetic correlation between these traits and five psychiatric conditions, including autism.
Objectives: (1) To identify common genetic variants associated with self-report measures of empathing and systemizing; (2) To quantify additive heritabilities explained by the common variants and the differences in heritability of these traits in typical males and females; (3) To identify enrichment in biological pathways; (4) To calculate the genetic correlation between these traits and other psychiatric conditions, including autism.
Methods: We collaborated with 23andMe Inc., a personal genetics company, to perform a genome wide association study (GWAS) of empathy (measured using the Empathy Quotient (EQ), n = 46,861) and systemizing (measured using the Systemizing Quotient-Revised (SQ-R), n = 51,564). Sex specific analyses were performed to identify sex-specific architecture. Linkage disequalibrium (LD) score regression was used to calculate inflation in p-values due to unaccounted population stratification, heritability, and genetic correlation. We calculated genetic correlation between the psychological traits and five psychiatric conditions (autism, schizophrenia, anorexia nervosa, bipolar disorder, and major depressive disorder) using summary GWAS data from the Psychiatric Genomics Consortium. Pathway analysis was performed to identify enriched biological networks, gene sets, and tissue specific expression.
Results: We identified two significant loci associated with systemizing, and one with empathy. Additionally, we identified a locus that was significant in the males-only subset with systemizing. Approximately 11% of the variance for both the traits is explained by additive genetic effects of the SNPs examined. There was no statistical difference between male and female heritabilities. As expected, empathy had a negative genetic correlation (i.e SNPs contributed to higher autism risk but lower empathy) with autism, and systemizing had a positive genetic correlation with autism (i.e SNPs contributed to higher autism risk and higher systemizing). Unexpectedly, both systemizing and empathy were positively correlated with other psychiatric conditions, namely schizophrenia, major depressive disorder, anorexia nervosa, and bipolar disorder.
Conclusions: The study shows that empathy and systemizing are genetically correlated with several psychiatric conditions. Though males and females perform differently on the SQ-R and the EQ, their additive heritabilities are not statistically different.

2:52 **186.002** Homozygous Deletions of Non-Coding DNA Sequences in Autism Spectrum Disorder

K. Schmitz-Abe[1,2], *G. Sanchez-Schmitz*[1,2], *E. M. Morrow*[3], *M. Greenberg*[1,2], *T. W. Yu*[1], *C. A. Walsh*[1,2] *and K. Markianos*[1,2], *(1)Harvard Medical School, Boston, MA, (2)Children's Hospital Boston, Boston, MA, (3)Department of Molecular Biology, Cell Biology and Biochemistry and Institute for Brain Science, Brown University, Providence, RI*

Background:
Noncoding DNA comprises 99% of the genome but methods for identifying its contribution to disease have greatly lagged our understanding of protein-coding mutations. Autism Spectrum Disorder (ASD), associated with defects in social and/or cognitive function, has previously been linked to *de novo* Copy Number Variants (CNVs), *de novo* Single Nucleotide Variants (SNVs) or inherited recessive biallelic SNVs; however, most cases remain unexplained.
Objectives:
We analyzed CNVs and homozygosity in 187 families ascertained through the Homozygosity Mapping Collaborative for Autism (HMCA), an ASD cohort highly enriched for families that are consanguineous (792 individuals). We compared findings in our cohort to data from the Autism Genetic Resource Exchange cohort (AGRE, 740 families, 2985 individuals) and from the Simons Simplex Collection (SSC, 1,027 families, 3881 individuals).
Methods:
CNV detection, annotation, and analysis were done using a custom build, rule based “Variant Explorer” pipeline. It uses concordant calls between multiple algorithms to maximize specificity, and classified as common/rare based on overlap with 1,251 HapMap controls processed by the same pipeline.
Results:
In consanguineous families, children affected with ASD are significantly enriched for autosomal homozygous deletions compared to unaffected siblings (17% versus 4%, $p<0.001$). Most homozygous deletions were small (<50 kb) and only a few were predicted to result in protein inactivation through coding exon disruption. In contrast, affected children were significantly enriched for homozygous deletions in DNA regulatory regions, with regions disrupting ENCODE histone methylation peaks, a rate much higher than predicted by chance ($p<0.001$).
Conclusions:
While the importance of regulatory elements has been previously anticipated, such non-coding variants are not as readily identifiable as the disruption of coding sequence. High consanguinity allows us to study biallelic deletions and take advantage of the favorable signal to noise ratio provided by complete loss of coding or regulatory regions. The importance of biallelic deletions is supported by two lines of evidence: 1) a significantly higher rate of biallelic deletions in affected children relative to their unaffected siblings ($p<0.001$), and 2) a striking enrichment/depletion pattern of intersection between biallelic deletions and ENCODE control regions in affected/unaffected children ($p<0.001$). While (1) provides unambiguous evidence for the role of biallelic deletions in recessive ASD, the ENCODE analysis provides formal evidence for the mode of action of a significant subset of biallelic deletions.
The biallelic deletions regions identified here represent an important starting point to the understanding of the role of patterned gene activation/regulation in cognitive and social function. ASD in general appears to show an especially important role for gene dosage in causation, given the central importance of heterozygous CNV and SNV all of which affect gene dosage, and the importance of hypomorphic recessive mutation. Upon neuronal depolarization neurons are known to show rapid and reversible changes in the levels of expression of a large number of activity-regulated genes, and this temporally regulated transcriptional program is known to be essential for the functional changes that underlie memory formation and learning. Biallelic noncoding mutations, or heterozygous mutations affecting gene dosage, may well cause disease by disrupting such finely tuned transcriptional programs.

3:04 **186.003** Combining Autism and Intellectual Disability Exome Data Yields Insight into Both Disorders

J. D. Buxbaum[1], *A. E. Cicek*[2], *L. Klei*[3], *B. Devlin*[4] *and K. Roeder*[2], *(1)Mount Sinai School of Medicine, New York, NY, (2)Carnegie Mellon University, Pittsburgh, PA, (3)University of Pittsburgh Medical Center, Pittsburgh, PA, (4)University of Pittsburgh, Pittsburgh, PA*

Background: Autism spectrum disorder (ASD) is known to have a complex genetic architecture. Recently, exome sequencing studies have enjoyed great success using de novo single nucleotide variants (SNVs) and short indels to identify risk genes. However, calculations indicate that there are hundreds of additional genes that confer risk yet to be discovered.
Objectives: ASD and intellectual disability (ID) are known to co-occur and consequently their risk genes show considerable overlap. These findings motivate an analysis that contrasts and combines discoveries in ASD and ID.
Methods: The Autism Sequencing Consortium (ASC), in collaboration with the Deciphering Developmental Disabilities (DDD) consortium, assimilated published exome sequencing data from 6564 probands and controls. We used TADA (Transmission And De novo Association) to identify likely risk genes in both disorders individually and we combined the trios to find additional genes that affect risk for both disorders. We applied the algorithm DAWN (Detecting Association With Networks) to networks estimated from brain gene expression data to discover subnetworks of interacting risk genes. We then determined which gene networks communities showed enrichment of ASD and ID risk genes.
Results: Our results revealed 31 and 64 risk genes (FDR < .05) associated with risk for ASD and ID, respectively (with 12 genes identified in both), and 16 additional genes when combining the data. Based on the pattern of de novo loss-of-function (dnLoF) variants, we estimated that the total number of autosomal dominant genes in which a dnLoF imparts substantial risk for ASD and ID, respectively. We estimated a 95% confidence interval for ASD of 500-950 and for ID of 185-225. Relative to the mean NVIQ in the sample, a proband with LoF mutation in one of the genes with the strongest signal for both disorders (ASD.ID) had an average drop in NVIQ of 24 points and a LoF mutation in an ID-related gene produced a similar reduction in NVIQ in the ASD proband. A LoF mutation in an ASD-related gene, which was not also implicated in ID, was associated with a weaker effect on NVIQ, reducing it relative to the sample mean by almost 12 points. We identified two functional ASD clusters enriched for chromatin modification. We used those components to identify which targets are enriched for ID-related risk genes. Genes strongly affecting cognitive function were primarily represented in clusters involving chromatin modification, implicating gene regulation as a mechanism shared by ID and ASD. Moreover, the results highlight disruption of corticofugal projections neurons as a source of risk.
Conclusions: We estimated that there are significantly fewer ID-related genes and that a large fraction of the ID-related risk genes are also ASD-related. Genes found in ID

samples had a marked impact on IQ even in ASD, compared to genes identified only in ASD. Genes strongly affecting cognitive function mapped to ASD gene networks involving chromatin modification. The results implicate disruption of neocortical development as a mechanism shared by ID and ASD.

3:16 **186.004** Genes with Extremely High Penetrance for Autism Are Often Involved in Largescale DNA Remodeling

E. L. Casanova[1], *H. Chakraborty*[2], *N. S. Sumi*[3] *and M. F. Casanova*[4], *(1)Biomedical Sciences, University of South Carolina, Greenville, SC, (2)Biostatistics and Epidemiology, University of South Carolina, Columbia, SC, (3)Epidemiology and Biostatistics, University of South Carolina, Columbia, SC, (4)Pediatrics and Biomedical Sciences, University of South Carolina School of Medicine, Greenville, SC*

Background: Rates of autism comorbidity vary across genetic syndromes, though underlying causes have been poorly addressed. While there has been much interest surrounding neurite and synapse involvement in autism's etiology, studies suggest there may be earlier embryonic disturbances in genetic syndromes associated with autism that are a reflection of the associated gene dysfunction.
Objectives: To determine whether genetics underlying monogenic forms of intellectual disability (ID) that are highly-comorbid with autism vary in comparison to IDs with low-to-no rates of autism comorbidity and in what ways that occurs.
Methods: A group of 492 forms of ID were curated using the Online Mendelian Inheritance in Man (OMIM) database as well as the larger literature. ID's were grouped according to comorbidity with autism: ID only, ID with highly-comorbid autism (ID/HCA), and ID with variable autism (VarAut). Minimum comorbidity cut-off for inclusion within ID/HCA was 20% for autosomal conditions and 30% in males for X-linked. Gene functions were assessed using a combination of Gene Ontology (GO) and UniProt/Swiss-Prot databases. These databases and The Human Protein Atlas (HPA) were used for confirmation of GO's Cellular Component results. Analyses for GO, frequency of "regulatory" genes across groups and within ID/HCA subgroup, and frequency of transcription factors across the ID/HCA upper/lower comorbidity ranges were performed using proportions comparisons. Analyses concerning ID/HCA interaction with the core protein-protein interaction (PPI) network (Wnt, Shh, Ncor, SWI/SNF, Notch, Erk1/2, TGF-β/BMP) were analyzed using 2-tailed heteroscedastic T-tests with Bonferroni correction for multiple comparisons ($\alpha = 0.0167$).
Results: Compared to ID only and VarAut, ID/HCA genes exhibited an extreme enrichment in protein functions associated with epigenetic, post-transcriptional, and translational regulation (called "regulatory") ($p < 0.001$ across all comparisons). Genes from this group were highly enriched in the GO term, "regulation of gene expression (GO:0010468)". In agreement with this finding, when we looked at "regulatory" gene function, a subgroup that comprised approximately 2/3rd of ID/HCA, more than half of genes within the upper range of comorbidity (median = 62%) were largescale DNA remodelers (i.e., heterochromatin remodelers, ubiquitin ligases, and methylation regulators); meanwhile, more than 2/3rd of the lower range were transcription factors/repressors ($p = 0.0216$; 95% CI of difference of proportions: 0.0588, 0.7412). In addition, approximately 80% of the "regulatory" gene products were located primarily within the nucleus of the cell. Finally, in contrast to other forms of ID, gene products associated with ID/HCA centered around a core PPI network that is foundational to axial patterning of the CNS as well as later processes of neural maturation and plasticity ($p < 0.001$ across all comparisons). Of particular note to this project, genes associated with 19 of the ID/HCA conditions are not currently included within the SFARI Gene Database.
Conclusions: These results indicate that high mutation penetrance for the autism phenotype is afforded most strongly by epigenetic, post-transcriptional, and translational regulators. Largescale DNA remodelers predispose towards highest penetrance, followed by specific transcription factors/repressors. In addition, our curated list suggests that the SFARI Gene Database is missing an important subset of highly-penetrant risk genes.

Oral Session - 12A
187 - Natural Language Processing
1:45 PM - 2:35 PM - Room 307

1:45 **187.001** Developmental Deviance of Item-Level Responses on Standardized Language Measures Correlates with Autism Spectrum Disorder Diagnosis

A. E. Hare-Harris[1], *M. W. Mitchel*[1], *B. R. King*[2], *S. M. Myers*[1], *B. Greene*[3], *C. L. Martin*[1], *J. F. Flax*[3] *and L. M. Brzustowicz*[3], *(1)Autism & Developmental Medicine Institute, Geisinger Health System, Lewisburg, PA, (2)Computer Science, Bucknell Univeristy, Lewisburg, PA, (3)Genetics, Rutgers University, Piscataway, NJ*

Background: Developmental deviance (DDEV) refers to the non-sequential attainment of milestones within a developmental domain. This observation is in contrast to developmental delay (DD), where milestones are reached in the typical sequence, but the timeline of attainments is delayed. There is evidence that DDEV is associated with certain neurobehavioral diagnoses, such as autism spectrum disorder (ASD). Clinically, the attainment of developmental milestones is assessed through standardized measures of developmental domains. Many psychometric tests are arranged hierarchically, and on the surface, two individuals with the same overall score on a clinical measure may appear to be impaired to a similar extent. However, at the itemized level, individuals with DDEV exhibit a more scattered pattern of incorrect answers. Differentiating between DDEV and DD may inform prognosis and predict long-term outcomes.
Objectives: We used a modified measure of scatter, called *inefficiency*, to differentiate between DD and DDEV using standardized measures of language ability. We tested the accuracy of inefficiency to predict ASD diagnosis, and by extension DDEV, among probands from the New Jersey Language and Autism Genetics Study (NJLAGS) cohort.
Methods: NJLAGS consists of 157 families (500 individuals) ascertained for at least one individual with ASD and another with language impairment (LI). All individuals were given the Clinical Evaluation of Language Functioning (CELF) and Comprehensive Assessment of Spoken Language (CASL). Four phenotypic groups were defined: unaffected, ASD, LI, and LI+ASD. A hierarchical clustering model was fitted to each subtest to investigate if clusters of item responses correlate with an individual's diagnosis (LI or LI+ASD) regardless of scatter and ceiling effects. Inefficiency was defined for each subtest as the product of the total number of subtest items and the sum of the weights (percentage of unaffected family members who correctly answered the item) of the items missed. Group differences in inefficiency across subtests were assessed using ANOVA. We fit a generalized linear model to determine diagnostic outcomes of inefficiency with IQ and age included as covariates.
Results: Hierarchical clustering analysis indicated that the LI and LI+ASD groups segregate according to their item responses for subtests of the CASL and CELF. Overall raw scores did not differ between the LI and LI+ASD groups; however, the LI+ASD group had consistently higher inefficiency scores than the LI group for all language measures. The following subtests reached significance ($p<0.001$): CASL Nonliteral Language (NL), Pragmatic Judgement (PJ), Meaning From Context (MFC), and CELF Recalling Sentences (RS), Word Definitions (WD), and Word Classes (WC) subtests. When controlling for age and IQ, inefficiency was able to accurately predict ASD diagnostic status among the LI and LI+ASD groups for the NL ($p=0.002$), PJ ($p=0.009$), MFC ($p=0.005$) and RS ($p=0.005$) subtests.
Conclusions: Individuals with LI+ASD exhibit more DDEV, as measured by inefficiency, across measures of expressive, pragmatic, and metalinguistic language compared to individuals with LI. By distinguishing between DDEV and DD, inefficiency was able to predict ASD diagnosis among LI/LI+ASD probands. Inefficiency can be applied to measures across multiple developmental domains in order to characterize developmental profiles of individuals with DDEV/DD.

1:57 **187.002** Using Social Communication Dynamics Measures for Diagnostic Purposes in Adolescents with Autism Spectrum Disorder

V. Romero[1], *P. Fitzpatrick*[2], *R. Schmidt*[3] *and M. Richardson*[1], *(1)University of Cincinnati, Cincinnati, OH, (2)Psychology Department, Assumption College, Worcester, MA, (3)College of the Holy Cross, Worcester, MA*

Background: Children with Autism Spectrum Disorder (ASD) exhibit impairments in social interactions and at the core of these impairments are social communication deficits. Recent advances in the quantitative and computational measurement of conversational content has resulted in a novel set of methods that might provide a more objective and reliable way of identifying the conversational biomarkers of ASD, as well as a better understanding of the time-evolving dynamics of social communication in these individuals.
Objectives: The current study has two objectives: (1) to validate the use of newly developed computational measures of conversational interaction for assessing deficits in social communication in adolescents with ASD; and (2) to further identify whether deficits in social communication are interrelated to deficits in the social motor coordination that supports effective social interaction.
Methods: Twenty-four children previously diagnosed with ASD completed the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) and a battery of social motor coordination tasks. The conversations that each participant had with the clinician during the ADOS-2 administration were evaluated using Discursis, a computational time-series method that analyzes the conceptual and semantic content of an exchange between two or more individuals. Various measures were extracted to quantify different aspects of the conversation (e.g. self-similarity, other-similarity). Additionally, a measure of the child's social motor coordination ability was obtained (e.g. coherence). Of particular interest is the relationship between ASD symptom severity and the dynamical measures of communication and social motor coordination and the degree to which some of these dynamical measures better predict ASD communication deficits.
Results: Some Discursis measures were correlated with some ADOS-2 sub-category scores (e.g. social affect), as well as the composite score obtained from the test. Stepwise regressions confirmed that Discursis measures can be used to predict composite scores and traditional multiple regression showed that by including a measure of social coordination we are able to account for more of the variability present in ADOS-2 composite scores as well as some sub-category scores.
Conclusions: This pilot data provides some mixed results, but indicates that Discursis could be a sensible and important addition to our diagnostic procedures that would help us better understand the communicational deficits exhibited by some children with ASD. Furthermore, it seems that the social motor coordination that takes place during conversations is interrelated to the verbal communication and necessary to quantify for further understanding of this deficit. Finally, the addition of these measures has the potential to improve our diagnostic tools, as well as help with planning what types of treatment will most benefit the specific child once diganosed.

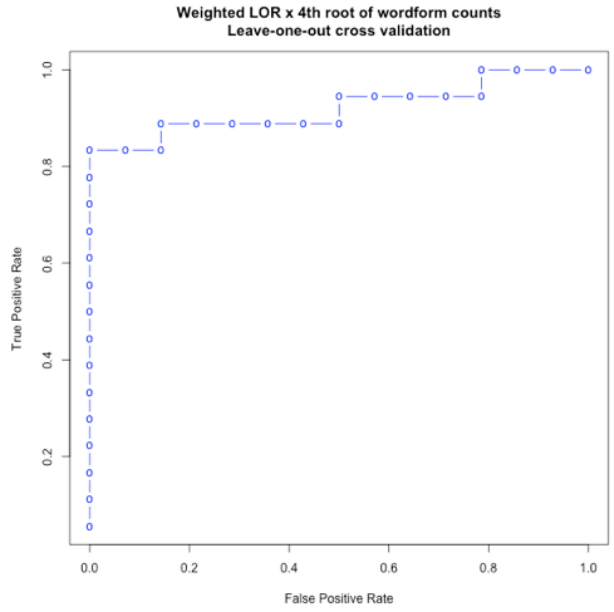
2:09 **187.003** Linguistic Markers of Autism Spectrum Disorder: Classification Sensitivity and Specificity of Language Produced during Clinical Evaluations

J. Parish-Morris[1], *R. T. Schultz*[2], *M. Y. Liberman*[3] *and C. Cieri*[3], *(1)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (2)The Center for Autism Research, The Children's Hospital of Philadelphia, Philadelphia, PA, (3)Linguistic Data Consortium, University of Pennsylvania, Philadelphia, PA*

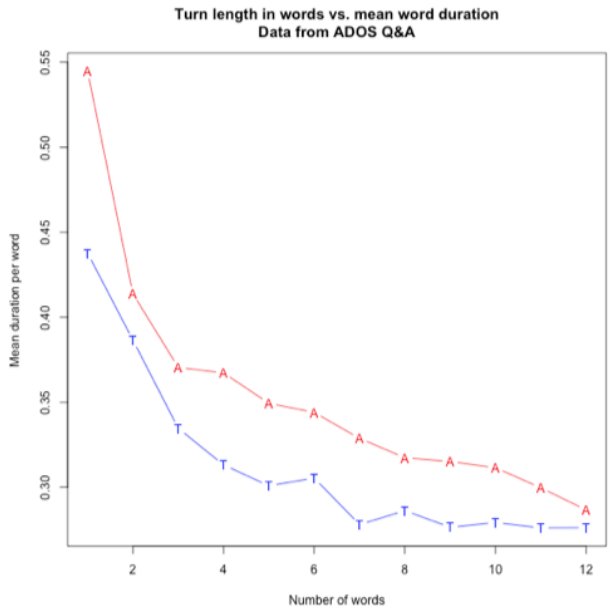
Background: Infants and toddlers later diagnosed with autism spectrum disorder (ASD) often experience significant language delays, and concern about language is one of the first reasons parents seek evaluation (Tager-Flusberg, Paul, & Lord, 2005). Gold-standard clinical evaluations of ASD include administration of the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000), which is based on a series of 0-3 ratings that sometimes differ from clinician to clinician. Given the importance of early identification and intervention for maximizing positive outcomes, it is crucial to develop objective, quantitative measures that can aid in diagnosis, inform intervention decisions, and predict trajectory. Computational linguistics methods and machine learning offer novel ways to analyze highly granular language data, revealing variation that may be informative for accurate, objective diagnosis and phenotypic characterization. For example, markers such as reduced co-articulation may reflect the increased cognitive and behavioral "rigidity" that characterizes ASD. Inter-turn pause length, an aspect of prosody that quantifies the gap between speaker turns, may relate to perceptions of pragmatic comptence. When pauses are too short (interrupting or speaking over a conversational partner) or too long (awkward silences), smooth conversational interactions are disrupted. In this preliminary research, we explore four potential linguistic markers of ASD: word choice, speech rate, inter-turn pause length, and rates of conversational turn-taking.
Objectives: Using a machine-learning approach, determine whether features of natural language produced during the ADOS distinguish ASD from typically developing controls (TDC).
Methods: Thirty-two participants aged 6-14 years (18 ASD, 14 TDC), individually matched on sex ratio, age, and IQ) were administered the ADOS during a clinical evaluation. 20-minute segments were transcribed, and parent reports of social responsiveness were collected (SRS; Constantino et al., 2003).
Results: First, we applied naïve Bayes classification to word choice (words produced by children during the evaluation) to assess the sensitivity and specificity of diagnostic classification based on this variable. Weighted log-odds calculations with leave-one-out-cross-validation resulted in 14/18 children correctly classified as having ASD and 100% of TDC participants classified correctly. Receiver Operating Characteristic (ROC) analyses showed high sensitivity and specificity using this classification metric, with area under the curve=92%, CIs 82%-100%, $p<.001$ (Figure 1a). In addition, we observed that participants with ASD spoke significantly more slowly (reduced speaking rate is associated with less co-articulation; Figure 1b), used significantly fewer words per turn, and had significantly longer inter-turn gaps than TDC participants. To assess continuous relationships between linguistic variables and clinical phenotype, we conducted Pearson correlations: results revealed that speaking rate, rate of conversational turn-taking, and overall speaking time correlated with symptom severity as measured by the SRS (rs range from -.34 to -.44, all ps<.01) but not with IQ or age. These promising preliminary findings with a relatively small sample are consistent with the literature and highly suggestive of real effects.
Conclusions: Computational linguistics represents a promising new way to parse heterogeneity and aid in diagnostic classification of ASD. New data from more heterogeneous populations are currently being analyzed, with the goal of increasing sample size and classification power.

Figures 1a & 1b. 1a. ROC curve showing ability of a classifier to separate cases from controls, using specific words produced by participants during the ADOS. 1b. The ASD group demonstrated significantly slower speech rates than the TDC group, shown as a function of number of words.

1a.



1b.

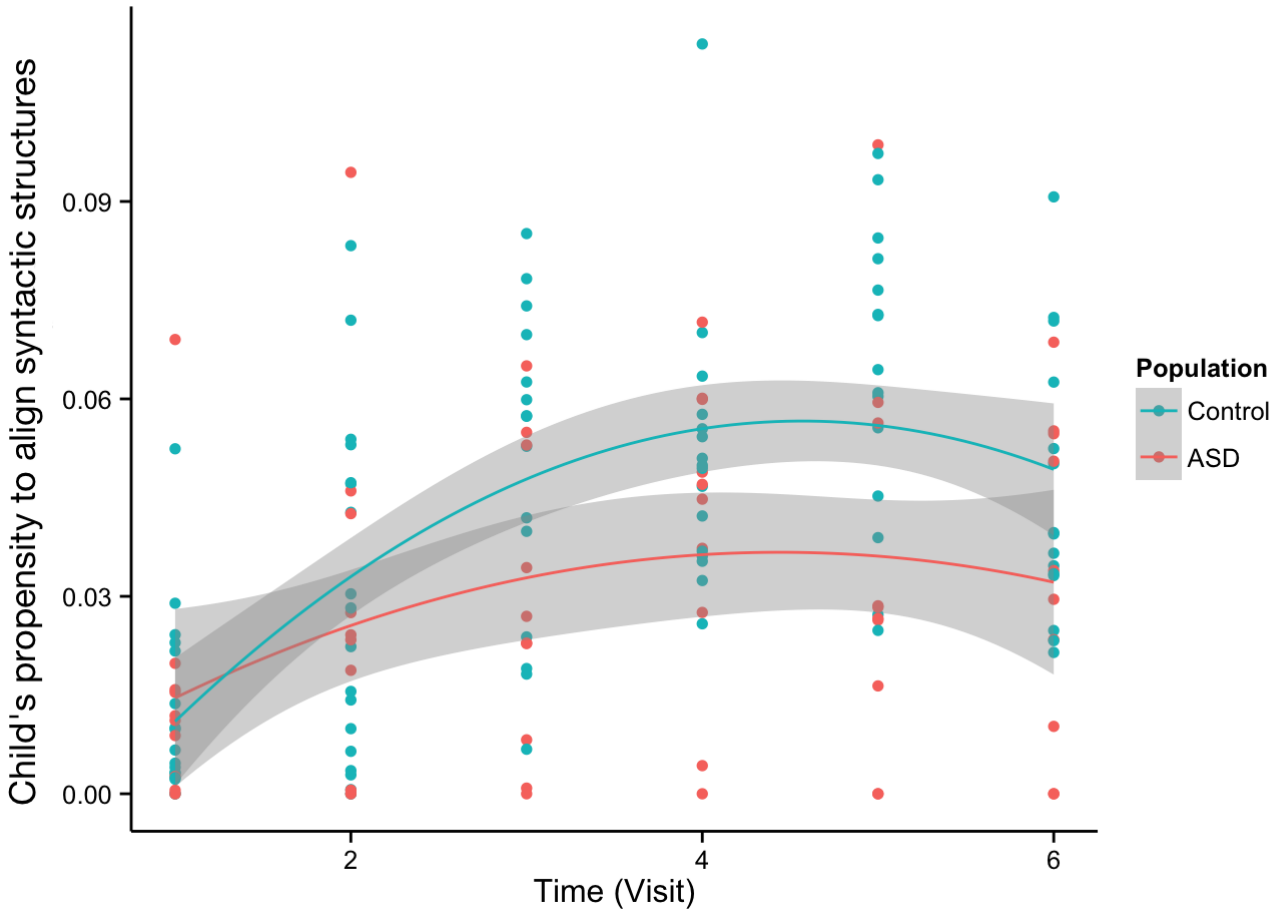


2:21 **187.004** Learning to Interact: Developmental Trajectories of Linguistic Alignment in ASD

R. Fusaroli[1,2], *E. Weed*[3] *and L. Naigles*[4], *(1)Center for Semiotics, Aarhus University, Aarhus, Denmark, (2)Interacting Minds, Aarhus University, Aarhus, Denmark, (3)Aarhus University, Tranbjerg J, Denmark, (4)University of Connecticut, Storrs, CT*

Background: Interactive alignment (IA) has been argued to underlie not only successful social interactions (Pickering & Garrod, 2004), but also language development. By re-using each other's words, the child and the caregiver engage each other, and the child acquires new linguistic items and receives feedback on their use (Nguyen & Delvaux, 2015; Messum & Howard 2015). IA has been shown to be unimpaired in high-functioning children and adults with ASD during highly structured task-oriented conversations (Hopkins et al, 2014; Slocombe et al 2014; Allen et al 2011). However, little is known about how the ability to align develops, and whether it is impaired in everyday unstructured interactions.
Objectives: We ask two questions: i) does IA evolve over time as children becomes a more competent speakers? and ii) is IA impaired in children with ASD?
Methods: We analyzed spontaneous speech in parent-child dyads from a longitudinal corpus (6 visits over 2 years), consisting of 30 minutes of controlled playful activities between parents and 66 children (33 ASD; MA = 33 months) and 33 initially-language-matched (Mullen EL, RL) typically developing (TD; MA = 20 months) (cf. Goodwin et al. 2012). Lexical and syntactic alignment was calculated between neighboring utterances as the probability of words (lexical) or parts of speech (syntactic) to be repeated, normalized by the length of the utterances involved. Syntactic alignment was calculated excluding repeated lexical items to maximally distinguish it from lexical alignment. To assess the development of alignment we used mixed-effects growth curve models. The models included gender, Mullen scores (Mullen 1995), and ADOS (Gotham 2009) scores as fixed factors.
Results: Across groups, we observed a general increase of alignment over time, with two primary effects: (1) *Development had significant linear and quadratic components* (lexical linear: β=0.76, SE=0.2, t-stat=3.88, p=0.0001; lexical quadratic: β=-0.56, SE=0.18, t-stat=-3.07, p=0.002; syntactic linear: β=1.12, SE=0.44, t-stat=2.53, p=0.011; syntactic quadratic: β=-0.95, SE= 0.45, t-stat=-2.12, p=0.034). (2) *Children with ASD displayed a lower degree of alignment*(lexical: β=-0.01, SE=0.01, t-stat=-1.96, p=0.05; syntactic: ASD: β=-0.07, SE=0.04, t-stat=-2, p=0.045). There were main effects of ADOS and Mullen scores: higher Mullen is related to higher lexical (β=0.01, SE=0.01, t-stat=1.94, p=0.05) and lower syntactic alignment (β=-1.16, SE=0.33, t-stat=-3.48, p<0.0001); higher ADOS is related to lower lexical (β=-0.13, SE=0.05, t-stat=-2.6, p= 0.01)

and syntactic alignment (β=-0.09, SE= 0.04, t-stat=-2.47 p=0.013). Gender had no impact. None of these factors interacted significantly with time.
Conclusions: Our data support the hypothesis that children's propensity to lexical and syntactic alignment develops over time. Contrary to previous findings on older populations, in our analysis of unstructured play between children and caregivers, we found that interactive alignment was impaired in the ASD group, as a function of symptom severity and intellectual functioning. This has important implications for understanding linguistic and social development in ASD. More work is needed to investigate how alignment develops at later ages, how alignment in unstructured contexts relates to alignment in structured task-oriented conversations, and what effect reduced alignment has on language development in ASD.



Oral Session - 12B
188 - Minimally Verbal Individuals with ASD
2:40 PM - 3:30 PM - Room 307

2:40 **188.001** Minimally Verbal Children with ASD and Cognitive Impairment: Do Definitions Matter?

V. Hus Bal[1,2], *T. Katz*[3,4], *S. L. Bishop*[1,2] *and K. Krasileva*[1], *(1)Department of Psychiatry, University of California San Francisco, San Francisco, CA, (2)STAR Center for ASD & NDDs, San Francisco, CA, (3)Autism and Developmental Disabilities Clinic, University of Colorado School of Medicine, Aurora, CO, (4)Children's Hospital Colorado and JFK Partners, Aurora, CO*

Background:
Guidelines for defining "minimally verbal" (MV) have been proposed (e.g., Kasari et al., 2013); however, to date, studies have used a variety of methods to classify samples. It is unknown how different parent-report or direct assessments used to classify MV samples compare. Some instruments may yield a very narrowly defined group of MV children, which may limit variability and make it difficult to identify dimensions that affect later language acquisition or other outcomes. This has implications for answering basic questions, such as the extent to which cognitive and language skills overlap in children with nonverbal cognitive impairment (i.e., NVIQ<70). A better understanding of methods used to define MV children is important to advancing understanding of this understudied group.
Objectives:
To examine how using different instruments to define MV cohorts affects sample characteristics (demographics; ASD symptom, cognitive and adaptive profiles) and the overlap between cognitive and verbal abilities in children with NVIQ<70.
Methods:
Children with ASD between 6 and 18 years old (N=2044) were drawn from the Simons Simplex Collection. All children had the ADI-R, Vineland, ADOS, cognitive assessment and parent questionnaires. Children were divided using the following MV definitions: ADOS Module 1 (No words/Some words), ADI-R language level (<5 words, 5+ words/no flexible phrases), Vineland Expressive age equivalent (<18 months), Social Communication Questionnaire (item 1 indicating no phrases) and parent estimate of vocabulary (none, 1-5, 5-25 words). Within children with NVIQ <70, MV children (ADOS Module 1, some words vs. no words) and verbal children (ADOS Module 2-4) were compared.
Results:
328 children (16% of the sample) were classified as MV. Of the 328, 24% were MV on two instruments and 38% on three or more. Most children (93%) were administered an ADOS Module 1 and 61% were reportedly not using daily, flexible phrases (ADI-R). Defining MV on the basis of the ADOS yielded the largest group with the most discrepancies across measures (e.g., 62% MV on ADI-R). Across MV definitions, 44-60% of children had VIQ<NVIQ profiles (i.e., VIQ 1+ SD below NVIQ), with as many as 15% of children with NVIQ>70.
Within the NVIQ<70 group (n=507), MV children were younger ($F(2,504)=12.63$, $p<.001$) and had lower VIQ ($F(2,504)=222.97$, $p<.001$) and NVIQ ($F(2,504)=122.95$, $p<.001$) than verbal children. A higher proportion of MV children (45%) had VIQ<NVIQ profiles than verbal children (20%; $X^2=78.82$, $p<.001$). MV children had less severe current social-communication impairments on the ADOS ($F(2,504)=24.38$, $p<.001$), but more past symptoms on the ADI-R ($F(2,504)=34.59$, $p<.001$).
Conclusions:
While no single approach is obviously "best," these results demonstrate how using different instruments to define MV samples affects sample composition. Results will inform comparisons across existing samples and design of studies ascertaining new samples of MV children. Within children with NVIQ<70, verbal and MV children differed on several characteristics. Nearly half of MV children exhibited VIQ<NVIQ profiles, suggesting a distinct subgroup of MV children whose language impairments are not attributable to general cognitive impairment. This highlights the need for future research to understand the unique strengths and challenges of MV children with ASD.

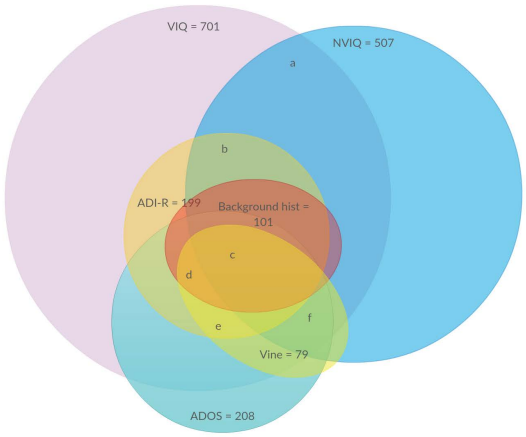


Figure 1. Overlap between definitions of Minimally Verbal and IQ<70
VIQ=Verbal IQ <70; NVIQ=Nonverbal IQ <70; ADI-R=Overall Level of Language #30=1 or 2; Vine=Vineland Expressive Age Equivalent <18 months; ADOS=Module 1; Background Hist=Parent estimate of vocabulary size (25 words or less). Letters indicate overlap between measures:
a: VIQ, NVIQ: n= 444
b: VIQ, NVIQ, ADI-R: n = 179
c: VIQ, NVIQ, ADI-R, ADOS, Vine, Background hist: n = 64
d: VIQ, ADI-R, ADOS, Vine, Background hist: n = 65
e: VIQ, ADI-R, ADOS, Vine: n = 74
f: VIQ, NVIQ, ADOS, Vine: n = 72

2:52 **188.002** What Predicts Speech Development in Young, Minimally Verbal Children with ASD?

P. Mirenda[1], *I. M. Smith*[2], *E. Duku*[3], *P. Szatmari*[4], *S. E. Bryson*[5], *E. Fombonne*[6], *T. Vaillancourt*[7], *J. Volden*[8], *L. Zwaigenbaum*[9], *S. Georgiades*[3], *T. Bennett*[3] *and M. Elsabbagh*[10], *(1)University of British Columbia, Vancouver, BC, Canada, (2)Dalhousie University / IWK Health Centre, Halifax, NS, Canada, (3)McMaster University, Hamilton, ON, Canada, (4)Centre for Addiction and Mental Health, Toronto, ON, Canada, (5)Dalhousie University, Halifax, NS, Canada, (6)Oregon Health & Science University, Portland, OR, (7)University of Ottawa, Ottawa, ON, Canada, (8)University of Alberta, University of Alberta, AB, Canada, (9)University of Alberta, Edmonton, AB, Canada, (10)McGill University, Montreal, PQ, Canada*

Background: Current estimates are that 10%-30% of children with autism are minimally verbal (MV); that is, they fail to acquire spoken language beyond a minimal level by the time they enter school, despite access to early intervention (Kasari, 2013). Past research suggests that nonverbal IQ (NVIQ), ASD severity, imitation skills, and/or joint attention skills at the time of diagnosis predict language outcomes in general (Ellis Weismer & Kover, 2015; Norrelgen et al., 2014; Thurm et al., 2014). However, no study to date has examined the extent to which changes in these variables are predictive of outcomes in children who are MV at the time of diagnosis.
Objectives: The purpose of this study was to examine the extent to which NVIQ, ASD severity, imitation and joint attention skills at diagnosis, and changes in imitation and joint attention over the first 6 months thereafter predict verbal status of children with ASD who were MV at diagnosis.
Methods: Data were drawn from the Canadian *Pathways in ASD* study and included only children who were MV at the time of diagnosis (T1) and for whom the data required to assess verbal status at age 6 were available. Participants were 91 children (89% males) from five Canadian provinces (mean age at T1 = 33.7 mo; range = 19-55 mo). MV

status at diagnosis was established by research-reliable assessors using two criteria: (a) code of 1 or 2 on question 30 (Q30) of the Autism Diagnostic Interview-Revised (ADI-R), and (b) code of 3 or 8 on Module 1 of the Autism Diagnostic Observation Schedule (ADOS). At T1, the Merrill-Palmer-Revised Scales of Development was used to measure NVIQ, and the Multidimensional Imitation Assessment (MIA) and Early Social Communication Scales (ESCS) were used to measure imitation and joint attention, respectively. In addition, 66 children completed the MIA and ESCS six months after T1 (T2), and all children were re-assessed with the ADI-R and ADOS at age 6 (T3). Verbal status at T3 was established based on ADI-R Q30 and the ADOS Module completed at that time. Correlation and multinomial regression analyses were conducted to examine the predictors of verbal status at T3.

Results: Of the total sample (N=91), 37.4% remained MV at age 6, 16.5% had words but not phrases, 27.5% had phrase speech, and 18.7% had fluent speech. Neither MIA or ESCS scores at T1 predicted verbal status at T3; the only significant predictor was T1 NVIQ. For the subsample (n=66), MIA Total change scores and ESCS Responding to Joint Attention change scores from T1-T2 were directly related to higher verbal status at T3.

Conclusions: NVIQ at the time of diagnosis and gains in imitation skills and responding to bids for joint attention during the first six months post-diagnosis (associated for many with the onset of early intervention) predicted verbal status at age 6. These results might be useful to guide decision-making related to the effectiveness of early interventions designed to support speech development in young children who are MV at diagnosis.

3:04 **188.003** Understanding the Changing Face of Autism: Determining Language Profiles of Children with ASD at Age Three Years

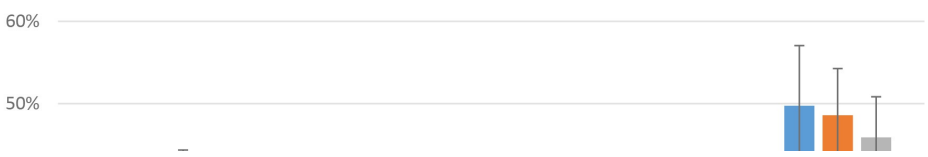
E. C. Bacon[1], *S. Osuna*[2], *C. Carter*[1], *D. Cha*[1], *S. Pence*[1], *E. Courchesne*[1] *and K. Pierce*[1], *(1)Neuroscience, UCSD Autism Center of Excellence, La Jolla, CA, (2)San Francisco Clinical Research Center, San Francisco, CA*

Background:
Estimates in the literature have long referenced that 20-50% of children are nonverbal (Eigsti, 2011; Lord et al., 2004; Tager-Flusberg et al., 2005). However, these estimates are likely inaccurate given earlier identification and treatment of ASD, and changes in diagnostic criteria. Consequently, fine analysis of natural language, beyond standardized scores, is needed to further understand the language profile of toddlers with ASD. Research in this area is emerging (Tek et al., 2013), but further research with large samples and comparisons to other delay groups is needed.
Objectives:
This study aimed to provide a detailed characterization of language abilities of children with ASD at age three, when most children receive a final diagnosis, and provide a more modern estimate regarding the percentage of ASD children with functional language.
Methods:
Participants were recruited from the general population largely via the 1-Year Well-Baby Check-Up Approach (Pierce et al., 2011) and included 109 with ASD, 60 typically developing (TD), and 42 with language delay (LD; note: 52% of the LD group had a transient diagnosis and did not show persistent delay). Data were analyzed from a ten-minute free-play interaction between the child and parent when children were between 30-42 months of age (M=34.95). Spoken language was assessed globally, and children with 15 words or fewer were categorized as minimally verbal (Paul et al., 2013; Tager-Flusberg, 2009). Partial-interval scoring was conducted to code features of the child's and parent's speech (see table 1). MANOVAs were conducted to compare differences between groups.
Results:
Thirty-four children with ASD used fewer than 15 words during the assessment, and four used no words. MANOVA analyses revealed significant effects between groups for many language features (see table 1). The largest effect sizes were seen for word approximations ($F=39.523$, $p < .000$, $\eta^2 = .275$), full words ($F=54.353$, $p < .000$, $\eta^2 = .343$), MLU ($F=40.126$, $p < .000$, $\eta^2 = .278$), child initiations ($F=43.591$, $p < .000$, $\eta^2 = .295$), child response ($F=19.441$, $p < .000$, $\eta^2 = .157$), and Wh- questions ($F=26.061$, $p < .000$, $\eta^2 = .200$). The aforementioned variables, also showed significant differences between ASD and TD children, as well as ASD and LD. See Figure 1 for a sample of language features across groups. Children with a persistent language delay versus a transient delay will be further analyzed in the future.
Conclusions:
Thirty-one percent of the children with ASD presented as minimally verbal, and only 3.7% used no words at all, suggesting that the idea that up to 50% of children with ASD are nonverbal is outdated. Children with ASD showed delays across variables and showed more impairment than LD and TD groups. Children with ASD and LD had similar usage of grammatical markings, although both were reduced compared to TD children. The social use of language was markedly different in children with ASD compared to LD and TD, as children with ASD also showed reduced initiations and responses to their parent, although their parents initiated to them just as frequently as other parents.

Table 1. Coding Examples and MANOVA Results.

Child Vocalization/Word Level Coding					
Code	**Function**	**Examples**	**F**	**Sig**	**Partial Eta Squared**
Unidentified Sounds	Non-word sounds/vocalizations	"Bah," "tuh"	3.995	.020	.37
Babbling	Sound reduplications	"bababa"	8.821	.000	.078
Sound Effects	Sounds used during play to accompany play scenarios	"Vroom" "Moo"	1.247	.290	.012
Word Approximation	An imperfect or unclear attempt at a word	"Ba" (ball)	39.523	.000	.275
Fully Articulated Word	Clearly articulated word	"Yes"	54.353	.000	.343
Self-Stimulatory Speech	Repetitive sounds composed of only vowel sounds	"Aa-ee aa-ee"	4.365	.014	.040
Child Phrase Level Coding					
Code	**Function**	**Examples**	**F**	**Sig**	**Partial Eta Squared**
Immediate Echolalia (Exact)	Repeating the exact word, phrase or part of phrase said immediately prior by the caregiver	Parent: Hello Thomas! Child: Hello Thomas!	.511	.601	.005
Immediate Echolalia (Partial)	Repeating part of the sounds, word, phrase or part of phrase said immediately prior by the caregiver. This must be altered in some way.	Parent: Get the car! Child: The car!	3.848	.023	.036
Delayed Echolalia	Repeating a sound, word, or phrase that has not recently been said by another person in the environment	Parent: Let's play with baby! Child: Elmo's world! Elmo's world!	.608	.546	.006

Initiation	Child makes statement or asks a question	Child: Let's play with baby!	43.591	.000	.295
Response	Child responds to statement or question asked by caregiver	Parent: "Do you want the ball?" Child: "No"	19.441	.000	.147
Mean Length of Utterance	Mean number of words in phrases spoken by child during assessment	Ex: 2.5	40.126	.000	.278
Parent Language Coding					
Code	**Function**	**Examples**	**F**	**Sig**	**Partial Eta Squared**
Initiation	Question, command, or attempt to capture child's attention	"Pass the doll," "What is that?"	1.344	.263	.013
Response	Repeating the child's words or answering a question	Child: "Can we play?" Parent: "Yes!"	16.903	.000	.140
Narration	Descriptions of the play environment or the use of non-directive speech such as sound effects or singing	"Baby is sleeping"	6.394	.002	.058
Discipline	Used to regulate a child's behavior	"No, don't throw that"	.632	.533	.006
Praise	Intended to encourage or praise the child	"Good job!"	3.249	.041	.030
Morpheme scoring (Brown, 1973)					
Order of Acquisition	**Morpheme**	**Example**	**F**	**Sig**	**Partial Eta Squared**
1	Present progressive - *ing* (no auxiliary verb)	Mommy driv*ing*.	8.516	.000	.076
2	*In*	Ball *in* cup.	15.993	.000	.133
3	*On*	Doggie *on* sofa.	13.536	.000	.115
4	Regular plural - *s*	Kitties eat my ice cream.	7.269	.001	.065
5	Irregular past	*Came*, *fell*, *sat*, *went*	6.076	.003	.055
6	Possessive - '*s*	Mommy'*s* balloon broke.	2.725	.068	.026
7	Uncontractible copula (Verb *to be* as main verb)	Who'*s* sick? Response: He *is*.	8.880	.000	.079
8	Articles	I see *a* kitty. I throw *the* ball to daddy.	8.348	.000	.074
9	Regular past - *ed*	Mommy pulled the wagon.	1.994	.139	.019
10	Regular third person -*s*	Kathy *hits*.	9.884	.000	.087
11	Irregular third person	*Does*, *has*	1.718	.182	.016
12	Uncontractible auxiliary	Who'*s* wearing your hat? Response: He *is*.	1.235	.293	.012
13	Contractible copula	Man *is* big. Man'*s* big.	28.847	.00	.217
14	Contractible auxiliary	Daddy *is* drinking juice. Daddy'*s* drinking juice.	.	.	.
-	Wh- questions	*What* is it?	26.061	.000	.200



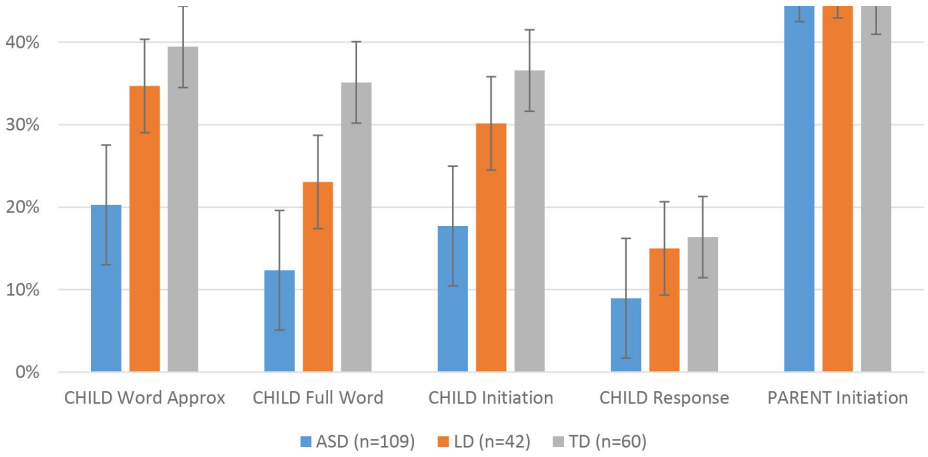


Figure 1. Differences in communication across diagnostic groups.

3:16 **188.004** Exploring Visual Social Attention in Minimally Verbal Children and Adolescents with ASD

D. Plesa-Skwerer[1], *A. Chu*[2], *B. Brukilacchio*[3] *and H. Tager-Flusberg*[1], *(1)Boston University, Boston, MA, (2)Psychological and Brain Sciences, Boston University, Boston, MA, (3)Harvard Graduate School of Education, Somerville, MA*

Background: Attending preferentially to social information in the environment is important in developing socio-communicative skills and language. Research using eye-tracking to explore how individuals with autism spectrum disorders (ASD) orient to and engage attention towards various stimuli surged in the last decade (Guillon et al., 2014). However, studies rarely included nonverbal/minimally verbal individuals (MV_ASD); investigating their spontaneous viewing patterns could provide insights into the possible connections between social attention deficits and failure to acquire spoken language.
Objectives: We used eye-tracking to examine whether distinctive patterns of attending to and processing social information differentiate minimally verbal from verbal individuals with ASD (V_ASD) when viewing naturalistic dynamic scenes.
Methods: Participants were 38 MV_ASD and 19 V_ASD children and adolescence between 5; 8 and 18 years, matched on age. The eye-tracking task (modeled after Chawarska et al., 2012) involved short video-clips showing an actor seated behind a table, making a snack or wrapping a book. Four interesting objects surrounded the actor. Areas of interest (AOIs) were defined around each object and the actor's face, eyes and hands. The videos were divided into 6 episodes based on the actor's behavior: most salient were 3 episodes, one showing the actor looking toward the camera addressing the viewer directly, another showing a toy-spider moving on the table and the actor's gaze following the spider's movement (expected gaze shift); the third showing the spider moving again, but the actor looked toward the unmoving object diagonally opposite from the toy-spider (unexpected gaze shift). The variables of interest were proportion of looking time in each AOI, by episode, relative to total time spent looking at the screen.
Results: Relative to total movie duration both V_ASD and MV-ASD participants spent proportionally more time looking at the actor compared to the objects (71.3% vs. 28.7% and 65% vs. 35%, respectively) and increased their attention toward the actor's face when she started talking. However, in the segments that entailed interpreting the actor's gaze shift toward and away from a surprising moving object, fewer MV_ASD participants showed fixations on the actor's face (26.3% in segment 3 and 39.5% in segment 5) compared to the V_ASD participants (61.5% and 67%, respectively). Only 15.8% of the MV_ASD group followed the actor's unexpected gaze shift, compared to 39% of the V-ASD participants who displayed a triadic pattern of visually scanning the scene, involving the toy-spider, the actor's face/line of regard and the object toward which the actor shifted gaze.
Conclusions: These findings underscore the need to qualify the widely-held assumption that individuals with ASD distribute attention between objects and persons in atypical ways, by examining the social-inferential challenges of the scenes viewed. The differences in visual scanning patterns found between MV_ASD and V_ASD participants reflect decreased attention to behaviors that entail inferring the underlying intentions of the actor. Consequently, minimally verbal children with ASD may be less able to learn from interactive opportunities involving joint attention, which may further impair their ability to detect and interpret social cues and affect their acquisition of language.

Oral Session - 13A
189 - Identifying Autism Pathogenesis using Human Induced Pluripotent Stem Cells (iPSCs)
1:45 PM - 2:35 PM - Room 308

1:45 **189.001** Using iPSCs to Model Angelman and Chromosome 15q11.2-q13 Duplication (Dup15q) Syndromes

S. Chamberlain[1], *N. Germain*[1], *J. S. Hsiao*[1] *and C. Sirois*[1,2], *(1)Genetics and Genome Sciences, University of Connecticut Health Center, Farmington, CT, (2)Neuroscience, University of Connecticut Health Center, Farmington, CT*

Background: Angelman syndrome (AS) is a neurodevelopmental disorder with profound impacts on cognitive function, speech/language, and seizure susceptibility that is most frequently caused by deletions of maternal chromosome 15q11.2-q13. Autism is frequently diagnosed in individuals with AS. Conversely, duplications of maternal chromosome 15q11.2-q13 are one of the most common cytogenetic anomalies associated with autism. Cognitive function, speech/language, and seizure susceptibility is also impacted in individuals with Dup15q syndrome. Disruption in the copy number of one gene, *UBE3A*, underlies both disorders.
Objectives: To develop human iPSC models of AS and Dup15q syndromes to 1.) understand the local gene regulation underlying these disorders, 2.) to identify cellular phenotypes associated with both disorders, and 3.) to test potential therapeutic approaches to restore normal 15q gene expression.
Methods: iPSCs from AS and Dup15q patients were generated from patient fibroblast, cord blood, or peripheral blood samples using retrovirus, lentivirus, episomal, and sendai virus reprogramming methods. Genome editing using CRISPR/CAS9 technology was used to modulate gene regulation. iPSCs were differentiated into forebrain cortical neurons using an embryoid body-based or monolayer protocol. RT-qPCR and RNA-Seq were used to quantify local and global gene expression. Microscopy and electrophysiology were used to investigate cellular phenotypes.
Results: We have generated iPSCs from several individuals with AS and Dup15q syndromes and have differentiated them into forebrain cortical neurons. We have genetically corrected AS iPSCs and have modulated expression of UBE3A in iPSCs and neurons using a variety of methods. We compared 15q gene expression between the different iPSC lines as well as from their neuronal derivatives. We found that gene expression closely followed copy number in iPSCs, but deviated somewhat from copy number in iPSC-derived neurons. Early electrophysiology experiments and examination of dendritic spine morphology corroborate a defect in neuronal development.
Conclusions: Human iPSCs derived from individuals with AS and Dup15q syndrome provide an attractive model to study gene expression and cellular phenotypes of neurodevelopmental disorders, including ASD. They can be used to gain important insight into the neuronal development deficits underlying these autism-related disorders, as well as to test potential therapeutic approaches.

1:57 **189.002** ASD Patient-Derived Neural Stem Cells Exhibit Defective Proliferation in Comparison to Sibling Control

M. Williams[1], *S. Prem*[2], *C. Pinto*[3], *X. Zhou*[4], *P. G. Matteson*[5], *P. Yeung*[6], *C. W. Lu*[6], *Z. Pang*[6], *J. H. Millonig*[4] *and E. DiCicco-Bloom*[7], *(1)3rd Floor, Rm 354, Graduate School of Biomedical Sciences, Piscataway, NJ, (2)Neuroscience, Graduate School of Biomedical Sciences, Piscataway, NJ, (3)Rutgers University, New Brunswick, NJ, (4)Rutgers Robert Wood Johnson Medical School, Piscataway, NJ, (5)Rutgers University, Piscataway, NJ, (6)Child Health Institute of New Jersey, Rutgers Robert Wood Johnson Medical School, New Brunswick, NJ, (7)Rutgers University - Robert Wood Johnson Medical School, Piscataway, NJ*

Background:
Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by abnormalities in social interactions and stereotyped/restrictive behavior. The study of

ASD etiology has been hindered by disease heterogeneity and difficulties in creating representative mouse models. To examine neurobiological deficits in idiopathic autism, we (NJ Autism Center of Excellence; PI Millonig) generated iPSC lines from 8 severely affected males with ASD and their unaffected brothers (Sib) and derived neural stem cells (NSCs) to study fundamental developmental processes.
Objectives: Our goal is to uncover potential differences in proliferation in idiopathic autism patient-derived NSCs by using developmentally relevant exogenous factors (EFs). We have examined an array of EFs including FGF, pituitary adenylate cyclase-activating peptide, BDNF, NT3, 5-HT, H_2O_2 and MeHg.
Methods:
To define effects, cells were grown at high density (50K cells/cm^2) without and with EFs. At 48h cells were labeled with tritiated thymidine to assess DNA synthesis and EdU for S-phase entry. In parallel, single cell analyses were conducted by acutely dissociating high-density cultures, plating at low density (10K/cm^2) and fixing at 2h for immunostaining. Further, sister cultures were dissociated every 48h for 6 days to quantify live cell numbers via hemocytometer. To address possible variability, studies were performed blind, and all results have been replicated in multiple NSCs obtained from 2-3 independent iPSC lines for each subject.
Results:
As might be expected, FGF induced increases in DNA synthesis and S-phase entry by ~50% at 48h. These early increases predict 50% – 100% increases in cell numbers by 4 and 6 days. Though both ASD and sibling NSCs show a response to FGF stimulation, ASD NSCs from a single-family comparison exhibit a remarkable proliferation defect under baseline conditions. At 48 hours ASD NSCS display a 50% reduction in DNA synthesis. Additionally, ASD NSCs exhibit a 33% reduction in the proportion of cells entering S-Phase as well as a 75% reduction in cell numbers after 6 days in culture. Furthermore, preliminary results suggest ASD NSCs have differential proliferative responses to growth regulator, 5-HT, and greater sensitivity to environmental toxicant, MeHg, in comparison with sibling control.
Conclusions:
In aggregate, our results indicate that we are able to employ EFs to discover differences in ASD-implicated biological processes, namely proliferation. Ultimately, this methodology may lead to the development of personalized pharmacological treatment for ASD individuals. Future studies will examine underlying mechanisms by assessing NSC cell death, cell cycle machinery, mRNA transcriptome, and metabolomic profiles.

2:09 **189.003** Decreased Overall Network Activity in iPSC-Derived Cortical Neurons in Individuals with Idiopathic Autism

*E. Artimovich[1], A. W. Phillips[1], B. A. DeRosa[2], J. E. Nestor[1], M. L. Cuccaro[2], D. Dykxhoorn[2] and **M. W. Nestor**[1], (1)The Hussman Institute for Autism, Baltimore, MD, (2)The Hussman Institute for Human Genomics, Miami, FL*

Background:
The early establishment of functional cortical neural networks is an important step in overall brain development, and may be impaired in individuals with autism. Understanding the physiological characteristics of network-level activity and the effect that autism-related genes have on that activity is paramount to developing genotype-phenotype relationships at the cellular level in autism spectrum disorder (ASD).
Objectives:
To use cell based assays to interrogate network-level electrophysiological activity, calcium transients, and other aspects of synaptic function from induced pluripotent stem cell (iPSC)-derived cortical neurons in ASD individuals with putative risk contributing genetic variants (Cukier et al., 2014).
Methods:
iPSC lines were created from peripheral blood mononuclear cells (PBMCs) of individuals with autism (N=5) and unrelated, sex-matched controls (N=3 lines). iPSCs were derived into neurons with transcriptional lineages resembling cortical neurons (DeRosa et al., 2012). Neurons were plated and differentiated into mixed networks for 0, 14, 28, and 35 days. Developing networks were interrogated with multi-electrode array (MEA) recordings, measurements of calcium transients using Fluo-4, and fixed and stained for relevant morphological markers.
Results:
Lines from ASD individuals demonstrated significantly decreased network spiking activity from MEA recordings ($p < 0.001$, ANOVA) as well as decreased numbers of calcium transients ($p < 0.05$, t-test). Additionally, ASD lines showed significant differences in measures of neurite morphology ($p < 0.001$, ANOVA) at early neuronal differentiation times.
Conclusions:
The results of this study suggest that in iPSC-derived neurons derived from individuals with ASD, there may be early deficits in network activity and morphology based on a combination of cell based assays, including MEA, Fluo-4 measured calcium transients, and quantification of neurite outgrowth.

2:21 **189.004** Functional Effect of GRIN2B Alterations in Humans Neuro Progenitor Cells, a Model for Intellectual Disabilities

***G. Maussion**, Douglas Mental Health Institute, Montreal, QC, Canada*

Background:
Gene mutations and chromosomal rearrangements are found in a proportion of patients diagnosed with autism spectrum disorders (ASDs) or intellectual disabilities (IDs). Modifications at the DNA level are likely responsible for altering neurodevelopmental programs; however, the molecular mechanisms that links mutations with altered sub-cellular and cellular processes leading to neuronal dysfunctions are poorly understood. A new approach which may help to better understand such mechanisms involves using human neuroprogenitor cells (NPCs) derived from induced pluripotent stem cells (iPSC). In fact, proliferation and differentiation processes of such cells determined to become neurons, glia or oligodendrocytes can be easily observed in vitro, in physiological and pathological contexts.
Several studies have reported mutations, deletions, or disruptions of *GRIN2B* gene in cases diagnosed with ASDs or neurodevelopmental disorders. *GRIN2B*gene is located on chromosome 12p12. That gene codes for an NMDA receptor subunit which plays important roles at pre and post natal stages in synaptic development and glutamatergic neurotransmission.
Objectives:
The main objective of that study is to understand how alterations in GRIN2B gene may lead to an altered neurodevelopmental program using neural progenitor cell models. At a molecular level, we aim to identify the genes and gene networks that are deregulated in a model of GRIN2B silencing or in a NPC cell line from a patient with GRIN2B mutation.
We would determine if those changes at the DNA or at the RNA levels could affect cell morphology and electrophysiological properties.
Methods:
DNA from patients diagnosed with ASD or ID were analysed using deep sequencing. NPCs producing sh-RNA that targets *GRIN2B* gene or derived from patients with a *GRIN2B* mutation were expanded and differentiated for 30 days. Whole transcritptome profiling was performed on the *GRIN2B*silenced cell lines using RNA sequencing. Differentially expressed genes were validated by quantitative real-time PCR. 3D reconstructions and electrophysiological recordings were done to assess morphology and glutamate receptor function, respectively.
Results:
Gene expression analysis performed on the model of *GRIN2B*silencing shows that differentially expressed genes are related to synapse functioning and ion transport. We have validated the differential expression of many mRNA glutamatergic subunits such as GRIK1, GRIK2, GRIA1, GRIA2 and GRIA4. Preliminary data of 3D reconstruction suggest that GRIN2B silenced cells present dendritic abnormalities.
Conclusions:
These data suggest that reduced dosage of GRIN2B affects the expression of other mRNA coding glutamatergic subunits which potentially alter crosstalks between receptors and consequently dendritic spine development. These mechanisms may be crucial in the pathophysiology of ASDs and IDs.

Oral Session - 13B
190 - Pharmaceutical Interventions for ASD
2:40 PM - 3:30 PM - Room 308

2:40 **190.001** The Role of Precompetitive Consortia, Data Sharing and Regulatory Science in Catalyzing Innovation for Autism Spectrum Disorders

***D. T. Stephenson**[1], B. Abrahams[2], K. Romero[3], J. Larkindale[4], J. McPartland[5], L. Fitzgerald[6], H. Mayer[7], J. E. Spiro[8], M. T. Pletcher[9] and W. Spooren[10], (1)Critical Path Institute, Tucson, AZ, (2)Albert Einstein College of Medicine, Bronx, NY, (3)Critical Path Institute, tucson, AZ, (4)critical path institute, tucson, AZ, (5)Yale Child Study Center, New Haven, CT, (6)LW Fitzgerald Consulting, LLC, east lyme, CT, (7)Shire, Lexington, MA, (8)Simons Foundation, New York, NY, (9)Autism Speaks, Boston, MA, (10)Roche, Basel, Switzerland*

Background: The lack of success in development of effective therapies for Autism Spectrum Disorders (ASD) suggests that public private partnerships are catalysts to tackling the challenges and sharing costs and risks amongst diverse stakeholders. The Innovative Medicine's Initiative's European Autism Interventions - A Multicentre Study for Developing New Medications (EU-AIMS) and the nascent Autism Biomarkers Consortium for Clinical Trials (ABC-CT) initiatives serve as a striking examples of the positive impact that can be achieved in precompetitive alliances for ASD. Regulatory agencies in the U.S., Europe and Japan have identified drug development tool platforms

to accelerate drug development.
Objectives: This presentation aims to highlight existing initiatives in ASD and opportunities for future expansion and extension in the areas of regulatory science and innovation.
Methods:
Critical Path Institute is a nonprofit organization that is dedicated to accelerating drug development by delivering on the mission outlined by the U.S. Food and Drug Administration's (FDA's) critical path initiative. Fundamental to the mission of C-Path consortia is the sharing of patient level data from longitudinal natural history studies and legacy clinical trials, and transformation of those data into generalizable and applicable knowledge to advance therapies for specific diseases. C-Path consortia are comprised of industry members, regulatory agencies, academic experts, government agencies and patient advocacy organizations that collaborate to achieve regulatory milestones not achievable by any one organization. Data standardization, database development and integration are core to the success of all C-Path consortia.
Results:
Diseases to date that have achieved positive qualification opinions from both European Medicines Agency and FDA enabled by C-Path's consortia include Alzheimer's disease, Polycystic Kidney Disease and Tuberculosis. For example, an Alzheimer's disease (AD) clinical trial simulation tool has been made publically available and represents a milestone that serves to encourage the advancement of drug-disease-trial models and promises to increase the probability of success in future AD therapeutic trials. The applicability of a similar path for ASD holds tremendous promise. Recently launched C-Path consortia are focused on pediatric drug development including Duchenne Muscular Dystrophy (D-RSC), International Neonatal consortium (INC) and a pediatric clinical trial network (PTC) focused on trial recruitment. Success of C-Path consortia is enabled by collaborations with other global initiatives. The prospects for the future in integrative collaborations and global data sharing initiatives include alliances with fNIH biomarkers consortium, NIMH, IMI EU-AIMS, SFARI/Simons Foundation, academic institutions and investigators, industry sponsors, Autism Speaks and other patient-driven initiatives.
Conclusions: Regulatory science strategies enabled by active collaboration of diverse stakeholders promises to encourage and incentivize sponsors to discover and advance therapies for ASD.

2:52 **190.002** Gene Therapy in Fragile X Syndrome

***D. R. Hampson**, Pharmaceutical Sciences, University of Toronto, Toronto, ON, Canada*

Background: Fragile X Syndrome (FXS) is a genetic disorder causing cognitive impairment and is one of the leading known genetic causes of autism. The genetic aberration is caused by an expanded CGG repeat in the 5' untranslated region of the FMR1 gene on the X chromosome. The expanded CGG repeat causes an elimination or severe reduction in the level of Fragile X Mental Retardation Protein (FMRP), an mRNA binding protein that controls translation of its bound mRNA substrates.
Objectives: To determine if FMRP transgene expression in the CNS could reverse phenotypic deficits in the Fmr1 knockout mouse model of fragile X, we used a single-stranded adeno-associated viral (AAV) vector that contained a major isoform of FMRP.
Methods: The vector was delivered to the brain via a single bilateral intra-cerebroventricular injection into neonatal Fmr1 knockout mice.
Results: Treated Fmr1 KO mice displayed prominent FMRP transgene expression in most regions of the forebrain but little or no expression more caudal regions. Reduced levels of the synaptic protein PSD-95, and abnormal motor activity, anxiety, and acoustic startle responses observed in Fmr1 KO mice, were fully or partially rescued by treatment with AAV-FMRP. We also demonstrate that mRNA for MeCP2, an epigenetic modulator mutated in Rett Syndrome, is substrate for FMRP and that MeCP2 protein levels are elevated in the Fmr1 mouse brain. Further analysis revealed a correlation between motor activity and levels of MeCP2, suggesting that motor hyperactivity in fragile X could be linked to elevated brain MeCP2 expression.
Conclusions: Our results provide proof-of-principle that gene therapy using a viral vector can correct specific behavioral abnormalities in a mouse model of fragile X syndrome. The results indicate that early postnatal administration of AAV-FMRP facilitates vector diffusion and distribution within the CNS. Early postnatal treatment may promote normal neurogenesis and maturation of the brain and might have contributed to the behavioral rescue subsequently seen in adult mice. Finally, our findings also raise the intriguing possibility that MeCP2 over-expression could contribute to the fragile X phenotype.

3:04 **190.003** A Double-Blind, Placebo-Controlled Trial of Memantine Vs. Placebo in Children with Autism Targeting Neurocognitive Outcomes

***L. Soorya**[1], S. Youngkin[2], S. J. Lee[3], J. W. Lee[2], A. Mischel[2], D. Graber[2], D. Grodberg[4], H. T. Rieger[5], D. Zaghloul[6] and E. Anagnostou[7], (1)Suite 603, Rush University Medical Center, Chicago, IL, (2)Rush University Medical Center, Chicago, IL, (3)Rush University Medical Center, Hoffman Estates, IL, (4)Yale Child Study Center, New Haven, CT, (5)Psychiatry, Icahn School of Medicine at Mount Sinai, New York, NY, (6)Autism Research Centre, Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada, (7)University of Toronto, Toronto, ON, Canada*

Background: Abnormalities in the modulation of the glutamate system and glutamatergic function have been reported in disorders affecting a variety of behavioral and neurological domains, such as cognitive flexibility, memory, and motor function. Impairments in memory and motor deficits in individuals with ASD are well documented. Whereas the neurobiology of such deficits is an area of active research, there is a paucity of intervention research for such deficits in autism. Memantine, an NMDA inhibitor, may provide improvements in memory and motor praxis/expressive language skills in children with autism.
Objectives: The study was initially designed as a large, multi-site, randomized trial to evaluate the tolerability of memantine and primary efficacy on memory and motor planning. Budgeting and recruitment changes resulted in narrowing the original trial objectives to a signal finding study at two sites. Treatment targets include apraxia, expressive communication, memory, motor skills, and adaptive skills in children with ASD in a double-blind, placebo-controlled parallel study.
Methods: Children with ASD and phrase speech were recruited. Participants (n=23), ages 6-12 (M=9.45, SD=2.03) were randomized at a 1:1 ratio to treatment with memantine or placebo for 24 weeks. Memantine and placebo were initiated at 3 mg and the dose was titrated up 3 mg a week for a maximum of dose of 12 mg depending on weight. Apriori defined outcomes included: apraxia and expressive language (primary); and memory and adaptive skills (secondary). Exploratory measures included additional neurocognitive tests of memory, fine & gross motor skills and apraxia; as well as functional outcomes measures (e.g. maladaptive behavior, social communication skills). All outcomes were collected at three time-points: baseline, Week 12, and Week 24. MANOVAs were conducted on change score composites for each primary outcome domain and individual subtests scores by domain (e.g. neurocognitive, functional skills, behavior).
Results: Memantine was well-tolerated with no significant adverse events reported during the trial. Initial analyses were guided by the analytic protocol for the original, large clinical trial. No significant effects were found on composite change scores on apraxia subtests of the NEPSY2 (e.g. oromotor sequences, manual motor sequences, imitating hand postures) or expressive language measures (e.g. EVT2 and NEPSY2 repetition of nonsense words). Exploratory analyses for the revised signal finding protocol included analyses of individual neurocognitive and functional outcome measures. Results suggest trends on measures of motor proficiency, apraxia, and expressive language. One representative test was selected for each domain and entered into a MANOVA: *motor proficiency, expressive language, verbal memory, and visual-spatial memory*. The MANOVA indicated an overall trend for facilitative effects of memantine on neurocognitive outcomes after 6 months of treatment (F=3.056, df=4, p=.050). Effect sizes were moderate to strong (partial eta squared = .449). Future analyses include evaluation of composite scores, responder analyses, and covariates of treatment response to support the development of larger, randomized controlled trials targeting neurocognitive outcomes.
Conclusions: This 24-week randomized placebo-controlled pilot study suggests that memantine may improve understudied neurocognitive domains including motor proficiency and expressive speech in school-aged children with ASD.

3:16 **190.004** The Effects of a Novel Vasopressin V1a Antagonist in Combination with Others' Gaze Behaviors on Attention to Others' Heads in Adults with ASD

***C. Foster**[1], M. del Valle Rubido[2], J. McCracken[3], E. Hollander[4], L. Scahill[5], L. Boak[6], O. Khwaja[2], F. Bolognani[7], P. Fontoura[8], D. Umbricht[2], S. S. Jeste[9], E. S. Kim[10], R. J. Jou[11], C. A. Wall[1] and F. Shic[1], (1)Yale Child Study Center, Yale University School of Medicine, New Haven, CT, (2)F. Hoffmann - La Roche AG, Basel, Switzerland, (3)UCLA Semel Institute for Neuroscience & Human Behavior, Los Angeles, CA, (4)Albert Einstein College of Medicine, Mamaroneck 10543, NY, (5)Pediatrics, Marcus Autism Center, Atlanta 30329, GA, (6)F. Hoffmann-La Roche AG, Basel, Switzerland, (7)F. Hoffmann-La Roche, Basel, Switzerland, (8)Roche Pharma Research and Exploratory Development, Basel, Switzerland, (9)Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA, (10)The Children's Hospital of Philadelphia, Philadelphia, PA, (11)Yale Child Study Center, Yale School of Medicine, New Haven, CT*

Background: Oxytocin and vasopressin appear to modulate neural circuitry and behavioral responses associated with social cognition (Zink et al., 2010; Heinrichs et al., 2008), providing a potential target for pharmacological intervention. Eye tracking has been used extensively in ASD research for examining social deficits (Boraston et al., 2007), and it has the potential to be developed as a robust and sensitive outcome measure for clinical trials.
Objectives: To explore the impact of a novel vasopressin receptor V1a antagonist, RG7713, vs. placebo on looking patterns influenced by the gaze behaviors of others in high-functioning adults with autism.
Methods: High-functioning adults (N=17; M_{age}=23.4 years, range=18 to 40 years) with autism participated in a multi-center randomized, double-blind, placebo-controlled, crossover study of the effects of RG7713. Participants completed two visits following identical procedures with the exception of a crossover for the compound administered (RG7713 vs. placebo). Participants in dosing Order 1 received RG7713 compound during their first visit (Day 1), while those in dosing Order 2 received RG7713 during their second (Day 2). Visits included: (1) pre-infusion assessments and eye-tracking battery, (2) a 2 hour IV infusion of RG7713 or placebo, (3) post-infusion assessments and eye tracking battery. The eye-tracking battery included an activity monitoring task, in which participants viewed 12 20s video clips of 2 actresses interacting and engaging in a shared activity. The task was parsed into two gaze conditions: (1) the actresses fixated on the shared play activity (activity gaze), (2) the actresses fixated on each other (mutual gaze). Analyses were conducted to examine the effects of RG7713 vs. placebo on the proportion of time spent attending to the actresses' heads (%Head).

Results: Linear mixed model analyses revealed a main effect of drug (p<.05, d=.29) and gaze condition (p<.01, d= 0.53) on %Head. Participants exhibited a larger %Head post-RG4914 vs. both pre-infusion (p <.05, d= 0.15) and post-placebo (p<.01, d=0.24), as well as a larger %Head during mutual gaze trials vs. activity gaze trials (p<.01 d=.53). There was no significant main effect of day of RG7713 administration and no significant interaction effects (p>.05). Results are illustrated in Figure 1.
Conclusions: These findings provide preliminary evidence of the ability of a novel V1a antagonist RG7713 to augment attention to others' heads in high functioning adults with ASD. When paired with preexisting response patterns to gaze behaviors of others, administration of RG7713 may result in an optimization of attention to others' heads. Although the administration of RG7713 did not alter the degree to which attention increased from activity to mutual gaze trials, administration of the compound was associated with an overall heightened amount of time spent attending to heads above both pre-infusion and placebo levels, with attention optimized in post-RG7713 mutual gaze trials. Furthermore, this study suggests that eye tracking may be a useful tool for developing and monitoring treatment effects of novel pharmacological interventions in ASD.

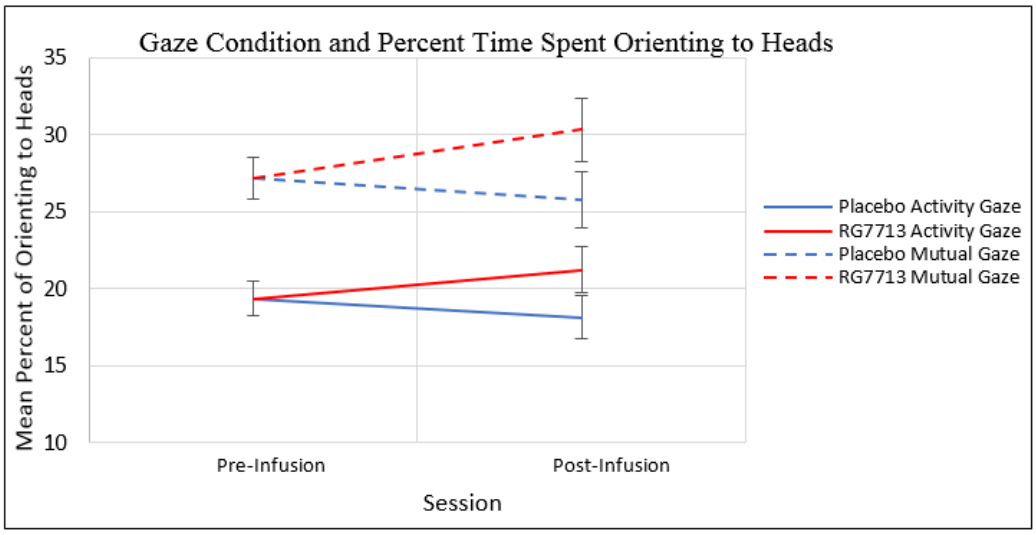


Figure 1. Gaze condition and the mean percent of time spent orienting to heads during activity monitoring, in pre- and post-placebo and RG7713 infusion trials. Error bars – 1 SE

Oral Session - 14A
191 - Overlooked Academic and Language Issues in the Treatment of ASD
1:45 PM - 2:35 PM - Room 309

1:45 **191.001** Technology-Based Intervention to Teach Mathematics Skills to Students with Autism

G. Yakubova[1], *E. M. Hughes*[1] *and M. Shinaberry*[2], *(1)Duquesne University, Pittsburgh, PA, (2)Duquesne University, Pittsburgh, PA*

Background:
Research examining video-based interventions and other instructional strategies to determine evidence-based practices for students with autism spectrum disorder has been limited to social, behavioral, communication, and daily living skills. Limited attention to teaching academic skills necessary for independent life can be disadvantageous given the necessity of at least basic academic skills to perform daily life activities, such as purchasing, managing the budget, and others. Students with autism spectrum disorder (ASD) face many challenges learning mathematics yet limited research supporting interventions exist in this area. Additionally, the economic development in the 21st century and rise of jobs that require at least some level of academic skills necessitate teaching of academic skills necessary for various aspects of post-school adult life. The presentation describes the results of the study examining the effectiveness of technology-based concrete-representational-abstract sequencing instruction in teaching mathematics skills to students with ASD.
Objectives:
The purpose of this study was to determine the effectiveness of video modeling intervention with concrete-representational-abstract (CRA) instructional sequence in teaching mathematics concepts to students with ASD.
Methods:
A multiple baseline across skills design of single-case experimental methodology was used to determine the effectiveness of the intervention on the acquisition and maintenance of mathematics skills for students with ASD. Three different mathematics skills were targeted for each participant based on their individual education goals. Students participated in a minimum of five baseline sessions, 11 intervention sessions, and three maintenance sessions during a three-week follow-up period. Data were analyzed using the recommended approaches for single-case experimental data: visual analysis analyzing for trend, level, variability, magnitude of effect and effect size calculation to determine the existence and magnitude of a causal relationship between an intervention and target skills (Kratochwill et al., 2013).
Results:
Results demonstrated that each student solved mathematics problems with improved accuracy during intervention compared to baseline levels. The intervention had a strong effect on students' skill acquisition and maintenance. Students' response accuracy improved from the mean of as low as 0 to 3% to as high as 61 to 100% accuracy. Two main findings were found: (1) increase in students' responses on addition, subtraction, and number comparison problems from baseline to intervention phases, suggesting the effectiveness of a technology-based intervention and (2) continued response accuracy at a three-week follow-up assessment for all skills for three of four students. Students and teachers also held positive perceptions on the effectiveness and practicality of the intervention.
Conclusions:
The findings of the study contribute to interventions on teaching mathematics skills necessary for further success in school and post-school life via technology-based instruction in a student-centered manner. This can provide valuable contributions for research and practice in the education of students with ASD. Findings offer potential for future research in examining this under-researched area of using CRA with technology in teaching students with ASD. It also offers implications for practice in using technology combined with other strategies to improve skill acquisition and learning outcomes of students with ASD.

1:57 **191.002** Teaching Reading Skills to Minimally Verbal School-Aged Children with Autism Spectrum Disorders with a Serious Game. a Controlled Study

S. Serret[1], *S. Hun-Billiaut*[1], *S. Thümmler*[2] *and F. Askenazy*[3], *(1)Autism Resource Center, Nice, France, (2)University Child and Adolescent Psychiatry Department, Autism Research Centre, Children's Hospitals of Nice CHU-Lenval, Nice, France, (3)University Child and Adolescent Psychiatry Department, Children's Hospitals of Nice CHU-Lenval, Nice, France*

Background: School-aged children with Autism Spectrum Disorders (ASD) and minimally verbal skills are usually judged "low-functioning" in accordance with poor performance on conventional assessment of global cognitive skills. However, recent studies suggest that some of these children have spared non-verbal cognitive abilities despite failing to acquire spoken functional language. As reading instruction for these children are limited by the traditional phonics approach, we developed the serious game SEMA-TIC based on non-verbal cognitive skills. SEMA-TIC is a computer-based intervention with 10 series of 10 games, progressively teaching reading skills based on specific learning strategies adapted to the autistic profile and without verbal instructions.
Objectives: The study investigates the efficiency of SEMA-TIC for the improvement of reading skills of minimally verbal school-aged children with ASD. It also compares the results with basic reading skills of typically developing children after formal academic reading training.
Methods: Twenty five ASD children (6 -11 years) with no functional language were recruited. Two groups were constituted: (1) ASD intervention group (n=12) who received four thirty-minute SEMA-TIC sessions per week over an average of 22 weeks; (2) ASD non-intervention group (n=13). The two groups completed at baseline and after the follow-up period five experimental reading skill tasks (alphabet knowledge, words reading, words / non-words discrimination, sentences reading and words segmentation)

and two standardized reading tasks (ALOUETTE and ODEDYS). Furthermore, a group of 16 typically developing children (TD group) from 6 to7 years schooled at the end of the first year of primary school and already readers were assessed by means of the same tasks.
Results: The two ASD groups showed no significant difference concerning clinical characteristics and results on experimental tasks at baseline. Results revealed significant main effects of group (ASD intervention versus ASD non- intervention group, ANOVA; $F(1,23)=256$; $p<.001$) and session (ANOVA; $F(1,23) = 301$; $p<.001$) on experimental tasks. A significant group x session x experimental tasks interaction was also found (ANOVA; $F(4,92) = 4.6$; $p<.01$). Post-hoc analysis revealed that ASD intervention group significantly improved in 4 out of 5 experimental tasks after training compared to ASD non-intervention group. Results also showed a main effect of group (ASD intervention versus TD group) on experimental tasks (ANOVA; $F(1,26) = 11$; $p<.01$). However and most importantly for the purpose of this study, results of post-hoc analysis (Tukey tests) show no significant difference between ASD intervention and TD group on each experimental task. Moreover, SEMA-TIC training enabled 25% of ASD intervention group to complete standardized tasks (ALOUETTE and ODEDYS) and to become decoding readers.
Conclusions: The present study shows that minimally verbal school-aged children with ASD are able to be instructed reading skills by means of a specific intervention using non-verbal cognitive skills. We therefore suggest that teaching reading skills to ASD children is not ineluctably linked to spoken language. The development of specific serious games as SEMA-TIC will be a major advance for these children.

2:09 **191.003** The Secondary School Success Checklist (SSSC): A Transition Planning Tool for High School Students on the Autism Spectrum

T. E. Regan[1], *S. Kucharczyk*[2], *K. Hume*[3] *and T. White*[1], *(1)University of North Carolina at Chapel Hill, Chapel Hill, NC, (2)University of Arkansas, Fayetteville, AR, (3)University of North Carolina, Chapel Hlll, Carrboro, NC*

Background: Post high school, students with autism spectrum disorder (ASD) face a number of challenges, including lower rates of employment than graduating students with other disabilities (Shattuck et al., 2012). Effective and quality transition plans developed by high school Individualized Education Plan (IEP) teams are a contributor to positive postsecondary outcomes (Mazzotti et al., 2009). An important part of the transition planning process is using transition assessment to develop measureable postsecondary goals, transition services, and annual IEP goals (Szidon et al., 2015). To create effective and high quality transition plans, school personnel need a psychometrically sound and efficient transition assessment that addresses challenging areas for students with ASD, identifies strengths, gathers information from multiple sources, and provides data that translate into relevant goals for the transition plan.
Objectives: The Secondary School Success Checklist (SSSC) is a teacher-, parent-, and student-report tool designed to assess the unique skill profiles of high school students with ASD, identify priority skill targets, and compile this information across the stakeholders. Based on preliminary data from a sample of high school students with ASD, psychometric properties of the SSSC were evaluated in regard to (1)reliability of scores by assessment of internal consistency and (2)validity of scores by assessment of concurrent and criterion validity analyses.
Methods:
Development: The SSSC content and process is based on items and feedback gathered from measures already used and accepted in the field, pilot studies, focus group data across 7 stakeholder groups, and current literature. The SSSC was finalized after an 18-month development process. The SSSC was completed by 279 students, 111 staff members and 279 parents across 30 high schools as part of the Center on Secondary Education for Students with ASD, a large-scale RCT study of a comprehensive intervention model for high school students with ASD.
Data Analysis: Internal consistency reliability of each respondent version for domains and subdomains were examined by calculation of Cronbach's alpha coefficients. Concurrent validity was assessed by examining the correlations between student, parent, and teacher measures for each SSSC domain. Criterion validity was assessed by examining correlations between the teacher reported SSSC domain scores and the teacher completed subdomains of the Vineland Adaptive Behavior Scales.
Results:
1)Internal consistency was examined using Cronbach's alpha and was at least .60 across all subdomains via student, parent, and staff reporters.
2)Concurrent validity was found to be low in student ($r<.25$) correlations with either parents or teachers. Teachers and parents were moderately consistent with each other with correlations between .39 and .56.
3)Criterion validity in correlations between SSSC domains and the Vineland subdomains were consistent with a range of .40-.55 (.33-.66).
Conclusions: Based on the preliminary psychometric data, the SSSC is reliable and collects data from students, parents, and teachers, who each contribute unique and valuable information and perspectives to the transition planning process. The SSSC appears to be a valid tool that could be extremely useful for IEP teams seeking to develop relevant transition goals that address the postsecondary needs of high school students with ASD.

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2:21 **191.004** A Randomized Control Trial to Evaluate the Efficacy of a Mobile Application to Treat Prosodic Deficits

E. Schoen Simmons[1], *C. A. Wall*[2], *M. Mademtzi*[3], *M. C. Lyons*[2], *R. Paul*[4] *and F. Shic*[2], *(1)Department of Psychological Sciences, University of Connecticut, Storrs, CT, (2)Yale Child Study Center, Yale University School of Medicine, New Haven, CT, (3)University of Birmingham, Bimringham, United Kingdom, (4)Sacred Heart University, Fairfield, CT*

Background: For those individuals with ASD who acquire spoken language, 50 – 80% will present with prosodic deficits (Baltaxe & Simmons, 1985). Emerging research suggests that mobile technology may be useful in treating these types of impairments; however, no randomized control trial has been conducted to validate their efficacy (Simmons, Paul & Shic, 2015).
Objectives: The purpose of this study was to assess the preliminary efficacy from a randomized control trial of an application, SpeechPrompts, for treating impairments in prosodic functioning.
Methods: Fifty-three students with prosodic deficits (Mean age = 8.64 years, SD = 3.06; Expressive language SS = 84.1, SD = 19.1) were recruited from school speech-language pathologists (SLPs; N = 22) and randomly assigned to either the experimental treatment condition (SpeechPrompts; n = 32) or treatment as usual (TAU; n = 21). For the experimental condition, SLPs used the SpeechPrompts software with their students 1x/week for 12 weeks. Those assigned to the control group continued receiving their speech and language intervention as usual. SpeechPrompts is an iOS application with four components that each target a prosodic construct (Intensity, Stress, Rate/Rhythm, Pitch). Students' prosody was rated pre- and post-treatment. Time spent using the application compared to time spent engaging in non-prosody related speech-language activities was measured.
Results: Global intonation ratings suggest there was no significant difference in prosody between groups at pre-treatment ($p=0.42$). The SpeechPrompts sessions had a mean length of 8.66 minutes (SD = 5) whereas non-SpeechPrompts sessions (e.g., sessions pertaining to non-prosody speech and language goals) had a mean length of 14.72 minutes (SD = 8.3). Following intervention, there was a trend for those assigned to the experimental group to be rated as more "typical" sounding in post-treatment prosody ratings of rhythm and intensity with moderate effect sizes; however, these results were not significant. Within-group analyses suggest that students in the SpeechPrompts condition were significantly more likely to be rated as more "typical" in Rate, Stress, Rhythm, Articulation, and Intonation ($p's<.05$) at study conclusion with moderate to large effect sizes. Conversely, students in the TAU condition, only showed significant improvements in Articulation ($p < .001$) with a moderate effect size.
Conclusions: This randomized controlled pilot was one of the first to evaluate an application to treat prosodic deficits in students with ASD. SLPs implemented the software with their students; however, usage data highlights that the software was implemented less than activities used to target social-communication and other language goals.

Given the complexity of ASD, it is unsurprising that prosody might not be on the top of a clinician's intervention priority list. Although no significant differences were observed in post-treatment ratings of prosody between treatment groups, trends in improvement of intensity and rhythm were emerging for the treatment condition. While SpeechPrompts may not be more effective than standard prosody interventions administered at greater intensity, its use appears to be associated with positive changes in prosody. These results suggest that SpeechPrompts might be an appropriate intervention option for those with prosodic deficits secondary to neurodevelopmental disorders.

Oral Session - 14B
192 - Issues in Treatment of Anxiety
2:40 PM - 3:30 PM - Room 309

2:40 **192.001** Maintenance of Intervention Effects of a Family-Focused Cognitive-Behavioral Treatment for Anxiety in Youth with ASD

S. Hepburn[1], *A. Blakeley-Smith*[2] *and J. Reaven*[3], *(1)Psychiatry & Pediatrics, University of Colorado / JFK Partners/Neurodevelopmental Behavioral Pediatrics, Aurora, CO, (2)Univ. of Colo. Denver-JFK Partners, Aurora, CO, (3)Univ. of Colorado Denver-JFK Partners, Aurora, CO*

Background: Empirical support for the efficacy of modified cognitive-behavioral interventions targeting anxiety symptoms in youth with ASD is building; however, there are few reports of maintenance of treatment gains beyond a 3-month follow-up period in the autism literature.
Objectives: To conduct a 1-year follow-up study of anxiety symptoms in 50 youth with ASD who participated in a randomized controlled trial of Facing Your Fears, initially reported in Reaven et al., 2012.
Methods: In the original study, 26 youth were randomly assigned to Treatment as Usual (TAU) and 24 to Active Treatment (Facing Your Fears, Reaven et al., 2010). Youth in the TAU condition were offered the opportunity to complete the intervention following completion of their post-TAU measures. Forty-seven youth, ages 7-11 with a confirmed diagnosis of ASD, completed the intervention and 35 families provided parent report of anxiety symptom severity in the youth 1-2 years after completing the 12-week intervention.
Results: *Preliminary Analyses.* Examination of differences between those families who provided follow-up data and those who did not yielded no significant differences in anxiety symptom severity (at baseline or at post-treatment), autism symptom severity, intellectual functioning, socioeconomic status (income and mother's level of education) or gender. There were also no differences in session attendance or parent/youth satisfaction ratings with the intervention. Anxiety symptoms were measured with the SCARED- Parent Version (Birmharer et al., 1999) at pre-treatment, post-treatment and at 1-year follow-up. The SCARED Total Score was used in this study, where scores of 25 or higher indicate greater risk of a clinically significant anxiety disorder. The mean number of days between post-treatment assessment and follow-up assessment was 378.06 (*sd* = 62.17).
Anxiety Outcomes 1 year post-treatment. Overall, parent report of anxiety symptom severity on the SCARED suggests that symptoms continue to maintain or decrease approximately one year after completing the Facing Your Fears Intervention. Mean SCARED scores were: Pre-treatment mean: 31.93 (*sd* = 11.85); Post-treatment mean: 27.36 (*sd* = 12.11); 1-year follow-up mean: 19.06 (*sd* = 10.34). At pre-treatment, 98% of youth obtained a clinically significant Total score on the SCARED (i.e, >25); at post-treatment, 51.4% obtained a score in the clinically significant range, and at 1-year follow-up, 17.1% obtained a score in the clinically significant range. Paired t-tests show statistically significant improvements at 1-year follow-up, relative to scores obtained immediately after completing the intervention (t (1,34) = 4.64, p = .000). Examination of responder characteristics and other intervening variables are underway.
Conclusions: These data are amongst the first reports of maintenance of intervention effects over a 1-2 year period for a cognitive-behavioral treatment for anxiety in youth with ASD. These findings add to the growing body of evidence supporting the potential impact of family-focused, cognitive-behavioral approaches to anxiety in ASD. Limitations include reliance on parent report of youth anxiety. Further research, utilizing more robust outcome measures, is warranted.

2:52 **192.002** Treatment Fidelity and Clinician Experience: Implementation of "Facing Your Fears" in Outpatient Settings

A. Blakeley-Smith[1], *L. G. Klinger*[2], *A. Keefer*[3], *A. Duncan*[4], *S. E. O'Kelley*[5], *E. Moody*[6], *S. Hepburn*[7] *and J. Reaven*[8], *(1)Univ. of Colo. Denver-JFK Partners, Aurora, CO, (2)Psychiatry, University of North Carolina TEACCH Autism Program, Chapel Hill, NC, (3)Kennedy Krieger Institute, Baltimore, MD, (4)Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (5)Psychology, University of Alabama at Birmingham, Birmingham, AL, (6)University of Colorado Anschutz Medical Campus, Aurora, CO, (7)University of Colorado / JFK Partners, Aurora, CO, (8)Univ. of Colorado Denver-JFK Partners, Aurora, CO*

Background: Clinician training and ability to implement a treatment program to fidelity are potential barriers to the transportability of evidenced based interventions (EBP) for youth with autism spectrum disorders (ASD) to outpatient clinics. When youth present with both ASD and anxiety, clinician training issues are even more relevant. Unfortunately, there are few clinicians with both ASD and anxiety experience. In efforts to increase training of new clinicians, it is important to determine the background or experience required to implement an EBP to fidelity, (e.g., experience with ASD or experience with anxiety). The role of clinician experience was examined in a study implementing one such EBP, Facing Your Fears (FYF; Reaven et al., 2011), a group cognitive behavior therapy for youth with ASD and anxiety, in outpatient settings.
Objectives:
(1) Examine whether clinician experience (i.e., years of ASD and/or anxiety experience) impacted fidelity ratings across three instructional conditions: *Manual* (manual only), *Workshop* (two-day workshop) and *Workshop Plus* (workshop plus bi-weekly consultation).
(2) Examine whether the quality of overall FYF delivery and the delivery of certain FYF components (i.e., psychoeducation, instruction on exposure, and implementation of exposure) varied across instructional conditions.
Methods: A three group parallel design was used to randomize eight teams of three clinicians, to one of the three training conditions. Four outpatient university clinics with 35 clinicians participated in delivering 24 groups of FYF across sites. Clinicians completed a questionnaire on treatment experience, reporting the number of years' experience with anxiety and/or ASD. Treatment fidelity was evaluated by two clinicians who rated 100% of videotaped sessions across all sites and conditions. Sessions were scored for absolute fidelity of all treatment components (absence/presence), quality of implementation (Likert scale, 1-5), and thoroughness of delivery of specified intervention components (i.e., Likert scale, 1-5).
Results:
(1) *Clinician Characteristics*. There were no significant differences across conditions in the number of years' experience clinicians had with ASD: F (2,31)=.053, p=.95. However, clinicians in the Manual condition had significantly more experience treating anxiety [F (2,31)=5.34, p=.95] . Greater ASD experience was associated with better fidelity (p = .039).(2) *Quality of Treatment Delivery and Treatment Components:* Quality ratings for the delivery of FYF was significantly greater for the Workshop/Workshop Plus conditions than for the Manual condition: F (2, 1374)=50.55, p<0001. There were no significant differences in the thoroughness by which clinicians implemented psychoeducational activities or instructional activities on exposure across conditions; however, Workshop Plus had significantly higher ratings of thorough implementation of in-vivo exposure activities, with the Manual condition faring significantly worse than chance (standardized residual 3.5 for fidelity=0).
Conclusions: Clinicians with greater ASD experience had significantly higher treatment fidelity ratings; however, clinicians across all three instructional conditions delivered FYF with good adherence. Clinicians in the Manual condition had significantly greater anxiety experience than clinicians in the Workshop conditions. Clinicians participating in the Workshop conditions provided significantly higher quality delivery of FYF and were more thorough in the implementation of all treatment components (including in-vivo exposure). These results will be discussed in light of child treatment outcome.

3:04 **192.003** Training Clinicians to Deliver Group Cognitive Behavior Therapy to Manage Anxiety in Youth with High-Functioning ASD: Results of a Multi-Site Trial

J. Reaven[1], *A. Blakeley-Smith*[2], *L. G. Klinger*[3], *A. Keefer*[4], *A. Duncan*[5], *S. E. O'Kelley*[6], *A. T. Meyer*[7], *C. Johnson*[8], *E. Moody*[9] *and S. Hepburn*[10], *(1)Univ. of Colorado Denver-JFK Partners, Aurora, CO, (2)Univ. of Colo. Denver-JFK Partners, Aurora, CO, (3)Psychiatry, University of North Carolina TEACCH Autism Program, Chapel Hill, NC, (4)Kennedy Krieger Institute, Baltimore, MD, (5)Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (6)Psychology, University of Alabama at Birmingham, Birmingham, AL, (7)University of North Carolina, Carrboro, NC, (8)Center for Autism and Related Disorders, Kennedy Krieger Institute, Baltimore, MD, (9)University of Colorado Anschutz Medical Campus, Aurora, CO, (10)University of Colorado / JFK Partners, Aurora, CO*

Background: Children with ASD are at high risk for developing anxiety disorders (van Steensel et al. 2011). Cognitive-behavioral treatments (CBT) such as the Facing Your Fears (FYF) group treatment (Reaven et al., 2011) have demonstrated strong efficacy in the reduction of anxiety for youth with high-functioning ASD (Reaven et al. 2012; Ung et al. 2014). While it has been critically important to develop treatments for anxiety, it is equally important to facilitate the portability of these treatments to "real world" settings. Common efforts to disseminate treatments in the community consist of distribution of manuals, only *occasionally* paired with brief trainings (Rounsaville et al. 2005). A systematic comparison of clinician training methods for delivering CBT to children with ASD, tied to improved child outcomes, can provide guidelines for training real-world clinicians.
Objectives: (1) To identify an optimal training model to deliver FYF by comparing three instructional conditions: *Manual* (manual only), *Workshop* (two-day workshop) and *Workshop Plus* (workshop plus bi-weekly consultation); and (2) To examine the effectiveness of instructional method by assessing: a) clinicians' understanding of FYF (CBT Knowledge; Treatment Fidelity), and b) decreases in anxiety symptoms for youth participants (SCARED; ADIS-P).
Methods: A three group parallel design was used to randomize eight teams of three clinicians, to one of the three aforementioned conditions. Four outpatient clinics across the US, serving youth with ASD, participated in the study. Thirty-five clinicians delivered the 14-week FYF intervention across sites. A well-characterized sample (e.g., ADOS-2; SCQ) of 94 children with ASD ages 8-14 (and their parents) were randomized to condition; 80 children completed treatment. Fidelity and youth anxiety treatment outcome

(SCARED; ADIS-P) was examined across all sites and conditions.
Results: Clinicians in both *Workshop* conditions significantly increased CBT knowledge post-workshop F (1,18)=19.81, p< .0001. Excellent treatment fidelity (absence/presence of core components) was obtained across all conditions (*Manual* – 89.9%; *Workshop* – 92.8%; and *Workshop Plus* – 93.2%), although *Manual* was significantly lower than would be expected by chance X(2)=11.94, p=.003. Results of the intent-to-treat sample, yielded a significant interaction between time/condition in parent reported anxiety (SCARED) p=.04, with youth in both *Workshop* conditions demonstrating significant decreases in anxiety, and better than *Manual*. There was also a significant effect for time for child reported anxiety (SCARED), but not for condition, p=.04. Significant decreases in severity of Separation (p<.002), Specific (p<.0001), Generalized (p<.0001) and Social Anxiety Disorders (p<.0001), as derived from the ADIS-P, occurred for time. There was also a significant effect for time/condition, as youth with Social Anxiety Disorder in the *Workshop*condition, demonstrated significant improvements in symptoms relative to the other conditions p=.002.
Conclusions: Clinicians in all conditions delivered FYF with good adherence. Significant reductions in anxiety symptoms were apparent across conditions. While there may be an advantage to participating in the *Workshop* conditions, these results suggest that clinicians in *Manual* condition were able to read the Facing Your Fears manual, and achieve solid fidelity and youth outcome. Implications for implementation of evidenced based programs will be discussed.

3:16 **192.004** High Risk, High Gain: High-Anxiety Adolescents with ASD Make the Most Gains over the Course of Treatment

A. McVey[1]*, K. S. Willar*[1]*, B. Dolan*[1]*, S. Stevens*[2]*, A. M. Carson*[3]*, J. S. Karst*[4] *and A. V. Van Hecke*[1]*, (1)Marquette University, Milwaukee, WI, (2)University of Minnesota, Minneapolis, MN, (3)Autism Center & Psychology Service, Baylor College of Medicine/Texas Children's Hospital, Houston, TX, (4)Children's Hospital of Wisconsin, Wauwatosa, WI*

Background: Many individuals with ASD are characterized by high social anxiety (White et al., 2009). Social anxiety curtails initiation of social interaction, and may lead to further disruption of healthy social development. Social anxiety may limit positive outcomes for this population, especially in adolescence, when peer interactions become more heavily emphasized. Research has shown that social skills treatments are an effective treatment for ASD (Reichow, Steiner, & Volkmar, 2012), and that anxiety can decrease over the course of social skills treatments for ASD (Schohl et al., 2014). However, it is unknown whether adolescents with ASD, who also present with high levels of anxiety, show similar responses to social skills treatment, versus low-anxiety adolescents.
Objectives: Do treatment outcomes differ in high- and low-anxious adolescents with ASD?
Methods: 106 adolescents (mean/sd age= 13.5/1.5; 91 male; 88% Caucasian) with ASD and their caregivers were recruited. Participants had a verbal IQ > 70 (mean/sd=100/18.5) and diagnoses confirmed with the ADOS-G. A randomized controlled trial (RCT: immediate vs. waitlist control) of the PEERS® (Laugeson & Frankel, 2010) intervention was conducted. To examine the specific effects of anxiety on treatment outcomes, analyses were conducted with the 30 least anxious adolescents (lowest quartile, less than a score of 13) and the 27 most anxious adolescents (highest quartile, greater than a score of 23) on the *Social Anxiety Scale-Adolescent* (SADNEW subscale: self-report of fear and anxiety about unfamiliar peers; La Greca & Lopez, 1998). Data at pre- and post-PEERS® included: (1) the TASSK (adolescent report of PEERS®social skills knowledge; Laugeson, 2012), (2) the QSQ (adolescent report of social interaction frequency; Laugeson, 2012), and (3) the SRS-Parent Total score (ASD symptoms; Constantino, 2005).
Results: Multivariate ANOVAs indicated time (pre, post) by group (experimental, waitlist control) interactions for both High [$F(4, 15) = 7.26$, $p = .002$] and Low [$F(4, 16) = 7.83$, $p = .001$] anxiety groups. Follow-up univariate ANOVAs, separately for High and Low anxiety groups, indicated that only one outcome measure, the TASSK, showed a time by group interaction for Low anxious teens, $F(1, 19) = 30.70$, $p = .001$. In contrast, the High anxious teens showed significant time by group interactions for TASSK [$F(1, 18) = 19.25$, $p = .001$] and SRS [$F(1, 18) = 11.21$, $p = .004$], with QSQ approaching significance, $F(1, 18) = 3.82$, $p = .06$.
Conclusions: Both high- and low-anxious adolescents benefitted from the PEERS intervention, in the form of increased social skills knowledge. However, highly anxious adolescents showed more widespread improvement in outcomes than less anxious adolescents, specifically showing fewer symptoms of ASD and more social interactions with peers. These results highlight a unique opportunity and imperative to address social skills and friendships in a sub-group of adolescents with ASD who also have high levels of anxiety.

Oral Session - 15A
193 - Mechanisms/Correlates of Psychopathology
1:45 PM - 2:35 PM - Room 310

1:45 **193.001** Do Shared Mechanisms in Autism and Depression Underlie This Comorbidity?

K. Gotham[1]*, R. N. Crist*[2] *and J. W. Bodfish*[3]*, (1)Vanderbilt University, Nashville, TN, (2)Psychiatry, Vanderbilt University School of Medicine, Nashville, TN, (3)Vanderbilt University School of Medicine, Nashville, TN*

Background:
Depression is a leading form of clinical impairment for adults with autism spectrum disorder (ASD). Both depression and autism separately have been linked to deficits in social motivation and affect modulation (i.e., reflexive neurological responses to emotionally evocative stimuli).
Rumination is a robust predictor of depression in the general population (Robinson & Alloy, 2003) and conceptually similar to cognitive perseveration associated with ASD. Thus, social motivation, affect modulation, and rumination warrant study as indicators of potential mechanisms underlying depression in ASD.
Objectives:
(1) To assess the relation between mood, rumination, and social motivation in an adult ASD sample;
(2) To provide evidence of biomarkers of rumination and affect modulation while directly comparing adults with ASD, depression (DEP), and typical development (TD) on these constructs.
Methods:
Study 1 participants included n=50 adolescents and adults with ASD (16-35 years) and verbal IQ ≥ 70. For Study 2, ongoing data collection includes adults aged 18-35 with ASD (goal n=50), typically developing (TD) adults with current depression (goal n=30) or a previous, remitted depressive disorder (goal n=30), and TD never-depressed controls (goal n=30). See Table 1 for current Study 2 n's. Diagnoses were confirmed with the Autism Diagnostic Observation Schedule (ADOS-2) in both studies, as well as the Structured Clinical Interview for DSM-5 Disorders (SCID-5) in Study 2. A variety of psychometric instruments were used in both studies to assess social motivation (e.g., Social Interests and Habits Questionnaire [SIH; Gotham, Bishop et al., 2014]) and rumination (e.g., Ruminative Response Scale [RRS; Nolen-Hoeksema & Morrow, 1991]). Pupil diameter, measured through infrared videography on an eye-tracker, provides a quantitative index of neural reactivity to emotional stimuli, and was used to assess rumination and affect modulation in Study 2 (see Table 1 for task descriptions).
Results:
Neither rumination nor social motivation scores were significantly associated with age or verbal IQ in our ASD sample, nor were they associated with each other. Rumination scores, however, were strongly related to depressive symptoms (r=.662; p<.001) and to insistence on sameness (r=.545; p<.05). Pupillometry will be tested as a biomarker in which pupil wave amplitude operationalizes initial affect modulation, and latency has additional implications for rumination (Siegle et al., 2003). We expect to see sustained arousal (per pupil response to single stimuli) and attentional bias (per eye-tracking of paired stimuli) specifically to sad faces, images, and sentences in our three clinical groups compared to controls. We hypothesize that pupil response to positive facial stimuli will be related to self-reported level of social motivation.
Conclusions:
Creating evidence-based care for common and impairing comorbidities may be the most direct line to improving quality of life and reducing general health care needs for individuals with ASD as they age into adulthood. Ideally, treatment for depression in ASD should be guided by research into the multiple potential causes for these two disorders to co-occur, and the ways in which those mechanisms might interact. Studying this comorbidity may also provide a novel opportunity for discovery about the mechanisms themselves.

Table 1.
Eye-tracking and pupillometry tasks to assess shared mechanisms in depression and autism in Study 2

TASK	STIMULI	DURATION	TO ASSESS...
Pupil: Social Condition	• Faces (Happy, Sad, Angry, Neutral) • Scrambled mask	• 350 ms image • 8 second mask	Affect Modulation to Social Stimuli, Rumination
Pupil: Nonsocial Condition	• Positive (e.g., landscape) • Negative (e.g., caged animals) • Neutral (e.g., table)	8 seconds	Affect Modulation, Rumination
Pupil: Lexical Condition	Self-referential sentences (Positive, Negative, Neutral)	8 seconds	Affect Modulation, Rumination
Eye-tracking: Paired Preference	Neutral and Emotional (Happy, Sad, Angry) Pair	5 seconds	Attentional Bias

Note. We are collecting data on affect modulation from several tasks, some novel and some replicated, that involving passive viewing of single or paired presentations of emotional stimuli with social and nonsocial conditions. Continuously captured pupillometry data will be assessed at varying durations to indicate ruminative processing.

For Study 2, we currently have collected data from 15 participants (n=7 current depressed; n=2 depressed by history; n=6 typical controls) over the course of 6 weeks. We currently have 10 more participants scheduled, and will soon begin to recruit from our list of n=130 adults with ASD who have consented to be recontacted for research. In December 2015, we will begin co-recruitment and data collection with another ASD study inviting longitudinal participants back. We are on track to have robust preliminary data by May 2016 for a novel comparison of these two clinical populations.

1:57 **193.002** Infant Predictors of School-Age ADHD Symptoms in Siblings at High Familial Risk for ASD

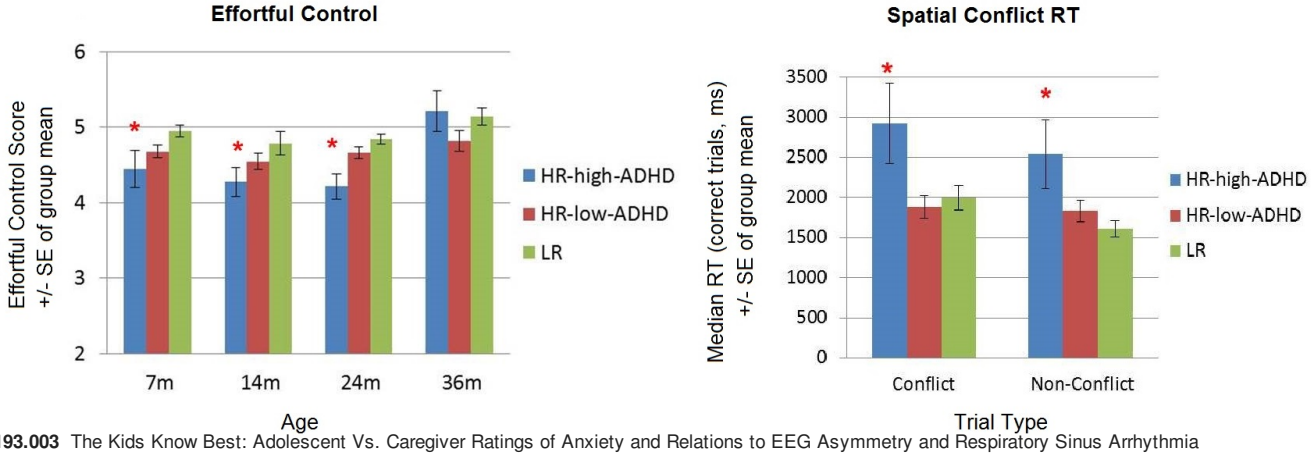
E. Shephard[1], *B. Milosavljevic*[2,3], *T. Gliga*[4], *G. Pasco*[5], *E. J. Jones*[6], *F. Happé*[7], *M. H. Johnson*[8] *and T. Charman*[2], *(1)Institute of Psychiatry, Psychology, & Neuroscience, King's College London, London, United Kingdom, (2)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (3)Psychology, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (4)Birkbeck College, London, United Kingdom of Great Britain and Northern Ireland, (5)Institute of Psychiatry, London, United Kingdom of Great Britain and Northern Ireland, (6)CBCD, Birkbeck College, University of London, London, United Kingdom, (7)Social Genetic and Developmental Psychiatry, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (8)Birkbeck, University of London, London, United Kingdom of Great Britain and Northern Ireland*

Background: Many children with autism spectrum disorder (ASD) also have symptoms of attention-deficit/hyperactivity disorder (ADHD), a developmental disorder characterised by impairing inattentiveness, hyperactivity, and impulsivity. The high co-occurrence rate, combined with evidence that ASD and ADHD share genetic and neurobiological pathways, suggests that infants who are at high familial risk for ASD may also be at increased genetic vulnerability to developing ADHD. Since ADHD is associated with significant school, social, emotional and behavioural problems, it is crucial to understand the development of ADHD in high-risk infants and, ideally, identify predictors of these symptoms early in life to facilitate timely intervention.
Objectives: The objectives were first, to assess school-age levels of ADHD symptoms in high-risk children prospectively studied since the first year of life, and second, to identify infant and early-life characteristics associated with school-age ADHD outcomes.
Methods: 42 infants with an older sibling with ASD (high-risk infants) and 37 infants with typically developing older sibling/s (low-risk infants) were enrolled in a prospective longitudinal study and completed assessments at 7-, 14-, 24-, 36- months and 7 years of age. At 7 years, parent-rated ADHD symptoms on the Conners 3 were compared between high-risk children who met DSM-5 criteria for ASD (HR-ASD; n = 15), high-risk children without ASD (HR-No ASD; n = 27) and low-risk controls (LR; n = 37). Early life (< 3 years) neurocognitive characteristics that were predictive of school-age ADHD symptoms in high-risk children were explored. Predictors were selected based on their robust association with ADHD in the literature. These were: saccadic RT and reaction time variability (RTV) measured at 7m, 14m and 36m on an attention shifting task, cognitive control performance (RT) on a Spatial Conflict task at 36m, and the temperament factors Surgency, Negative Affect, and Effortful Control measured at 7m, 14m, 24m, and 36m.
Results: 7-year ADHD symptoms were significantly higher in HR-ASD than HR-No ASD ($p < .05$, $d = .79$) and LR ($p < .01$, $d = 1.13$), but were low and comparable in the latter two groups ($p > .2$). Within the high-risk group, ADHD symptoms were significantly associated with earlier manual and saccadic RT and temperament, such that individuals with the slowest RTs and lowest Effortful Control in infancy and toddlerhood showed the highest levels of ADHD symptoms later in childhood (table 1). When the high-risk group was divided into those with elevated ADHD symptoms at 7 (Conners 3 T-scores > 60; HR-high-ADHD) and those with typical levels of ADHD at 7 (Conners T-scores < 60; HR-low-ADHD), the HR-high-ADHD children exhibited significantly slower RTs and significantly lower Effortful Control in infancy and toddlerhood than the HR-low-ADHD and LR control groups (figure 1). These effects remained when covarying for ASD symptoms at 7 years.
Conclusions: A proportion of high-risk infants, particularly those who develop clinically significant ASD, show high levels of ADHD symptoms at school-age. Slowed RTs and poor self-regulation in infancy and toddlerhood are associated with school-age ADHD symptoms in high-risk children, and may represent early risk-markers of later-childhood ADHD problems.

Table 1
Associations between 7-year ADHD symptoms and early-life predictors (RT and Effortful Control) in high-risk children

	Conners 3 Hyperactive/Impulsive T-score at 7-years	Conners 3 Inattentive T-score at 7-years
Saccadic RT at 7 months	$r\ (38) = .372,\ p = .02,\ r^2 = .14$	n/s
Manual RT (Conflict trials) at 36 months	$r\ (17) = .572,\ p = .016,\ r^2 = .33$	$r\ (17) = .530,\ p = .029,\ r^2 = .28$
Effortful Control at 14 months	$r\ (41) = -.349,\ p = .025,\ r^2 = .12$	n/s
Effortful Control at 24 months	$r\ (37) = -.419,\ p = .01,\ r^2 = .18$	$r\ (37) = -.423,\ p = .009,\ r^2 = .18$

Figure 1
Effortful Control scores and manual RT in infancy and toddlerhood by 7-year ADHD outcome groups



2:09 **193.003** The Kids Know Best: Adolescent Vs. Caregiver Ratings of Anxiety and Relations to EEG Asymmetry and Respiratory Sinus Arrhythmia

B. Dolan[1], *K. A. Schohl*[1], *A. McVey*[1], *S. Stevens*[2], *A. M. Carson*[3], *J. S. Karst*[4] *and A. V. Van Hecke*[1], *(1)Marquette University, Milwaukee, WI, (2)University of Minnesota, Minneapolis, MN, (3)Autism Center & Psychology Service, Baylor College of Medicine/Texas Children's Hospital, Houston, TX, (4)Children's Hospital of Wisconsin, Wauwatosa, WI*

Background: Measurement of anxiety in young people with ASD has often relied on caregiver or self-report checklists, but very few studies have examined the ecological validity of such approaches when compared to neurobiological or physiological measures of stress/ anxiety. Along with high social anxiety (White et al., 2009), many individuals with ASD present with right hemisphere asymmetry/dominance, and dysregulated physiological arousal (quantified as lower respiratory sinus arrhythmia, RSA), both of which may contribute to anxiety profiles in ASD (Van Hecke et al., 2009, 2013).
Objectives: 1) how strongly are self- vs. caregiver-rated measures of anxiety related, and 2) which, if any, of the anxiety ratings are related to RSA and EEG asymmetry in adolescents with ASD?
Methods: 106 adolescents (mean/sd age= 13.5/1.5 years; 91 male; 88% Caucasian) with ASD and their caregivers were recruited. Participants had a verbal IQ > 70 (mean/sd=100/18.5) and diagnoses were confirmed with the ADOS-G. Data included (1) resting-state frontal EEG gamma asymmetry; (2) resting-state RSA; and (3) the *Social Anxiety Scale- Adolescent* and *Caregiver* forms (SAS: La Greca & Lopez, 1998).
Results: Adolescent and caregiver ratings of adolescent anxiety on all subscales and total score on the SAS were significantly related, *rs* (83) = .21 - .47, *ps* = .05 - .0001. Higher left hemisphere frontal EEG asymmetry/dominance was related to higher anxiety as rated by adolescents on the SAS-SADNEW subscale (measures fear and anxiety about unfamiliar peers), $r\ (102) = -.20$, $p = .04$. Higher RSA was related to higher anxiety as rated by adolescents on the SAS-SADNEW, $r\ (104) = .20$, $p = .04$.
Conclusions: Although all self- and caregiver-rated measurements of social anxiety were related, only anxiety measures rated by adolescents were related to physiological and neurological measures. Further, these relations were not in the predicted direction. Adolescents with ASD, with higher physiological regulation (RSA) and higher relative left hemisphere asymmetry, also endorsed high levels of social anxiety. Results suggest a unique additive value of self-ratings when considering links amongst anxiety and neurophysiological measures, and a potential paradoxical effect, in that neurophysiological systems that support social approach may be linked with higher anxiety in adolescents with ASD.

2:21 **193.004** Exploring the Structure and Neurocognitive Correlates of Challenging Behaviour in Young People with Autism Spectrum Disorder

V. Carter Leno[1], *R. Kent*[2], *T. Charman*[2], *C. Jones*[3], *F. Happé*[4], *G. Baird*[5], *A. Pickles*[1] *and E. Simonoff*[2], *(1)Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (2)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (3)School of Psychology, Cardiff University, Cardiff, United Kingdom, (4)Social Genetic and Developmental Psychiatry, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom, (5)Guy's and St Thomas' NHS Foundation Trust, London, United Kingdom*

Background:
Many young people with Autism Spectrum Disorder (ASD) exhibit 'challenging behaviour', characterised by severe non-compliance, aggression and self-injurious behaviour (SIB). The development of effective interventions requires greater knowledge of ASD-specific models of challenging behaviour. The collection of behaviours (non-compliance, aggression, SIB) subsumed under the term 'challenging behaviour' may be associated with different neurocognitive profiles.
Objectives:
A detailed exploration of the neurocognitive profile associated with different aspects of challenging behaviour. Structural equation modelling will be used to explore the relationship between SIB and aggression, and their associated neurocognitive profiles.
Methods:
This study involved 94 well-characterised adolescents (mean age 15.5 years) with a diagnosis of ASD from the Special Needs and Autism Project (SNAP), a longitudinal, population-based cohort. Parent-reported symptoms of SIB and aggressive behaviour were measured using items selected from the Profile of Neuropsychiatric Symptoms (PONS). Assessment of the neurocognitive profile included performance on tasks of executive functioning (inhibition, flexibility, sustained and selective attention) and social cognition (emotion recognition, theory of mind). Clinician-rated ASD ICD-10 symptoms and IQ were included as co-variates.
Results:
Initial analyses used bivariate regressions to explore relationships between aspects of challenging behaviour and neurocognitive task performance. FSIQ and then ASD symptoms were added as covariates to determine the specificity of the relationships. The final analyses will use SEM to build a comprehensive model.
Ratings of SIB and aggressive behaviour were explored in a varied sample of individuals with ASD (FSIQ: mean = 84.11 (17.46), range 50-119; clinician-rated ASD symptoms: mean = 8.04 (2.45), range 3-12).
Mean SIB = .57 (1.12), range = 0-5, and mean aggressive behaviour = 5.36 (4.61), range = 0-17.5. SIB and aggressive behaviour were significantly correlated (r=0.44,

p<0.01). SIB was associated with a greater number of ASD symptoms. No association was found with aggressive behaviour.
IQ: Aggressive behaviour was associated with lower FSIQ and performance but not verbal IQ. SIB was associated with a trend towards lower FS and verbal IQ.
Executive Functioning: Aggressive behaviour was associated with difficulties in flexibility, inhibition and sustained attention; however these did not remain after co-varying for IQ. SIB was not associated with any of these domains, but was associated with difficulties in selective attention. This became non-significant when co-varied for IQ.
Social Cognition: Aggressive behaviour was associated with specific difficulty in recognising fearful faces. This pattern of results remained when co-varied for both IQ and ASD symptoms. SIB was also associated with difficulties recognising fearful faces; however, this association became non-significant when co-varied for IQ. Neither aggressive behaviour nor SIB was associated with theory of mind ability.
Conclusions:
Although a useful clinical term, explanatory models of challenging behaviour may need to consider SIB and aggressive behaviour separately. There appeared to be differential associations of the two domains with respect to IQ, executive functioning and emotion recognition. Better characterisation of the neurocognitive profile associated with each domain may inform development of future interventions, and be used to tailor interventions dependent on which aspect of challenging behaviour is more problematic for a given individual.

Oral Session - 15B
194 - Eating Behavior in ASD
2:40 PM - 3:30 PM - Room 310

2:40 **194.001** Development and Validation of the Autism Eating Profile Questionnaire

E. Gal[1], *O. E. Stolar*[2] *and R. Gal-Mishael*[3], *(1)University of Haifa, Timrat, Israel, (2)Assaf Harofeh Medical Center, Ra'anana, Israel, (3)ALUT-The Israeli Society for Autistic Children, Giva'atim, Israel*

Background: Many children with autism spectrum disorders (ASD) exhibit a variety of eating/feeding problems, making eating a recurrent challenge. Despite recent research and developments in this area, there is a lack of thorough validated and reliable tools that specifically assess eating problems in children with ASD. The Autism Eating Problems and Patterns Questionnaire (AEPQ) was developed as a new and comprehensive assessment of children with ASD with the aim of better understanding the nature and sometimes the source of eating problems in this population.
Objectives: (1) To construct a questionnaire that will assess the eating problems and patterns of children with ASD (2) To determine the questionnaire's reliability and validity in two ways: a. examination of the internal consistency of the questionnaire's domains; and b. ascertaining its discriminative validity.
Methods: A 3-phase study was conducted: 1) construction of the questionnaire, including content validity and factor analysis 2) ascertaining internal consistency reliability, and 3) ascertaining discriminative validity by comparing the reports of parents of children with ASD to those of parents of typically developed children. Parents of 69 boys with ASD, mean age of 4 years and 10 months, and 85 typically developed children matched by age and gender, completed the AEPQ which includes three parts: (a) personal details and general information relating to eating habits, as well as medical and family history (b) a Likert scale part that addresses seven domains of eating problems, and (c) a food list aimed at assessing the actual diet of the child by means of types, variety of eaten foods. Cronbach's alpha coefficient was used to examine the domain scale's internal consistency. To test whether differences existed between the children with and without ASD, a Multiple Analysis of Variance (MANOVA) was conducted, followed by a series of ANOVA tests to investigate the differences between the two groups in the various questionnaire's domains.
Results: Factor analysis of the 46 items revealed seven factors that constructed seven different domains, namely: chewing and swallowing problems, food avoidance, eating selectivity, sameness and rigidity in eating, eating rituals, excessive eating and mealtime behavior problems. Internal consistency reliability of the AEPQ's seven domains range from a high to very high (Cronbach's alpha of r=.82 to .94).The MANOVA showed significant differences between the groups in their eating habits)F (6,69) =24.13 ,p<0.001, η^2=.65**(;** scores of children without developmental disabilities were significantly lower than the scores of children with HFASD in all of the questionnaire's domains, thus establishing the questionnaire's discriminant validity
Conclusions: The AEPQ presents a clear factor structure and is a reliable and valid tool for the assessment of eating problems, specifically various kinds of food selectivity of children with ASD. By generating a thorough profile of eating habits and problems that specifically relate to the characteristics of ASD, it may support clinical decision-making regarding interventions aimed at improving the eating problems of children with ASD.

2:52 **194.002** Continuous and Extreme Autistic Trait Ratings Are Associated with Avoidant Restrictive Food Intake Disorder

G. Wallace[1] *and N. L. Zucker*[2], *(1)The George Washington University, Washington, DC, (2)Duke Center for Eating Disorders, Duke University, Durham, NC*

Background: From its earliest description, autism spectrum disorder (ASD) has been linked with feeding-related problems. Dietary abnormalities are very common in ASD, including food selectivity, food refusal, and insistence on sameness while eating. Moreover, food selectivity is not limited to childhood, but clearly persists into the adolescent and adult years in ASD. With the adoption of DSM-5, a new eating/feeding disorder was introduced, avoidant restrictive food intake disorder (ARFID). ARFID is characterized by clinically significant difficulties with eating/feeding, including areas of likely phenotypic overlap with ASD, such as food avoidance based on sensory characteristics. In spite of this, no study to date has linked these two conditions. The present study seeks to fill this gap in knowledge.
Objectives: Examine continuous and extreme autistic trait ratings within a large group of participants oversampled for issues related to selective eating, including ARFID.
Methods: A large group of 1,992 adults (1,445 females) completed online surveys including self-ratings of autistic traits utilizing the original 50-item Autism-Spectrum Quotient (AQ) and eating-related behaviors (e.g., limitations in dietary intake, weight loss connected to limited dietary intake, sensory-related food sensitivities, etc.) validated to assess features of ARFID. The degree to which these eating related problems interfered with broader social and job functioning was also assessed.
Results: Individuals with symptoms consistent with ARFID (n=1,390), had higher overall autistic trait ratings (M=21.28, SD=7.38) than those without ARFID (n=602; M=20.16, SD=7.50; t=3.08, p=.002). More specifically, the ARFID group had elevated autistic traits in the areas of social skills (M=4.42, SD=2.76 vs. M=4.08, SD=2.78), attention switching/flexibility (M=5.35, SD=2.25 vs. M=4.94, SD=2.31), and communication (M=3.48, SD=2.28 vs. M=3.19, SD=2.23) compared to the non-ARFID group (ts>2.44, ps<.02). In turn, participants with extreme autistic trait ratings (total AQ score>31; n=160) were more likely to rate themselves as having ARFID (X^2=3.45, p=.036, one-tailed), than individuals with subthreshold scores. Finally when comparing how eating-related problems affected broader functioning, participants with both ARFID and elevated autistic traits (n=121) reported greater interference with their jobs than did those with ARFID alone (n= 1,268; X^2=3.39, p<.05, one-tailed) and greater anxiety and avoidance of social situations involving food (ts>2.25, ps<.025).
Conclusions: This is the first study to examine phenotypic overlaps of ASD and ARFID. Perhaps unsurprisingly, there were relatively strong associations between both continuous autistic trait ratings and extreme levels of autistic traits and ARFID. More specifically, the social-communication and inflexibility components of the ASD phenotype appeared most closely linked with ARFID. The inflexibility component of the ASD phenotype is particularly striking given conceptual connections drawn between it and selective eating in ASD. Additionally, elevated autistic traits appeared to exacerbate interference with everyday social and occupational functioning among individuals with ARFID. Much more work is needed to understand the shared and unique mechanisms driving eating-related idiosyncrasies that disrupt daily life among individuals with ASD and/or ARFID, which will serve to inform future intervention development.

3:04 **194.003** Changes in Food Selectivity over 6 Years in Children with Autism Spectrum Disorder

L. G. Bandini[1], *C. Curtin*[1], *S. Philips*[2], *S. E. Anderson*[3], *M. Maslin*[4] *and A. Must*[5], *(1)Eunice Kennedy Shriver Center, University of Massachusetts Medical School, Charlestown, MA, (2)Dept. of Public Health & Community Medicine, Tufts University School of Medicine, Boston, MA, (3)Division of Epidemiology, The Ohio State University College of Public Health, Columbus, OH, (4)E.K. Shriver Center – UMass Medical School, Charlestown, MA, (5)Public Health and Community Medicine, Tufts University School of Medicine, Boston, MA*

Background: Food selectivity is a common problem in children with autism spectrum disorder (ASD) and is of concern because of its impact on nutrient adequacy and family mealtimes. Despite recent research in this area, few studies have addressed whether food selectivity present in early childhood persists into adolescence in children with ASD.
Objectives: To determine if food selectivity and the characteristics/presentation of foods that affect food selectivity persist in in children with ASD.
Methods: We re-contacted children who participated in the Children's Activity and Meal Patterns Study which examined dietary patterns, mealtime behaviors, and food selectivity in typically developing children and children with ASD aged 3-11 years. At the initial time point and on average 6.5 years later, a parent-completed food frequency questionnaire was used to measure food refusal and consumption of fruits, vegetables, snacks, and beverages; a 3-day food diary was used to determine the number of unique foods eaten; a diet interview with parents assessed refusal by the child based on food characteristics and presentation of the food (e.g., texture, foods mixed together). Food refusal was defined as the percentage of foods offered that were not eaten.
Results: Seventeen of the 53 (32%) children in the original study participated in the follow-up study. Those who participated in the follow-up study did not differ in age or in measures of food selectivity at baseline compared to those who did not participate. The mean (SD) age at baseline was 6.9 (2.4) years; mean (SD) age at follow-up was 13.4 (2.6) years. Mean (SD) food refusal at baseline was 46.8% (22.4), compared to 32.2% (19.4) at follow-up (p<0.01). The number of unique foods eaten decreased an average of 2.1 foods between baseline and follow-up (borderline significance, p=0.08). We found no statistically significant changes in the servings of beverages, fruits and vegetables, or snacks consumed between baseline and follow-up (all p>0.05). At baseline, 94% of parents indicated that their child currently refused food based on

consistency, compared to 41% of parents at follow-up ($p<0.01$). We observed no significant change in food refusal based on temperature, whether foods were mixed together, or whether foods were touching each other.
Conclusions: Our examination of the change in food selectivity as children become adolescents found that some aspects of food selectivity improved while others persisted. While food refusal improved overall, we did not observe an increase in food repertoire (number of unique foods eaten). Larger longitudinal studies are required to determine the extent of the persistence of food selectivity and the impact on nutritional status in children with ASD.

3:16 **194.004** Mealtime Behavior Problems and Spousal Stress Among Children with ASD

C. Curtin[1], *S. Philips*[2], *A. Must*[3], *S. E. Anderson*[4] *and L. G. Bandini*[1], *(1)Eunice Kennedy Shriver Center, University of Massachusetts Medical School, Charlestown, MA, (2)Dept. of Public Health & Community Medicine, Tufts University School of Medicine, Boston, MA, (3)Public Health and Community Medicine, Tufts University School of Medicine, Boston, MA, (4)Division of Epidemiology, The Ohio State University College of Public Health, Columbus, OH*

Background: Children with ASD are reported to have atypical eating behaviors and problematic mealtime behaviors. It has been suggested that mealtimes provide structure and promote family unity, and that stressful mealtimes can contribute to family disharmony. Emerging evidence suggests that mealtime behavior problems exhibited by children with ASD contribute to parental stress at mealtimes.
Objectives: To describe changes in children's mealtime behaviors and parental stress over time and to determine whether spousal stress is associated with mealtime behavior problems in children with ASD.
Methods: We re-contacted parents of children with ASD (n=53) who participated in the Children's Activity and Meal Patterns Study (CHAMPS). The original CHAMPS study included children with ASD and typically developing children ages 3-11 years. The average follow-up period was 6.5 years. Both the original CHAMPS study and the follow-up study included a parent questionnaire about family mealtimes that contained questions about mealtime behavior problems (score range 0-40) and spousal stress at mealtimes (score range 0-20).
Results: Seventeen of the 53 (32%) children with ASD who took part in the original CHAMPS study participated in the follow-up study. Those who participated in the follow-up study did not differ in age or prevalence of mealtime behavior problems at baseline compared to those who did not participate. However, parents who participated in the follow-up study were more likely to report higher levels of spousal stress than those who did not participate ($p<0.001$). The mean (SD) child age at baseline was 6.9 (2.4) years; mean (SD) age at follow-up was 13.4 (2.6) years. The mean (SD) score for spousal stress at baseline was 13.7 (4.0), which decreased to 10.1 (5.0) at follow-up ($p<0.05$). The mean (SD) mealtime behavior problem score was 21.8 (5.9) at baseline, which declined to 15.6 (4.9) at follow-up ($p<0.01$). At baseline, spousal mealtime stress was significantly correlated with mealtime behavior problems ($r=0.67$; $p=.005$); at follow-up this association weakened and was no longer statistically significant ($r=0.37$, $p=0.17$).
Conclusions: Our findings suggest a high prevalence of mealtime behavior problems and spousal stress at mealtimes among families of children with ASD and an association between the two. Over time, however, both mealtime behavior problems and spousal stress appear to improve. Given that mealtimes are important for family cohesion, the challenges that children and families face at mealtimes may be important clinical targets. Larger studies that examine the nature of and course of these relationships is warranted.